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OCEAN-ICE OIL-WEATHERING COMPUTER PROGRAM USER'S MANUAL

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OCEAN-ICE OIL-WEATHERING COMPUTER PROGRAM USER'S WAL

Model Overview

The ocean-ice oil-weathering code is written in FORTRAN as a series of stand-alone subroutines that can be easily installed on most any computer. All of the trial-and-error routines, integration routines, and other special routines are written in the code so that nothing more than the normal system functions such as EXP are required. The code is user-interactive and requests input by prompting questions with suggested input. Therefore, the user can actually learn about the nature of crude oil and oil weathering by using this code. A complete code listing of the ocean-ice oil-weathering code is presented in Appendix A of this report.

The Ocean-Ice oil-weathering model considers the following weathering processes:

- evaporation
- dispersion (oil into water)
- mousse (water into oil)
- spreading

These processes are used to predict the mass balance and composition of oil remaining in the slick as a function of time and environmental parameters. Dissolution of oil into the water column is not considered as part of the main code because this weathering process is not significant with respect to the over-all material balance of the oil slick. The companion document to this User's Manual (Final Report for RU 664; Payne et al 1987) contains computer code for stand-alone models which consider component-specific dissolution from oil slicks and dispersed droplets, respectively.

An important assumption required in order to write material balance equations for evaporation is the state of mixedness of the oil in the slick. The Ocean-Ice Oil-Weathering Model is based on the assumption that the oil is well mixed. This might not always be true but data have been taken and

interpreted as if the oil is well mixed. Thus, experimental results based on this assumption must be used in the same way mathematically. There is growing thought based on physical and compositional observations that the oil is not always well mixed, As the oil weathers its viscosity increases (measured and known to be true) resulting in a slab-like oil phase. Clearly, the mass transfer within the oil will change drastically in going from a well-mixed to a slab-like phase.

The other three processes noted above are not explicitly component specific as is evaporation. However, the dispersion process is a function of the oil viscosity; oil viscosity is a function of composition. Thus the dispersion process does depend on the evaporation process. Mousse formation also alters the oil viscosity but the present knowledge of this process does not point to any quantifiable compositional dependence. The spreading of the slick results in an ever-increasing area for mass transfer.

The composition of the oil is described in terms of pseudocomponents that are obtained by fractionating the oil in a true-boiling-point distillation column. This procedure yields cuts of the oil which are characterized by boiling point and density. This information is then used to calculate many more parameters about the cut. The most important calculated parameters pertain to vapor pressure and molecular weight. The evaporation process is driven by vapor pressures, and system partial pressures are calculated assuming Raoult's law.

Sample runs of the model are included in this User's Manual in the following manner. Examples of the various input options are presented on pages 9 through 32, Examples of various calculated results appear on pages 33 through 74. Each output or run of the computer model always echoes the input to the output. In other words, what was entered as input is documented in the output . Therefore, the calculated results appearing on pages 33 through 74 contain all the user entered parameters. The illustrations of input are intended to illustrate all the options available and a real computer run would (probably) not invoke all these options (i.e. , spreading versus no-spreading, dispersion versus increased-dispersion, and many other on-off examples).

Model Description

The pseudo-component characterization of crude oil for the open-ocean oil-weathering model is described in detail (Payne et al., 1984a). The specific detail presented in oil characterization can vary depending upon exactly which literature references are used. Those references used to write the current open-ocean oil-weathering model are all essentially contained in a standard text (Hougen, Watson and Ragatz, 1965).

The pseudo-component evaporation model and the over-all mass-transfer coefficient required for evaporation has also been described in detail (Payne, Kirstein, et al., 1983 and 1984a). The fundamental process of evaporation is described in many texts, such as Mass Transfer Operations (Treybal, 1955) and in papers in the open literature. A paper on this subject relevant to oil weathering is that by Liss and Slater (Liss and Slater, 1974).

The equation which describes slick spreading has also been described (Payne et al., 1983). The spreading equation is based on observations due to Mackay (Mackay, et al., 1980) and is not based on the many publications which describe oil spreading due to gravity-viscosity-surface tension. The phenomenological approach to oil spreading does not pertain to a rough ocean surface, and the empirical approach at least reflects reality.

The viscosity prediction used in early oil-weathering model calculations is based on a (mole fraction) .(cut viscosity) summation (Reid, et al., 1977) . This viscosity prediction has been found to be inadequate in that the predicted viscosity is always too low. This viscosity prediction has been replaced with one due to Tebeau and Mackay (Tebeau, Mackay, et al. , 1981) where the viscosity at 25°C is a function of the fraction of oil evaporated on a dispersion-free basis. The functional relationship is $\exp(K_4 F)$ where K_4 is an oil-dependent constant and F is the fraction evaporated. The viscosity is scaled with respect to temperature according to the Andrade equation (Gold and Olge, 1969).

The prediction of water-in-oil emulsification is based on four parameters (Mackay, et al., 1980) appearing in the following equation:

$$(1 - K_2W) \exp\left[\frac{-2.5W}{1-K_1W}\right] = \exp(-K_5K_3t)$$

where W is the weight fraction water in the oil-water mixture, K_1 is a constant in a viscosity equation due to Mooney (Mooney, 1951), K_2 is a coalescing-tendency constant, K_3 is a lumped water incorporation rate constant, and K_5 is a factor by which the mousse formation rate is increased during broken- ice field weathering.

The change in visiosity due to mousse formation is predicted by:

$$\mu = \mu_o \exp\left[\frac{-2.5W}{1-K_1W}\right]$$

where $\mu°$ is the parent oil viscosity. K_1 is usually around 0,62 to 0.65 and apparently does not change much with respect to different types of oils. The constant K_2 above must satisfy the relation $K_2W < 1$ in order for the water incorporation rate term (right-hand side) to be > 0. Thus, K_2 is the inverse of the maximum weight fraction water in the mixture. K_3 is the water incorporation rate constant and is a function of wind speed in knots.

The dispersion (oil into water) weathering process is described by two equations (Mackay, et al., 1980), These equations are:

$$F = K_a K_c (U + 1)^2$$

$$F_B = (1 + K_b \mu^{0.5} \delta \chi)^{-1}$$

where F is the fraction of sea surface subject to dispersions per second, U is the wind speed in m/see, K_a is constant, and Kc is a factor by which dispersion is increased during broken-ice field weathering. F_b is the fraction of droplets of oil below a critical size which do not return to the slick, K_b is a constant, μ is the viscosity in centipoise, x is the slick thickness in meters, and δ is the surface tension in dynes/cm. The mass fraction that leaves the slick as dispersed droplets is (F_b). (F) and this fraction applies to each cut of oil.

User Input Description

The initial input required to perform an oil-weathering calculation is the distillation characterization of the crude oil. The desired input is termed a true-boiling-point (TBP) distillation and consists of distillate cuts of the oil with each cut characterized by its average boiling point and API gravity. For a description of the TBP distillation see Van Winkle (1967), An example of a TBP distillation is shown in Table 1. The petroleum product characterized in this table is a whole crude oil. The reason for choosing this example is that it is a text-book example of a true-boiling-point distillation. The introduction of the true-boiling-point distillation to characterize crude oil and products for environmental predictions is a new concept. Therefore, the objective in using this example is to illustrate that the concept is common in another branch of engineering. By providing this example, the reader has access to a readily available reference that actually used a TBP (i.e. , Van Winkle, 1967).

TBP distillations of crude oils are not always readily available. The more common inspection on crude oil is termed an ASTM (D-86) distillation. The ASTM distillation (Perry, R. H., and C. H. Chilton, 1973) differs in that the ASTM distillation is essentially a flask distillation and thus has no more than a few theoretical plates. The TBP distillation (ASTM D- 2982, 1977) is performed in a column with greater than 15 theoretical plates and at high reflux ratios . The high degree of fractionation in this distillation yields an accurate component distribution for the crude oil (mixture). Another type of crude oil inspection available is the equilibrium flash vaporation (EFV) which

TABLE 1. Example of True Boiling Point (TBP) Distillation of Crude Oil -(from Van Winkle, 1967).

% Distilled	T, *F	API Gravity
0	105	first drop
5	230	63.5
10	300	46.7
20	392	39.0
30	458	34.5
40	505	32.0
50	542	30.8
60	585	27.5
70	640	23.5
80	720	20.4
90	880	13.1
99	1090	------

differs from both the ASTM and TBP distillation in that the vapor is allowed to equilibrate with the liquid, and the quantity vaporized reported. In the distillations vapor is continuously removed from the still pot.

Both the ASTM distillation and EFV can be converted to a TBP distillation (API, 1964). However, at the present the ASTM D-86 distillation results can be used directly in the oil-weathering calculations because it is a reasonable approximation to the TBP-distillation result at the light end of the barrel, The differences between the two distillations at the heavy end of the barrel are noticeable but since the heavy ends of the barrel do not evaporate in oil weathering, this difference is of little consequence.

Currently, the best sources of distillation data are "Evaluation of World's Important Crudest' (O&GJ, 1973) where a tremendous number of distillations and other characterizations are reported. The distillations reported are a mix of ASTMS and TBPs. Another excellent source of distillation data is "Analyses of 800 Crude Oils from United States Oilfields" (Coleman, et al., 1978) . The distillations reported by Coleman are not TBP distillations but are essentially ASTM distillations and can be used in the oil-weathering calculations when the boiling points are all converted to one atmosphere total pressure. The reason parts of the ASTM or TBP distillations are conducted at sub-atmospheric pressure is that cracking begins to occur in the still pot at temperatures around 700F. Thus, the data reported by Coleman are around atmospheric pressure up to 527F, and for fractions boiling above this temperature the distillation is performed at 40 mm Hg. In order for the entire distillation to be used as input to the oil-weathering calculation, the cut data must be converted *to* one atmosphere total pressure. The procedure for converting sub-atmosphere boiling points to atmospheric boiling points is described in many places (Edmister and Okamoto, 1959; ASTM D-2892, 1977; API, 1964). An example of the sub-atmospheric boiling-point conversion is shown in Table 2 for Prudhoe Bay Crude Oil. The reported distillation pressure for Prudhoe Bay crude oil in (Table 2), which is near atmospheric but not exactly at one atmosphere, is not critical for the oil-weathering calculations.

TABLE 2. Distillation Data for Prudhoe Bay Crude Oil Showing Conversion of Sub-Atmosphere Boiling Points to Atmospheric Boiling Points (see text) (Coleman, et al, 1978).

Prudhoe Bay field
Sadlerochit, Triassic
8,890 - 9,008 feet

Alaska
North Slope

GENERAL CHARACTERISTICS

Gravity, specific, 0.893 Gravity, ° API, 27.0 Pour point, ° F., 15
Sulfur, percent, 0.82 Color, brownish black
Viscosity, Saybolt Universal at 77° F, 111 sec; 100° F, 84 sec Nitrogen, percent, 0.230

DISTILLATION, BUREAU OF MINES ROUTINE METHOD

Stage 1—Distillation at atmospheric pressure, 741 mm Hg
First drop 81 ° F

Fraction No.	Cut temp ° F	Percent	Sum percent	Sp. gr. 60/60° F	API at 60° F	C/H	Refractive index n_D at 20° C	Specific dispersion	S.U. visc. 100° F	Cloud test, ° F
1	122									
2	167	2.1	2.1	0.693	72.7	-	1.38591	127.9		
3	212	2.6	4.7	.723	64.2	23	1.40312	139.0		
4	257	3.5	8.2	.752	56.7	27	1.41922	141.9		
5	302	3.6	11.8	.773	51.6	30	1.43082	147.0		
6	347	3.7	15.5	.790	47.6	31	1.43922	149.6		
7	392	3.5	19.0	.801	45.2	30	1.44626	152.1		
8	437	4.3	23.3	.818	41.5	33	1.45528	154.7		
9	482	4.8	28.1	.836	37.8	36	1.46565	157.0		
10	527	5.0	33.1	.851	34.8	38	1.47467	160.5		
Stage 2—Distillation continued at 40 mm Hg										
11	392	2.8	35.9	0.873	30.6	43	1.48218	161.5	40	10
12	437	6.5	42.4	.881	29.1	45	1.48650	168.6	45	30
13	482	6.8	49.2	.897	26.2	49	1.49477	169.4	58	50
14	527	6.0	55.2	.910	24.0	52			93	70
15	572	7.4	62.6	.919	22.5	53			176	90
Residuum		36.3	98.9	.990	11.4					

Carbon residue, Conradson Residuum 11.6 percent; crude 4.7 percent. Residuum: Sulfur, percent, - Nitrogen, percent, -

APPROXIMATE SUMMARY

	Percent	Sp. gr.	API	Viscosity
Light gasoline	4.7	0.710	67.9	
Total gasoline and naphtha	19.0	0.752	56.2	
Kerosene distillate	4.3	.818	41.5	
Gas oil	18.4	.860	33.1	
Nonviscous lubricating distillate	11.0	.887-.911	28.0-23.9	50-100
Medium lubricating distillate	8.1	.911-.922	23.9-22.0	100-200
Viscous lubricating distillate	1.8	.922-.924	22.0-21.6	Above 200
Residuum	36.3	.990	11.4	
Distillation loss	1.1			

Fraction No.	Cut Temperature, 'F at 1 Atmosphere
10	580
11	638
12	638
13	738
14	790
Residuum	---

An example of the use of the distillation data as input for the oil-weathering calculation is shown in Table 3. This table is an actual computer display of what the user sees beginning with code execution. In this example the user is using data that is programmed into data statements and will not have to enter the distillation characterization data. The TBP cuts echoed to the user in Table 3 were obtained from the data of Coleman (Coleman, et al., 1978) in Table 2, and illustrate the transfer of these data to the oil-weathering calculation. Notice that cut 1 (fraction 1) in Table 2 has been deleted and the cuts renumbered. The reason cut 1 was deleted is because it is not the first cut with any measurable volume. Also note that the residuum cut is assigned a boiling point of >850F. This assigned boiling point is fictitious and used to indicate that this cut is indeed a residuum.

It can be noted that the true boiling point data presented here (e.g., Table 3) differ from values presented in the open-ocean oil weathering model (Payne et al., 1984a). Reasons for these differences can be explained as follows. The distillation data in Table 2 are presented as cumulative-cut temperatures and are to be interpreted as follows: Fraction #4 (for example) has a cut temperature of 257°F, which means the distillate receiver was changed at this temperature and Fraction #5 began being collected. Thus, the Fraction #4 temperature tabulated is the upper temperature at which that fraction was collected. The temperature used *to* characterize the entire fraction is the average temperature that is (rounded up to) 235°F.

A similar example of the use of distillation data from Coleman (Coleman, et al., 1978) is illustrated in Tables 4 and 5. Table 4 again is the published data and Table 5 illustrates how these data appear as input to the oil-weathering calculation.

The distillation cut data for non-library oils can be entered by the user. The user can either enter this data via the keyboard or use data from a disk file created from a previous execution of the model. An example of keyboard input is illustrated in Table 7 using TBP data for a gasoline cut (O&GJ, 1973, pg. 57) which is presented in Table 6.

TABLE 3. Distillation Cut Data as Used in Oil-Weathering Calculation (data obtained from Table 2).

```
ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED ON I2
IF YOU HAVE NO INPUT DATA JUST ENTER 99
A 99 ENTRY WILL USE A LIBRARY EXAMPLE
99
CHOOSE A CRUDE ACCORDING TO:
1 - PRUDHOE BAY, ALASKA
2 - COOK INLET, ALASKA
3 - WILMINGTON, CALIFORNIA
4 - MURBAN, ABU DHABI
5 - LAKE CHICOT, LOUISIANA
6 - LIGHT DIESEL 'CUT
1

YOU CHOSE: PRUDHOE BAY, ALASKA
```

CUT	TB	API	VOL
1	150.0	72.7	2.1
2	190.0	64.2	2.6
3	235.0	56.7	3.5
4	280.0	51.6	3.6
5	325.0	47.6	3.7
6	370.0	45.2	3.5
7	415.0	41.5	4.3
8	460.0	37.8	4.8
9	505.0	34.8	5.0
10	554.0	30.6	2.8
11	609.0	29.1	6.5
12	662.0	26.2	6.8
13	712.0	24.0	6.0
14	764.0	22.5	7.4
15	850.0	11.4	36.3

```
DO YOU WANT TO CHANGE ANY?
N
```

TABLE 4. Distillation Data for Wilmington Field Crude Oil (Coleman, et al, 1978)

Wilmington field
Repetto, Lower Pliocene
and Puente, Miocene

California
Los Angeles County

GENERA CH RACTERISTICS

Gravity, specific 0. 938 | Gravity, API 1 9 . 4 | Pour point F below 5
Sulfur, percent, 1..59 | Color, brownish black
Viscosity, Saybolt Universal 100° F, 470 sec; 130° F, 229 sec | Nitrogen, percent, 0,597

DISTILLATION, BUREAU OF MINES ROUTINE METHOD

Range 1—Distillation at atmospheric pressure, 738 mm Hg
First drop 118 F

Fraction No	Cut temp F	Percent	Sum percent	Sp gr, 60/60° F	API 60° F	C I	Refractive index (n_D at 20 C)	Specific dispersion	K U viscosity 100° F	Cost F
1	122									
2	167									
3	212	2.3	2.3	0.707	68.6	-	1.39794	122.7		
4	257	2.4	4.7	.744	58.7	24	1.41215	125.7		
5	302	2.4	7. 1	.767	53. 0	27	1.42308	127.1		
6	347	2.5	9.6	.788	48.1	30	1.43480	128.8		
7	392	2.8	12.4	.810	43.2	34	1.44651	133.3		
8	437	3.6	16.0	.831	38.8	39	1.45771	148.6		
9	482	4.4	20.4	.848	35.4	41	1.46754	150.5		
10	527	5.3	25.7	.864	32.3	41	1.47736	152.9		
Range 2—Distillation continued at 40 mm Hg										
11	392	4.7	30.4	0.894	26.8	55	1.48843	155.3	42	Below 5
12	437	6.3	36.7	.907	24.5	57	1.49898	163.8	.56	do.
13	482	4.1	40.8	.920	22.3	60			.87	do.
14	527	5.5	46.3	.932	20.3	62			172	do.
15	572									
Residuum		53.3	99.6	1.008	8.9					

1/

Carbon residue, Conradson: Residuum 8.6 percent; crude 4.9 percent. Residuum: Sulfur, percent. Nitrogen, percent, 1.043

APPROXIMATE SUMMARY

	Percent	Sp gr	API	Viscosity
Light gasoline	2.3	0.707	68.6	
Total gasoline and naphtha	12.4	0.765	53.4	
Kerosene distillate	-	-	-	
Gas oil	18.8	.863	32.5	
Nonviscous lubricating distillate	8.3	.901-.922	25.5-22.0	50-100
Medium lubricating distillate	5.6	.922-.936	22.0-19.7	100-200
Viscous lubricating distillate	1.2	.936-.939	19.7-19.2	Above 200
Residuum	53.3	1.008	8.9	
Distillation loss	.4			

1/ Distillation discontinued at 527° F.

TABLE 5. Distillation Data for Wilmington Field Crude Oil Illustrating Use in Oil-Weathering Calculations (See Table 4 for published data).

```
ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED ON I2
IF YOU HAVE NO INPUT DATA JUST ENTER 99
A 99 ENTRY WILL USE A LIBRARY EXAMPLE
99
CHOOSE A CRUDE ACCORDING TO:
1. = PRUDHOE BAY, ALASKA
2 =  COOK INLET, ALASKA
3 = WILMINGTON, CALIFORNIA
4 =  MURBAN, ABU DHABI
5 - LAKE CHICOT, LOUISIANA
6 =LIGHT DIESEL CUT
3

YOU CHOSE: WILMINGTON,  CALIFORNIA

CUT      TB          API        VOL
 1      195.0       68.6        2.3
 2      235.0       58.7        2.4
 3      280.0       53.0        2.4
 4      325.0       48.1        2.5
 5      370.0       43,2        2.8
 6      415.0       38.8        3.6
 7      460.0       35.4        4.4
 8      505.0       32.3        5.3
 9      554.0       26.8        4*7
s   o   609.o       24.5        6.3
11      662.0       22.3        4.1
12      712*O       20.3        5.5
13      850.0        0.9       53.3
DO YOU WANT TO CHANGE ANY?
N
DO YOU WANT THE MACKAY CONSTANTS?
```

TABLE 6. True Boiling Distillation Data for a Gasoline Cut (O&GJ, 1973, pg. 57).

Cut	Cut Temp., °F	Vol %	API Gravity
1	137	1.5	71.6
2	196	2.1	69.7
3	228	2.0	55.0
4	256	2.0	53.8
5	283	2.0	49.6

TABLE 7. Illustration of User Input of Data for a Gasoline Cut (See Table 6 for "published" data).

```
ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED ON I2
IF YOU HAVE NO INPUT DATA JUST ENTER 99
A 99 ENTRY WILL USE A LIBRARY EXAMPLE
5
IS THE CRUDE ON A FILE ?
N
ENTER THE NAME OF THE CRUDE
GASOLINE CUT
ENTER AN IDENTIFICATION NUMBER FOR THIS CRUDE ON I5
"1s.111
ENTER A SAMPLE NUMBER ON I5
22222
ENTER THE BULK API GRAVITY
55.

YOU MUST ENTER THE TRUE BOILING POINT CUT DATA STARTING
WITH THE MOST VOLATILE CUT AND GOING TO THE BOTTOM OF THE BARREL

ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 1
137.
ENTER API GRAVITY FOR CUT 1
71.6
ENTER VOLUME PER CENT FOR CUT 1
1.5
ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 2
196 *
ENTER API GRAVITY FOR CUT 2
59.7
ENTER VOLUME PER CENT FOR CUT 2
2.i
ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 3
228.
```

TABLE 7 continued). Illustration..af.User Input of Data for a Gasoline Cut (See Table 6 for published data).

```
ENTER API GRAVITY FOR CUT 3
55.
ENTER VOLUME PER CENT FOR CUT 3
2.
ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 4
256.
ENTER API GRAVITY FOR CUT 4
53.8
ENTER VOLUME PER CENT FOR CUT 4
2.0
ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 5
283.
ENTER API GRAVITY FOR CUT 5
49.6
ENTER VOLUME PER CENT FOR CUT 5
2.

CUT      TB          API         VOL
 1      137.0       71.6        1.5
 2      196.0       59.7        2.1
 3      228.0       55.0        2.0
 4      256.0       53.8        2.0
 5      283.0       49.6        2.0
DO YOU WANT TO CHANGE ANY?
N
THIS CRUDE WILL NOW BE WRITTEN TO A FILE.WHAT WOULD YOU LIKE TO CALL IT
[FRSNAM OPEN unit 38    DSK:FOR38.DAT at MAIN.+526 (PC 14421)]
[FRSEFS Enter correct file specs]
*GASCUT.OIL
DO YOU WANT THE MACKAY CONSTANTS?
N
```

Each time an input is required the user is prompted with an appropriate question. Since it is nearly impossible to enter many numbers into the oil-weathering calculation without an error, the distillation cut data are always echoed to the user for review. In the event an input error is discovered or it is desired to change an entry, the user's response to DO YOU WANT TO CHANGE ANY? is yes. The error recovery is illustrated in Table 8 where the gasoline-cut data from Table 6 is entered. Note the input error for TB (boiling temperature) for cut 3 where 22.8 was entered instead of 228. The user is prompted for the error-recovery information and the final data is echoed to the user. In the event another error is to be corrected, a "YES" would be entered in response to the very last question in Table 8.

Following keyboard data entry, the user will be prompted for a name to be assigned to a disk file which will contain the TBP data for the oil of interest. The format for this name is one to six characters followed by an optional period and one to three letter extension. In the example (Table 7), the file was named GASCUT.OIL.

An example of disk file input is illustrated in Table 9. In this example, the disk file created in the previous example (Table 7) is used as input for the model.

After the TBP data required as input have been specified, the user is asked if the Mackay Constants are desired. These constants are input constants for the Mackay evaporation model (Mackay, 1982). The calculation of these constants are an "add-on" calculation and do not affect the "weathering" portion of the model.

TABLE 8. Illustration of Input-Error Recovery (Note error for cut 3 boiling Temperature).

```
ENTER THE BOILING POINT AT 1 ATM IN DEG F FOR CUT 5
283.
ENTER API GRAVITY FOR CUT 5
49.6
ENTER VOLUME PER CENT FOR CUT 5
2.

CUT      TB          API         VOL
 1      137.0       71.6        1.5
 2      196.0       59*7        2*1
 3       22.8       55.0        2.0
 4      256.o       53.8        2.0
 5      283.0       49.6        2.0
DO YOU WANT TO CHANGE ANY?
Y
ENTER THE CUT NUMBER TO BE CHANGED ONI2
3
ENTER 1 TO CHANGE TB, 2 FOR API, 3 FOR VOL%
1
ENTER THE CHANGED DATA
228.

CUT      TB          API         VOL
 1      137.0       71.6        1.5
 2      196.0       59.7        2.1
 3      228.0       55.0        2.0
 4      256.0       53.8        2.0
 5      283.0       49.0        2.0
DO YOU WANT TO CHANGE ANY?
N
```

TABLE 9. Illustration of Disk-file Input of TBP Distillation Data.

```
ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED ON I2
IF YOU HAVE NO INPUT DATA JUST ENTER 99
A 99 ENTRY WILL USE A LIBRARY EXAMPLE
5
IS THE CRUDE ON A FILE ?
Y
WHAT IS THE FILE NAME?
[FRSNAM OPEN unit 36    DSK:FOR36.DAT at MAIN.+156 (PC 14051)]
[FRSEFS Enter correct file specs]
*GASCUT.OIL

CUT      TB          API         VOL
 1      137.0       71*6        15.6
 2      196.0       59.7        21.9
 3      228.0       55.0        20.8
 4      256.0       53.8        20.8
 5      283.0       49.6        20.8
DO YOU WANT TO CHANGE ANY?
N
DO YOU WANT THE MACKAY CONSTANTS?
N
```

At this point the calculation can be stopped. The crude oil characterization and, if desired, the Mackay Constants are all that will have been calculated. However, in order to "weather the crude", the user types "YES" 'n response to DO YOU WANT TO WEATHER THIS CRUDE?

The user input required for an oil-weathering calculation begins with a YES in response to the question DO YOU WANT TO WEATHER THIS CRUDE? The user is then prompted for the spill size in barrels.

Following this, the user is "led" through a series of three "compartments" of possible oil weathering. These three compartments are:

1. Oil weathering in pools on top of ice.
2. Oil weathering on the ocean surface in a broken-ice field,
3. Open ocean oil weathering.

The user is allowed to "mix and match" combinations of these three environmental configurations in order to design a scenario that will best match the actual or hypothetical conditions for which an oil weathering prediction is desired. Individual compartments can be skipped and environmental parameters such as temperature, wind speed, etc. can be changed from compartment to compartment. An example of user input for a scenario that involves all three compartments using a library crude oil is illustrated in Table 10. Following the spill size specification the user is asked WILL THE WEATHERING SCENARIO INCLUDE SEA ICE? If the user responds with "N", the first two compartments are not used and open ocean weathering follows. If the user enters 'Y', as in the example, all three weathering compartments are offered.

For weathering of oil on top of ice the required input data are: the number of hours for oil weathering, the temperature, the depth of the oil pools, the mass-transfer coefficient code, the wind speed, and, if desired, new viscosity constants.

TABLE 10. Illustration of User Input for Oil-Weathering Calculation with a Library-Specified Crude.

```
ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED ON I2
IF YOU HAVE NO INPUT DATA JUST ENTER 99
A 99 ENTRY WILL USE A LIBRARY EXAMPLE
99
CHOOSE A CRUDE ACCORDING TO:
1 = PRUDHOE BAY, ALASKA
2 - COOK INLET, ALASKA
3 = WILMINGTON, CALIFORNIA
4 =  MURBAN, ABU DHABI
5 - LAKE CHICOT, LOUISIANA
6 = LIGHT DIESEL CUT
1

YOU CHOSE: PRUDHOE BAY, ALASKA

CUT      TB          API         VOL
 1      150.0       72.7        2.1
 2      190.0       64*2        2.6
 3      235.0       56.7        3.5
 4      280.0       51.6        3.6
 5      325.0       47.6        3.7
 6      370.0       45.2        3.5
 7      415.0       41.5        4.3
 8      460*0       37.8        4.8
 9      505.o       34.8        5.0
10      554.o       30.6        2.8
11      609.0       29*1        6.5
12      662.0       26.2        6.8
13      712.0       24.0        6.0
14      764.o       22.5        7.4
15      850.0       11.4       36.3
DO YOU WANT TO CHANGE ANY?
N
DO YOU WANT THE MACKAY CONSTANTS?
Y
AT WHAT TEMPERATURE, DEG F?
32.

PLEASE WAIT
```

TABLE 10 (continued). Illustration of User Input for Oil-Weathering Calculation with a Library-Specified Crude.

```
DO YOU WANT To WEATHER THIS OIL?
Y
WHAT IS THE SPILL SIZE IN BARRELS?
10000
WILL THE WEATHERING SCENARIO INCLUDE SEA ICE?
Y
WHEN THE OIL REACHES THE OIL SURFACE,
WILL IT WEATHER IN POOLS ON TOP OF THE ICE?
Y
AT WHAT TEMPERATURE, DEG F?
20.
FOR HOW MANY HOURS?
24.
HOW DEEP WILL THE POOLS BE IN CM? TRY 2
2
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR 3 WHERE:
1=USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2=CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
2
ENTER "THE WIND SPEED IN KNOTS
10
DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?
N

PLEASE WAIT
WILL THE OIL NOW WEATHER IN THE BROKEN ICE FIELD?
Y
FOR HOW MANY HOURS?
100.
AT WHAT TEMPERATURE, DEG F?
32.
ENTER THE FRACTION OF ICE COVER, I.E. 0.7
.66
DO YOU WANT TO ENTER NEW MOUSSE FORMATION CONSTANTS?
N
DO YOU WANT TO ENTER A NEW OIL-WATER SURFACE TENSION (DYNES/CM)?
N
ENTER THE MASS-TRANSFER COEFFICIENT CODE:1,2, OR 3 WHERE:
I-USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2-CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
2
ENTER "THE WIND SPEED IN KNOTS
15.
DO YOU WANT THE SLICK TO SPREAD?
Y
DO YOU WANT To ENTER NEW VISCOSITY CONSTANTS?
N
DO YOU WANT THE WEATHERING To OCCUR WITH DISPERSION?
Y
DO YOU WANT TO ENTER NEW DISPERSION CONSTANTS?
N

PLEASE WAIT
```

TABLE 10 (continued). Illustration of User Input for Oil-Weathering Calculation with a Library-Specified Crude

```
WILL OPEN OCEAN WEATHERING NOW OCCUR?
Y
FOR HOW MANY HOURS?
240.
AT WHAT TEMPERATURE, DEG F?
40.
DO YOU WANT TO ENTER NEW MOUSSE FORMATION CONSTANTS?
N
DO YOU WANT TO ENTER A NEW OIL-MATER SURFACE TENSION (DYNES/CM)?
N
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR 3 WHERE:
1-USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2-CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
2
ENTER THE WIND SPEED IN KNOTS
20.
DO YOU WANT THE SLICK TO SPREAD?
Y
DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?
N
DO YOU WANT THE WEATHERING TO OCCUR WITH DISPERSION?
Y
DO YOU WANT TO ENTER NEW DISPERSION CONSTANTS?
N

PLEASE WAIT
CPU time 19.73  Elapsed time 2:36.35
```

The mass-transfer coefficient is for the evaporation weathering process, not dissolution. There are three possible mass-transfer coefficient input specifications, and the one recommended is 2 as illustrated in Table 10.

The wind speed, which is in knots, should be less than 40 knots because oil-weathering processes at and above this wind speed are not quantified. Also, the lowest wind speed used in the calculation is 2 knots and any value entered lower than this is reset to 2.

For now, new viscosity constant are not entered. The procedure for specifying new constants will be detailed later in this manual.

After all of the required data have been entered, the user is asked to wait while the numerical integration routine is executed. Following this pause, the user is asked if broken ice field weathering will take place. In the example (Table 10), the answer is "YES" so the input parameters for broken-ice field weathering are' now requested. For library oils the required data are the same for broken-ice and open-ocean weathering (with one minor exception noted below) so the following discussion applies to both of these compartments of the model.

The required data at this point are: the number of hours for weathering to occur, the temperature, new mousse formation constants (if desired), new oil-water surface tension (if desired), the mass-transfer coefficient code, the wind speed, whether or not the slick is to spread (YES) or (NO), new viscosity constants (if desired), whether or not the slick is to disperse (YES) or (NO), and new dispersion constants (if desired). For broken-ice weathering one other parameter is required, the fraction of ice cover.

As shown in Table 10, dispersion and spreading are "on" for the example and no new constants have been specified to replace the library values.

The same guidelines for mass-transfer coefficient code and wind speed outlined above apply for the last two compartments as well.

The fraction of ice cover is used to calculate the reduction in spreading rate due to the broken ice. The spreading equation (or algorithm) used in the oil weathering code(s) is a correlation based on observation. At present, there is not a mechanistic model (except possibly Elliot, 1986) that applies to the open ocean, and especially the situation where ice occurs or where ice cover changes as a function of time. The correlation algorithm for spreading can be changed quite readily in the oil-weathering codes in the event a useable algorithm is published. The search for a more realistic and mechanistic spreading model for all situations is on-going.

The preceding input description illustrates a straightforward use of the information programmed in the oil-weathering code, Illustrations of how the programmed information can be changed are presented in the following discussion. Altering the programmed information allows other crudes or petroleum cuts to be entered into the calculation, or actual spills and experiments can be analyzed to find the best physical properties or rate constants which predict observed data. Such alteration can be used in each of the three compartments of the model so the following discussion applies to each of those compartments.

The first input information that can be changed by the user is the mousse-formation constants as illustrated in Table 11. The mousse constants appear in an equation which quantifies the rate of water incorporation into the oil with respect to time. This rate equation is (Mackay, et al., 1980).

$$(1 - K_2W) \exp\left[\frac{-2.5W}{1-K_1W}\right] = \exp(-K_3K_5t)$$

where W is the weight fraction water is mousse. K_1 is a constant in the viscosity equation, K_2 is a coalescing-tendency constant, K_3 is a lumped water incorporation rate constant, and K_5 is the factor included in the equation to increase the mousse formation rate in the broken-ice field. K_1 appears in a stand-alone equation for the apparent viscosity of the emulsion as (Mooney, 1951)

TABLE 11. Illustration of User-Specified Mousse-Formation Constants

```
DO YOU WANT TO ENTER NEW MOUSSE FORMATION CONSTANTS?
Y
1. ENTER THE MAXIMUM WEIGHT FRACTION WATER IN OIL
.60
2. ENTER THE MOUSSE-VISCOSITY CONSTANT, TRY 0.65
.65
3. ENTER THE WATER INCORPORATION RATE CONSTANT, TRY 0.001
.001
4. ENTER THE BROKEN ICE FIELD MULTIPLIER FOR MOUSSE FORMATION
5.
DO YOU WANT TO ENTER A NEW OIL-WATER SURFACE TENSION (DYNES/CM)?
Y
TRY 30.
30.
```

$$\mu = \mu_0 \exp\left[\frac{-2.5W}{1-K_1W}\right]$$

where p″ is the parent oil viscosity, K_1 is usually around 0.62 to 0.65 and apparently does not change much with respect *to* different types of oils.

The constant K_2 must satisfy the relation $K_2W < 1$ in order for the water incorporation rate *to* be > 0. Thus, K_2 is the inverse of the maximum weight fraction water in mousse. K_3 is the water incorporation rate constant and **is** a function of wind speed in knots. Currently the oil-weathering code calculates K_3 from

$$K_3 = 0.001\ (\text{WIND SPEED})^2$$

and the constant actually entered by the user is the 0.001 constant above.

Thus, referring to Table 11, the first mousse formation constant entered is the maximum weight fraction water in the mousse. The reciprocal of this number is used for K_1. The second constant entered is the viscosity constant in Mooney's equation and this number should be 0.62 to 0.65 unless experimental evidence suggests otherwise. The third constant entered is the multiplier of the (wind speed)^2 which then yields K_3. This number is around 0.001 as indicated. There is limited data available for K_5 but some evidence points to a typical value of about 10 for broken-ice fields, which is the default value. In the open ocean, K_5 is by definition 1.0 so input is not required for this constant in the open-ocean section of the code. Note that most of the prompting for input also prints suggested values for each constant.

The next input parameter that the user can change is the **mass-**transfer coefficient for evaporation. The input illustration in Table 10 uses the correlation mass transfer coefficient as developed by Mackay and Matsugu (Mackay and Matsugu, 1973). Table 12 illustrates the three possible input

TABLE 12. Illustration of **Three Input Options for the Mass Transfer Coefficient for Evaporation**

```
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR 3 WHERE:
1=USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2-CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
1
ENTER THE WIND SPEED IN KNOTS
10.
DO YOU WANT THE SLICK TO SPREAD?
Y
ENTER THE OVER-ALL MASS-TRANSFER COEFFICIENT? CM/HR, TRY 10
1.0.
DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?
```

```
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR 3 WHERE:
l-USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2=CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
2
ENTER THE WIND SPEED IN KNOTS
10.
DO YOU WANT THE SLICK TO SPREAD?
Y
```

```
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR "3 WHERE:
1=USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2-CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
3
ENTER THE WIND SPEED IN KNOTS
10.
DO YOU WANT THE SLICK TO SPREAD?
Y
ENTER THE OIL-PHASE MASS-TRANSFER COEFFICIENT IN CM/HR, TRY 10
10.
ENTER "THE AIR-PHASE MASS-TRANSFER COEFFICIENT IN CM/HR, TRY 1000
1000.
ENTER THE MOLECULAR WEIGHT OF THE CONPOUND FOR K-AIR ABOVE, TRY 20(
200.
DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?
N
```

options for the evaporation mass transfer coefficient. The first input option shown in Table 12 allows the user to input the mass-transfer coefficient directly in contrast to the second input option where the coefficient is calculated as a function of wind speed and slick diameter. In the third input option the user can enter individual-phase mass transfer coefficients. In this last option the entered coefficient is scaled according to the square root of the molecular weight of each cut to yield a coefficient specific to each cut (Liss and Slater, 1974). The coefficient in this last option is also scaled according to wind speed according to Garratt's drag coefficient (Garratt, 1977).

After specifying the mass-transfer coefficient options the user can specify if the slick is to spread or not. This option is illustrated in Table 13 by entering YES or NO to the prompt. In this particular illustration the user has specified that the slick does not spread. This option is useful for investigating evaporation from spills on solid surfaces such as ice or land. When the no-spreading " option is selected the user is prompted for a starting thickness, unless previous weathering has occurred in which case the remaining thickness is used. In the illustration in Table 13 the entered thickness is 2 cm.

The final physical property optional input that can be specified by the user is the viscosity. The viscosity-prediction for the bulk weathered oil is important when dispersion of oil into water occurs since viscosity appears in the rate equation for dispersion. The current method of viscosity prediction is based on the viscosity of the initial crude at 25°C, a temperature-scaling constant, and a fraction-oil-weathered constant. The viscosity predicted at this stage of optional input is for oil only, and must not be interpreted as that viscosity when an water-in-oil emulsion is present. The further change in viscosity due to water-in-oil emulsification (mousse formation) was described on page 4.

The viscosity at 25°C is scaled to other temperatures by the Andrade equation (Gold and Olge, 1969) which is

TABLE 13. Illustration of the "No-Spreading" Option and Starting Thickness Specification

```
ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1, 2, OR 3 WHERE:
1-USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT
2=CORRELATION MASS-TRANSFER COEFFICIENT BY MACKAY & MATSUGU
3-INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS
2
ENTER THE WIND SPEED IN KNOTS
1i)
DO YOU WANT THE SLICK TO SPREAD?
N
SINCE THE SLICK DOES NOT SPREAD, ENTER A STARTING THICKNESS IN CM
2.
```

$$\ln\left[\frac{\mu_1}{\mu_0}\right] = B\left[\frac{1}{T_1} - \frac{1}{T_0}\right]$$

and the temperature-scaling constant is B. This viscosity of the weathered oil is calculated according to $\exp(K_4 F)$ where F is the fraction weathered (Tebeau, Mackay, et al., 1982) i.e., fresh crude oil has F = 0. As weathering proceeds, the parent oil viscosity increases exponentially with respect to F.

The user can enter the three viscosity constants by answering YES to the prompt illustrated in Table 14. In this illustration suggested input viscosity constants are printed along with the prompt.

The constants which appear in the dispersion process can also be specified by the user. The dispersion of oil into the water column is described by two equations (Mackay, et al., 1980):

$$F = K_a K_c (U + 1)^2$$

and

$$F_B = (1 + K_b \mu^{0.5} \delta x)^{-1}$$

where F is the fraction of sea surface subject to dispersions per second, U is the wind speed in m/see, and K_a is a constant, typically 0.1 hr^{-1}. F_B is the fraction of droplets of oil below a critical size which do not return to the slick, K_b is a constant, around 50, μ is the viscosity in centipoise, x is the slick thickness in meters, w is the surface tension in dynes/cm, and Kc is the constant which determines the increase in dispersion for broken-ice fields. Little experimental data is available for K_C, however some limited data suggests a value of 10, which is the default value. In open-ocean weathering, Kc is by definition 1.0, so input for this variable is not required in the

TABLE 14. Illustration of Viscosity-Constant Input Options

```
DO YOU WANT TO ENTER NEW  VISCOSITY  CONSTANTS?
Y
1. ENTER THE  BULK  CRUDE VISCOSITY AT 25 DEG C, CENTIPOISES TRY 35.
40.
2* ENTER  THE  VISCOSITY TEMPERATURE SCALING CONSTANT(ANDRADE), TRY  9000.
9000.
3. ENTER  THE  VISCOSITY-FRACTION-OIL-WEATHERED CONSTANT, TRY 10.5
10.5
DO YOU WANT  THE  WEATHERING TO  OCCUR  WITH  DISPERSION?
Y
DO YOU WANT TO ENTER NEW DISPERSION  CONSTANTS?
Y
ENTER  THE  WIND SPEED CONSTANT, "TRY 0.1
.1
ENTER  THE  CRITICAL  DROPLET  SIZE  CONSTANT,  TRY  50
50.
ENTER THE BROKEN ICE FIELD  DISPERSION  MULTIPLIER
8.
DO YOU WANT THE  WEATHERING  "TO  OCCUR  WITH  DISPERSION?
```

open-ocean portion of the model. The mass fraction that leaves the slick as dispersed droplets if (F_b). (F) and this fraction applies to each cut of oil. Table 15 illustrates the user input of the constants K_a, K_b, and Kc.

Output Description.

The output generated by the ocean-ice oil-weathering code is written to four disk files: OILICE.OUT, OILICE.TYP, OILICE.PLT and MACKAY.DAT. These files contain the calculated results in various forms. The OILICE.OUT file is 130 columns wide and intended to be printed on an appropriate high speed printer. The OILICE.TYP file is an abbreviated version of OILICE.OUT. The OILICE.PLT is a numbers-only raw data file and intended to be read by a plotting routine or other data processing routines which must be supplied by the user. The MACKAY.DAT file contains the input parameters for the MACKAY evaporation model.

An example of the OILICE.OUT file (130 column) is presented in Table 16 where the calculated results for an oil-weathering calculation for Prudhoe Bay crude is presented. The first page of this output is crude characterization information for fresh Prudhoe Bay Crude Oil as calculated according to previous descriptions (Payne et al., 1983, 1984a). Page 34 presents the mass-transfer coefficients, the input parameters and constants, and the beginning of the results of the calculations for weathering in pools on top of ice. Pages 35 through 38 are the remainder of these calculations. Page 39 presents the characterization of the oil after "pool-weathering". The intermediate characterization is used automatically as input for further weathering as directed by the user. (Note that the volume percents and bulk API gravity have changed,)

For the scenario presented in Table 16, weathering in the broken-ice field at 32F was chosen next. Page 40 presents the input constants and the beginning of the results for this weathering.

One important aspect of the code output to notice is the deletion of very volatile cuts. The information presented for various times is self

TABLE 15. Illustration of Dispersion Constants Input

```
DO YOU WANT THE WEATHERING TO OCCUR WITH DISPERSION?
Y
DO YOU WANT TO ENTER NEW DISPERSION CONSTANTS?
'f
ENTER THE WIND SPEED CONSTANT, TRY 0.1
.2
ENTER THE CRITICAL DROPLET SIZE CONSTANT, TRY 50
50.
ENTER THE BROKEN ICEFIELD DISPERSION MULTIPLIER
89.

PLEASE WAIT
```

TABLE 16. Illustration of Output from Oil-Weathering Calculations; Fresh Prudhoe Bay Crude Oil Characterization.

SUMMARY OF TBP CUTS CHARACTERIZAT ON FOR: PRUDHOE BAY, ALASKA

CODE VERSION IS CUTICA OF MAY 84
ITEM 9, SAMPLE 71011

	TB	API	SPGR	VOL	MW	TC	PC	VC	A	B	T10	VIS	NC	NS
1	1.50E+02	7.27E+01	6.81E-01	2.12E+00	8.35E+01	9.14E+02	3.95E+01	3.66E+02	3.17E+00	1.90E-01	4.47E+02	3.88E-01	3	
2	1.90E+02	6.42E+01	7.11E-01	2.63E+00	9.39E+01	9.63E+02	3.79E+01	4.07E+02	3.24E+00	2.03E-01	4.78E+02	4.48E-01	3	
3	2.35E+02	5.67E+01	7.39E-01	3.54E+00	1.06E+02	1.02E+03	3.64E+01	4.54E+02	3.31E+00	2.15E-01	5.13E+02	5.44E-01	3	
4	2.80E+02	5.16E+01	7.60E-01	3.64E+00	1.19E+02	1.07E+03	3.48E+01	5.07E+02	3.41E+00	2.27E-01	5.49E+02	6.73E-01	3	
5	3.25E+02	4.76E+01	7.77E-01	3.74E+00	1.34E+02	1.12E+03	3.32E+01	5.65E+02	3.52E+00	2.39E-01	5.86E+02	8.46E-01	3	
6	3.70E+02	4.52E+01	7.87E-01	3.54E+00	1.51E+02	1.16E+03	3.16E+01	6.32E+02	3.67E+00	2.50E-01	6.23E+02	1.07E+00	3	
7	4.15E+02	4.15E+01	8.04E-01	4.35E+00	1.67E+02	1.21E+03	3.03E+01	6.98E+02	3.80E+00	2.59E-01	6.60E+02	1.38E+00	3	
8	4.60E+02	3.78E+01	8.22E-01	4.85E+00	1.85E+02	1.26E+03	2.91E+01	7.67E+02	3.94E+00	2.67E-01	6.98E+02	1.81E+00	3	
9	5.05E+02	3.48E+01	8.36E-01	5.06E+00	2.00E+02	1.31E+03	2.84E+01	8.28E+02	4.06E+00	2.74E-01	7.36E+02	1.75E+00	3	
10	5.54E+02	3.06E+01	8.58E-01	2.83E+00	2.21E+02	1.35E+03	2.74E+01	9.09E+02	4.22E+00	2.82E-01	7.77E+02	2.48E+00	3	
11	6.09E+02	2.91E+01	8.66E-01	6.57E+00	2.52E+02	1.40E+03	2.58E+01	1.03E+03	4.49E+00	2.92E-01	8.26E+02	4.00E+00	3	
12	6.62E+02	2.62E+01	8.82E-01	6.88E+00	2.81E+02	1.45E+03	2.47E+01	1.15E+03	4.73E+00	2.99E-01	8.73E+02	7.18E+00	3	
13	7.12E+02	2.40E+01	8.94E-01	6.07E+00	3.13E+02	1.49E+03	2.36E+01	1.27E+03	5.00E+00	3.06E-01	9.19E+02	1.36E+01	3	1
14	7.64E+02	2.25E+01	9.03E-01	7.48E+00	3.51E+02	1.53E+03	2.25E+01	1.43E+03	5.35E+00	3.13E-01	9.68E+02	2.81E+01	3	1
15	8.50E+02	1.14E+01	9.73E-01	8.67E+01	6.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+02	0	0

	UOP K	CORRELATION INDEX
1	1.24E+01	1.16E+01
2	1.22E+01	1.66E+01
3	1.20E+01	2.12E+01
4	1.19E+01	2.32E+01
5	1.19E+01	2.43E+01
6	1.19E+01	2.32E+01
7	.19E+01	2.56E+01
8	.18E+01	2.90E+01
9	.18E+01	3.15E+01
10	.17E+01	3.73E+01
11	.18E+01	3.66E+01
12	.18E+01	4.02E+01
13	.18E+01	4.27E+01
14	.18E+01	4.36E+01
15	.12E+01	7.21E+01

BULK API GRAVITY = 20.9

TB = NORMAL BOILING TEMPERATURE, DEG F
API = API GRAVITY
VOL = VOLUME PER CENT OF TOTAL CRUDE
MW = MOLECULAR WEIGHT
TC = CRITICAL TEMPERATURE, DEG RANKINE
PC = CRITICAL PRESSURE, ATMOSPHERES
VC = CRITICAL VOLUME, CC/MOLE
A AND B ARE PARAMETERS IN THE VAPOR PRESSURE EQUATION
T10 IS THE TEMPERATURE IN DEG R WHERE THE VAPOR PRESSURE IS 10 MM HG
VIS IS THE KINEMATIC VISCOSITY IN CENTISTOKES AT 122 DEG F
UOP K IS THE U.O.P. K CHARACTERIZATION FACTOR
CORRELATION INDEX IS DEFINED IN (COLEMAN, 1978)
NC = ERROR CODE, SHOULD BE LESS THAN 20
NS = ERROR CODE, SHOULD BE EQUAL TO 1
IGNORE THE ERROR CODES FOR COMPONENT NUMBER 15 IF IT IS / RESIDUUM

MEAN MOLECULAR WEIGHT OF THE CRUDE 2.593E+02

TABLE 16 (continued). Output from Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time versus Calculated results of Weathering in Pools on Top of Ice at 32°F..

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WEATHERING OF OIL IN POOLS ON TOP OF ICE

OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT CODE 2

OVER-ALL MASS-TRANSFER COEFFICIENT FOR COMENE =  2.079E+01 M/HR

  CUT            M/HR        CM-MOLES/(HR)(ATM)(M**2)
   1          2.245E+01            1.028E+03
   2          2.212E+01            1.013E+03
   3          2.183E+01            9.994E+02
   4          2.156E+01            9.873E+02
   5          2.133E+01            9.767E+02
   6          2.112E+01            9.669E+02
   7          2.095E+01            9.591E+02
   8          2.080E+01            9.525E+02
   9          2.069E+01            9.474E+02
  10          2.057E+01            9.419E+02
  11          2.042E+01            9.351E+02
  12          2.031E+01            9.300E+02
  13          2.022E+01            9.257E+02
  14          2.012E+01            9.213E+02

FOR THIS SPILL OF  1.000E+04 BARRELS, THE MASS IS  1.395E+03 METRIC TONNES

VOLUME FROM SUMMING THE CUTS =  1.6E+03 M**3, OR  1.000E+04 BARRELS

WIND SPEED =  1.000E+01 KNOTS, OR  1.853E+04 M/HR

INITIAL SLICK DIAMETER =  3.182E+02 M, OR AREA =  7.950E+04 M**2

THIS SLICK DOES NOT SPREAD FOR THIS CALCULATION

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =  4.0E+00 CENTI: OKES AT 122 DEG F

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =  1.1E+00 AT T =  32.0 DEG F, SCALE FACTOR =  2.8E-01

VISCOSITY ACCORDING TO MASS EVAPORATED: VIS25C = 3.50E+01, ANDRADE = 9.00E+03, FRACT WEATHERED = 1.05E+01, VSLEAD = 1.25E+03 CP

MOUSSE CONSTANTS: MOONEY= 0.00E+00, MAX H20=-1.00, WIN E*2= 0.00E+00

THE FRACTIONAL SLICK AREA SUBJECT TO DISPERSION IS  0. E+00 PER HOUR

COUNT THE CUTS IN THE FOLLOWING OUTPUT FROM LEFT TO RI  IT

THE INITIAL GRAM MOLES IN THE SLICK ARE:
 2.740E+05  3.148E+05  3.907E+05  3.668E+05  3.433E+05  2.923E+05  3.304E+05  3.414E+05  3.340E+05  1.741E+05  3.576E+05
 3.412E+05  2.745E+05  3.042E+05  9.420E+05

THE INITIAL MASSES (GRAMS) IN THE SLICK ARE:
 2.288E+07  2.956E+07  4.138E+07  4.375E+07  4.5 5E+07  4.407E+07  5.530E+07  6.308E+07  6.690E+07  3.043E+07  9.005E+07
 9.594E+07  8.585E+07  1.069E+08  5.652E+08
THE TOTAL MASS FROM THESE CUTS IS  1.395E+09 GRA S


 STEP SIZE OF  8.047E-02 IS BASED ON CUT   1

 TIME =  0.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  1
 1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
 1.0E+00
 MASS REMAINING =  1.395E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  0.000E+00, SUM =  1.395E+09
 FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 1.0E+00, AREA= 7.9E+04 M**2, THICKNESS= 2.0E+00 CM, MOLE WT=259.3
 WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.3E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
 MASS/AREA= 1.8E+04 GMS/M*M, SPGR= 8.8E-01, TOTAL VOLUME= 1.0E+04 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 0.0E+00 GMS/M*M/H
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TABLE 16 (continued). Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Weathering in Pools on Top of Ice.

```
TIME =  1.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  2
5.8E-01  8.4E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.379E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  1.673E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICE= 9.9E-01, AREA= 7.9E+04 M**2, THICKNESS= 2.0E+00 CM, MOLE WT=265.4
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.4E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.8E-01, TOTAL VOLUME= 9.8E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.7E+02 GMS/M*M/HR

TIME =  2.1E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  3
3.3E-01  7.0E-01  9.2E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.367E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  2.864E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICE= 9.8E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=270.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.6E+03 CENTISTOKES, DISPERSION TERM = 0.0E+00 UNIT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.8E-01, TOTAL VOLUME= 9.7E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.3E+02 GMS/M*M/HR

TIME =  3.1E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  4
1.9E-01  5.8E-01  8.8E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.350E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  3.755E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.7E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=273.4
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.7E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.8E-01, TOTAL VOLUME= 9.7E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 9.5E+01 GMS/M*M/HR

TIME =  4.2E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  5
1.0E-01  4.8E-01  8.4E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.351E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  4.447E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.7E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=276.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.8E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.8E-01, TOTAL VOLUME= 9.6E+03 mu., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 7.5E+01 GMS/M*M/HR

TIME =  5.2E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  6
5.8E-02  4.0E-01  8.0E-01  9.5E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.345E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  5.005E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICE= 9.6E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=278.2
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.8E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.6E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 6.2E+01 GMS/M*M/HR

TIME =  6.3E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  7
3.2E-02  3.3E-01  7.7E-01  9.4E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.341E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  5.471E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=280.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  1.9E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.5E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 5.2E+01 tXS/H*H/tilt

TIME =  7.3E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  8
1.8E-02  2.7E-01  7.3E-01  9.4E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.337E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  5.870E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICE= 9.6E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=281.5
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.0E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.5E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 4.5E+01 GMS/M*M/HR
```

TABLE 16 (continued). Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Weathering in Pools on Top of Ice.

```
TIME =  8.4E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  9
9.7E-03  2.2E-01  7.0E-01  9.3E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.333E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  6.219E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=282.8
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.0E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.4E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 4.0E+01 GMS/M*M/HR

TIME =  9.4E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                 10
5.2E-03  1.8E-01  6.7E-01  9.2E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.330E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  6.535E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=284.0
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.1E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.4E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 3.6E+01 GMS/M*M/HR

TIME =  1.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                 11
2.8E-03  1.5E-01  6.4E-01  9.1E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.327E+09, MASS DISPERSED = 0.000E+00, MASS EVAPORATED =  6.819E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=285.1
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.1E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.4E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 3.3E+01 GMS/M*M/HR

STEP SIZE OF 2.619E-01 IS BASED ON CUT 2

TIME =  1.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                 12
1.5E-03  1.2E-01  6.1E-01  9.0E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.324E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  7.076E+07, sun =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=286.0
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.1E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.4E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 3.0E+01 GMS/M*M/HR

STEP SIZE OF 2.6062-01 IS BASED ON CUT 2

TIME =  1.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                 13
8.2E-04  9.9E-02  5.8E-01  8.9E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.322E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED = 7.310E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=286.9
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.2E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.4E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.8E+01 GMS/M*M/HR

STEP SIZE OF 2.594E-01 IS BASED ON CUT 2

TIME =  1.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                 14
4.4E-04  8.1E-02  5.5E-01  8.8E-01  9.8E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.320E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  7.525E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=287.7
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY =  2.2E+03 CENTISTOKES, DISPERSION TERM = 0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.6E+01 GMS/M*M/HR

STEP SIZE OF 2.582E-01 IS BASED ON CUT 2
```

TABLE 16 (continued). Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Weathering in Pools on Top of Ice.

```
TIME =  1.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    15
2.4E-04  6.6E-02  5.3E-01  8.7E-01  9.7E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.310E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  7.725E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=288.4
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.2E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.4E+01 GMS/M*M/HR

STEP SIZE OF  2.572E-01 IS BASED ON CUT   2

TIME =  1.6E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    16
1.3E-04  5.4E-02  5.0E-01  8.6E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.316E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  7.911E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=289.1
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.3E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.2E+01 GMS/M*M/HR

STEP SIZE OF  2.562E-01 IS BASED ON CUT   2

TIME =  1.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    17
6.9E-05  4.4E-02  4.8E-01  8.5E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.314E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.006E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=289.8
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.3E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.1E+01 GMS/M*M/HR

STEP SIZE OF  2.553E-01 IS BASED ON CUT   2

TIME =  1.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    18
3.7E-05  3.6E-02  4.6E-01  8.4E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.313E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.250E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=290.4
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.3E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 2.0E+01 GMS/M*M/HR

STEP SIZE OF  2.545E-01 IS BASED ON CUT   2

TIME =  1.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    19
2.0E-05  3.0E-02  4.3E-01  8.4E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.311E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.405E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.9E+00 CM, MOLE WT=291.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.4E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.3E+03 BBL., DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.9E+01 GMS/M*M/HR

STEP SIZE OF  2.537E-01 IS BASED ON CUT   2

TIME =  2.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    20
1.1E-05  2.4E-02  4.1E-01  8.3E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.310E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.552E+07, SUM =  1.395E+09
```

TABLE 16 (continued). Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Weathering in Pools on Top of Ice.

```
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.2E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.8E+01 GMS/M*M/HR

STEP SIZE OF  2.530E-01 IS BASED ON CUT  2

TIME =  2.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          21
5.9E-06  2.0E-02  3.9E-01  8.2E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.308E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.693E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.8E+00 CM, MOLE WT=292.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.4E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.2E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.7E+01 GMS/M*M/HR

STEP SIZE OF  2.522E-01 IS BASED ON CUT 2

TIME =  2.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          22
3.2E-06  1.6E-02  3.8E-01  8.1E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.307E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.826E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.8E+00 CM, MOLE WT=292.5
WEIGHT FRACTION WATER IN OIL = 0.0E+00, VISCOSITY = 2.4E+03 CENTISTOKES, DISPERSION TERM = 0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.2E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.6E+01 GMS/M*M/HR

STEP SIZE OF  2.516E-01 IS BASED ON CUT  2

TIME = 2.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                           23
1.7E-06  1.3E-02  3.6E-01  8.0E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.306E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  8.954E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.8E+00 CM, MOLE WT=293.0
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.5E+03 CENTISTOKES, DISPERSION TERM = 0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.2E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.6E+01 GMS/M*M/HR

STEP SIZE OF  2.509E-01 IS BASED ON CUT  2

TIME =  2.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          24
9.3E-07  1.1E-02  3.4E-01  7.9E-01  9.6E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
1.0E+00
MASS REMAINING =  1.304E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  9.076E+07, SUM =  1.395E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.8E+00 CM, MOLE WT=293.4
WEIGHT FRACTION WATER IN OIL =  0.0E+00, VISCOSITY =  2.5E+03 CENTISTOKES, DISPERSION TERM =  0.0E+00 WEIGHT FRACTION/HR
MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.2E+03 BBL, DISPERSION= 0.0E+00 GMS/M*M/HR, EVAP RATE= 1.5E+01 GMS/M*M/HR

STEP SIZE OF  2.503E-01 IS BASED ON CUT 2

THE CUT NUMBERING BEGINS WITH  1 BASED ON THE ORIGINAL CUT NUMBERS

THE FINAL MASS FRACTIONS FOR THE SLICK AT  2.4E+01 HOURS ARE:                                                        25
 6.842E-07  9.809E-03  3.344E-01  7.906E-01  9.549E-01  9.921E-01  9.987E-01  9.998E-01  1.000E+00  1.000E+00  1.000E+00
 1.000E+00  1.000E+00  1.000E+00  1.000E+00
 FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 7.9E+04 M**2, THICKNESS= 1.8E+00 CM, MOLE WT=293.4
 MASS REMAINING =  1.304E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  9.136E+07, SUM =  1.395E+09

*****************************************************************************
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TABLE 16. (Continued) Illustration of Output From Oil-Weathering Calculation; Characterization of Prudhoe Bay Crude Oil After Weathering in Pools on Top of Ice.

SUMMARY OF TBP CUTS CHARACTERIZATION FOR: PRUDHOE BAY, ALASKA
AFTER:
ICE POOL WEATHERING FOR 2.400E+01 HOURS

CODF VERSION IS CUTICA OF MAY 84
ITEM 9, SAMPLE 71011

	TB	API	SPGR	VOL	MW	TC	PC	VC	A	B	T10	VIS	NC	NS
1	1.50E+02	7.27E+01	6.81E-01	1.58E-06	8.35E+01	9.14E+02	3.95E+01	3.66E+02	3.17E+00	1.90E-01	4.47E+02	3.08E-01	3	1
2	1.90E+02	6.42E+01	7.11E-01	2.83E-02	9.39E+01	9.63E+02	3.79E+01	4.07E+02	3.24E+00	2.03E-01	4.78E+02	4.40E-01	3	1
3	2.35E+02	5.67E+01	7.39E-01	1.29E+00	1.06E+02	1.02E+03	3.64E+01	4.54E+02	3.31E+00	2.15E-01	5.13E+02	5.44E-01	3	1
4	2.80E+02	5.16E+01	7.60E-01	3.13E+00	1.19E+02	1.07E+03	3.48E+01	5.07E+02	3.41E+00	2.27E-01	5.49E+02	6.73E-01	3	1
5	3.25E+02	4.76E+01	7.77E-01	3.89E+00	1.34E+02	1.12E+03	3.32E+01	5.65E+02	3.52E+00	2.39E-01	5.86E+02	8.46E-01	3	1
6	3.70E+02	4.52E+01	7.87E-01	3.82E+00	1.51E+02	1.16E+03	3.16E+01	6.32E+02	3.67E+00	2.50E-01	6.23E+02	1.07E+00	3	1
7	4.15E+02	4.15E+01	8.04E-01	4.72E+00	1.67E+02	1.21E+03	3.03E+01	6.98E+02	3.80E+00	2.59E-01	6.60E+02	1.38E+00	3	1
8	4.60E+02	3.78E+01	8.22E-01	5.28E+00	1.85E+02	1.26E+03	2.91E+01	7.67E+02	3.94E+00	2.67E-01	6.98E+02	1.81E+00	3	1
9	5.05E+02	3.48E+01	8.36E-01	5.50E+00	2.00E+02	1.31E+03	2.84E+01	8.28E+02	4.06E+00	2.74E-01	7.36E+02	1.75E+00	3	1
10	5.54E+02	3.06E+01	8.58E-01	3.08E+00	2.21E+02	1.35E+03	2.74E+01	9.09E+02	4.22E+00	2.82E-01	7.77E+02	2.48E+00	3	1
11	6.09E+02	2.91E+01	8.66E-01	7.15E+00	2.52E+02	1.40E+03	2.58E+01	1.03E+03	4.49E+00	2.92E-01	8.26E+02	4.00E+00	3	1
12	6.62E+02	2.62E+01	8.82E-01	7.48E+00	2.81E+02	1.45E+03	2.47E+01	1.15E+03	4.73E+00	2.99E-01	8.73E+02	7.18E+00	3	1
13	7.12E+02	2.40E+01	8.94E-01	6.60E+00	3.13E+02	1.49E+03	2.36E+01	1.27E+03	5.00E+00	3.06E-01	9.19E+02	1.36E+01	3	1
14	7.64E+02	2.25E+01	9.03E-01	8.14E+00	3.51E+02	1.53E+03	2.25E+01	1.43E+03	5.35E+00	3.13E-01	9.68E+02	2.81E+01	3	1
15	8.50E+02	1.14E+01	9.73E-01	3.99E+01	6.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+02	0	0

	UOP K	CORRELATION INDEX
1	1.24E+01	1.16E+01
2	1.22E+01	1.66E+01
3	1.20E+01	2.12E+01
4	1.19E+01	2.32E+01
5	1.19E+01	2.43E+01
6	1.19E+01	2.32E+01
7	1.19E+01	2.56E+01
8	1.18E+01	2.90E+01
9	1.18E+01	3.15E+01
10	1.17E+01	3.73E+01
11	1.18E+01	3.66E+01
12	1.18E+01	4.02E+01
13	1.18E+01	4.27E+01
14	1.18E+01	4.36E+01
15	1.12E+01	7.21E+01

BULK API GRAVITY = 26.4

TB = NORMAL BOILING TEMPERATURE, DEG F
API = API GRAVITY
VOL = VOLUME PER CENT OF TOTAL CRUDE
MW = MOLECULAR WEIGHT
TC = CRITICAL TEMPERATURE, DEG RANKINE
PC = CRITICAL PRESSURE, ATMOSPHERES
VC = CRITICAL VOLUME, CC/MOLE
A AND B ARE PARAMETERS IN THE VAPOR PRESSURE EQUATION
T10 IS THE TEMPERATURE IN DEG R WHERE THE VAPOR PRESSURE IS 10 MM HG
VIS IS THE KINEMATIC VISCOSITY IN CENTISTOKES AT 122 DEG F
UOP K IS THE U.O.P. K CHARACTERIZATION FACTOR
CORRELATION INDEX IS DEFINED IN (COLEMAN, 1978
NC = ERROR CODE, SHOULD BE LESS THAN 20
NS = ERROR CODE, SHOULD BE EQUAL TO 1
IGNORE THE ERROR CODES FOR COMPONENT NUMBER 15 IF IT IS A RESIDUUM

MEAN MOLECULAR WEIGHT OF THE CRUDE = 9.977E+01

TABLE 16 (Continued) Output From Oil-Weathering Calculations: Beginning of Calculated Results for Broken Ice Field Weathering at 32°F. (Note deletion of cut 1 and renumbering of cuts).

```
WEATHERING DATA FOR OIL IN  A BROKEN ICE FIELD
AFTER ICE POOL WEATHERING FOR 2.400E+01 HOURS

OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT CODE 2

OVER-ALL MASS-TRANSFER COEFFICIENT FOR CUMENE  =   1.957E+01 M/HR

  CUT            M/HR        CM-MOLES/(HR)(ATM)(M**2)
   1           2.112E+01          9.435E+02
   2           2.082E+01          9.299E+02
   3           2.054E+01          9.174E+02
   4           2.029E+01          9.063E+02
   5           2.007E+01          8.965E+02
   6           1.987E+01          8.876E+02
   7           1.971E+01          8.804E+02
   u           1.957E+01          8.743E+02
   9           1.947E+01          8.697E+02
  10           1.935E+01          8.646E+02
  11           1.922E+01          8.584E+02
  12           1.911E+01          8.537E+02
  13           1.902E+01          8.497E+02
  14           1.893E+01          8.457E+02

FOR THIS SPILL OF  9.195E+03 BARRELS, THE MASS IS  1.304E+03 METRIC TONNES

VOLUME FROM SUMMING THE CUTS  =   1.5E+03  M**3, OR 9.195E+03  BARRELS

WIND SPEED  =   1.200E+01 KNOTS, OR  2.224E+04 M/HR

INITIAL SLICK DIAMETER = 3.182E+02 M, OR AREA  =   7.950E+04 M**2

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =   6.4E+00 CENTISTOKES AT 122 DEG F

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =   1.2E+01 AT T =  32.0 DEG F, SCALE FACTOR =   1.8E+00

VISCOSITY ACCORDING TO MASS EVAPORATED: VIS25C  = 3.50E+01, ANDRADE = 9.00E+03, FRACT WEATHERED  = 1.05E+01, VSLEAD  =  5.50E+02 CP

MOUSSE CONSTANTS: MOONEY= 6.20E-01 . MAX H20= 0.70, WIND**2= 1.00E-02

THE FRACTIONAL SLICK AREA SUBJECT TO DISPERSION IS  5.5E+01 PER HOUR

COUNT THE curs IN THE FOLLOWING OUTPUT FROM LEFT TO RIGHT

THE INITIAL GRAM MOLES IN THE SLICK ARE:
 1.875E-01  3.113E+03  1.307E+05  2.900E+05  3.278E+05  2.899E+05  3.299E+05  3.413E+05  3.339E+05  1.741E+05  3.576E+05
 3.412E+05  2.745E+05  3.042E+05  9.420E+05

THE INITIAL MASSES (GRAMS) IN THE SLICK ARE:
 1.566E+01  2.923E+05  1.384E+07  3.458E+07  4.389E+07  4.372E+07  5.523E+07  6.307E+07  6.689E+07  3.843E+07  9.005E+07
 9.594E+07  8.585E+07  1.069E+08  5.632E+08
THE TOTAL MASS FROM THESE CUTS IS  1.304E+09 GRAMS


CUT  1 GOES AWAY IN MINUTES, THEREFORE IT WAS DELETED AND THE CUTS RENUMBERED


 STEP SIZE OF  1.457E-01  IS BASED ON CUT   1

 TIME =   0.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:
 1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
 MASS REMAINING =  1.304E+09, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  0.000E+00, SUM =  1.304E+09
 FRACTION (BASED ON MASS) REMAINING IN THE SLICK: 1.0E+00, AREA= 7.9E+04 M**2, THICKNESS= 1.0E+00 CM, MOLE WT=293.7
 WEIGHT FRACTION WATER IN OIL -  6.9E-05, VISCOSITY -  1.1E+03 CENTISTOKES, DISPERSION TERM =  4.6E-03 WEIGHT FRACTION/HR
 MASS/AREA= 1.6E+04 GMS/M*M, SPGR= 0.9E-01, TOTAL VOLUME- 9.2E+03 BBL, DISPERSION= 7.6E+01 GMS/M*M/HR, EVAP RATE= 0.0E+00 GMS/M*M/HR
```

TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

```
TIME =  1.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    2
6.5E-01  8.9E-01  9.7E-01  9.9E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
MASS REMAINING =  1.295E+09, MASS DISPERSED =  6.121E+06, MASS EVAPORATED =  2.650E+06, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.9E-01, AREA= 1.1E+05 M**2, THICKNESS= 1.3E+00 CM, MOLE WT=294.6
WEIGHT FRACTION WATER IN OIL =  3.0E-01, VISCOSITY =  1.2E+03 CENTISTOKES, DISPERSION TERM = 6.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+04 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.1E+03 BBL, DISPERSION= 7.3E+01 GMS/M*M/HR, EVAP RATE= 2.5E+01 GMS/M*M/HR

TIME =  2.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    3.
3.8E-01  7.7E-01  9.3E-01  9.8E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-411  9.9E-01  9.9E-01
MASS REMAINING =  1.204E+09, MASS DISPERSED =  1.437E+07, MASS EVAPORATED =  5.734E+06, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.8E-01, AREA= 1.4E+05 M**2, THICKNESS= 1.1E+00 CM, MOLE WT=295.8
WEIGHT FRACTION WATER IN OIL =  4.9E-01, VISCOSITY =  3.2E+03 CENTISTOKES, DISPERSION TERM =  4.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.3E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.0E+03 BBL, DISPERSION= 4.4E+01 GMS/M*M/HR, EVAP RATE= 2.3E+01 GMS/M*M/HR

TIME =  3.1E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    4
2.0E-01  6.5E-01  9.0E-01  9.7E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING =  1.274E+09, MASS DISPERSED =  2.045E+07, MASS EVAPORATED = 9.[illegible], SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.8E-01, AREA= 1.6E+05 M**2, THICKNESS= 9.2E-01 CM, MOLE WT=297.0
WEIGHT FRACTION WATER IN OIL =  6.1E-01, VISCOSITY =  8.0E+03 CENTISTOKES, DISPERSION TERM =  3.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.2E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 9.0E+03 BBL, DISPERSION= 2.8E+01 GMS/M*M/HR, EVAP RATE= 2.1E+01 GMS/M*M/HR

TIME =  4.1E+00 HOURS, MASS MIACTION OF EACN CUT REMAINING:                                                                    5
9.6E-02  5.8E-01  8.6E-01  9.5E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING =  1.267E+09, MASS DISPERSED =  2.488E+07, MASS EVAPORATED =  1.232E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN T O E SLICK= 9.7E-01, AREA= 1.7E+05 M**2, THICKNESS= 8.2E-01 CM, MOLE WT=298.2
WEIGHT FRACTION WATER IN OIL =  6.7E-01, VISCOSITY =  1.7E+04 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 7.3E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 8.9E+03 BBL, DISPERSION= 1.9E+01 GMS/M*M/HR, EVAP RATE= 1.9E+01 GMS/M*M/HR

TIME=S.it+@@ HOURS, NASS FRACTION OF EACH CUT REMAINING:                                                                        6
4.3E-02  4.3E-01  8.1E-01  9.4E-01  9.7E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING =  1.260E+09, MASS DISPERSED =  2.829E+07, MASS EVAPORATED =  1.559E+07, SUM =  1.304E+09
FRACTION (BASED O N MASS) REMAINING IN THE SLICK= 9.7E-01, AREA= 1.9E+05 M**2, THICKNESS= 7.4E-01 CM, MOLE WT=299.5
WEIGHT FRACTION WATER IN OIL =  6.9E-01, VISCOSITY =  2.7E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 6.7E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 8.9E+03 BBL, DISPERSION=  1.5E+01  GMS/M*M/HR, EVAP RATE= 1.7E+01 GMS/M*M/HR

TIME =  6.1E+00 N OUNS, MASS FRACTION OF EACH CUT REMAINING:                                                                   7
1.8E-02  3.5E-01  7.7E-01  9.3E-01  9.7E-01  9.7E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING =  1.254E+09, MASS DISPERSED =  3.121E+07, MASS EVAPORATED =  1.876E+07, SUM =  1.304E+09
FRACTION (BASED O N MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 2.0E+05 M**2, THICKNESS= 6.9E-01 CM, MOLE WT=300.7
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  3.5E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 6.1E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 8.8E+03 BBL, DISPERSION= 1.3E+01 GMS/M*M/HR, EVAP RATE= 1.5E+01 GMS/M*M/HR

STEP SIZE OF  2.030E-01 IS BASED ON CUT  2

TIME =  7.3E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    8
6.2E-03  2.6E-01  7.2E-01  9.2E-01  9.6E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  1.247E+09, MASS DISPERSED =  3.432E+07, MASS EVAPORATED =  2.214E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 2.2E+05 M**2, THICKNESS= 6.4E-01 CM, MOLE WT=301.9
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  3.9E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.7E+03 GMS/M*M, SPGR= 8.9E-01, TOTAL VOLUME= 8.8E+03 BBL, DISPERSION= 1.3E+01 GMS/M*M/HR, EVAP RATE= 1.3E+01 GMS/M*M/HR

STEP SIZE OF  1.960E-01 IS BASED ON CUT 2

TIME =  8.4E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    9
1.9E-03  1.9E-01  6.7E-01  9.0E-01  9.6E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
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TABLE 8 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated REsults at 32°F for Broken Ice Field Weathering.

```
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.2E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.3E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.7E+03 BBL, DISPERSION= 1.2E+01 GMS/M*M/HR, EVAP RATE= 1.2E+01 GMS/M*M/HR

STEP SIZE OF  1.831E-01 IS BASED ON CUT   2

TIME =  9.6E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  10
5.8E-04  1.4E-01  6.3E-01  8.9E-01  9.5E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  1.235E+09, MASS DISPERSED =  4.080E+07, MASS EVAPORATED =  2.843E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 2.5E+05 M**2, THICKNESS= 5.6E-01 CM, MOLE WT=304.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.4E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.0E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.7E+03 BBL, DISPERSION= 1.2E+01 GMS/M*M/HR, EVAP RATE= 1.1E+01 GMS/M*M/HR

STEP SIZE OF  1.730E-01 IS BASED ON CUT   2

TIME =  1.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  11
1.8E-04  1.0E-01  5.8E-01  8.7E-01  9.5E-01  9.6E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  1.229E+09, MASS DISPERSED =  4.308E+07, MASS EVAPORATED =  3.168E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 2.6E+05 M**2, THICKNESS= 5.3E-01 CM, MOLE WT=305.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.6E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 4.8E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.6E+03 BBL, DISPERSION= 1.2E+01 GMS/M*M/HR, EVAP RATE= 9.6E+00 GMS/M*M/HR

STEP SIZE OF  1.647E-01 IS BASED ON CUT   2

TIME =  1.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  12
4.5E-05  7.2E-02  5.4E-01  8.5E-01  9.4E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  1.223E+09, MASS DISPERSED =  4.736E+07, MASS EVAPORATED =  3.385E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 2.7E+05 M**2, THICKNESS= 5.1E-01 CM, MOLE WT=306.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.9E+04 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 4.5E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.6E+03 BBL, DISPERSION= 1.1E+01 GMS/M*M/HR, EVAP RATE= 8.7E+00 GMS/M*M/HR

STEP SIZE OF  1.566E-01 IS BASED ON CUT   2

TIME =  1.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  13
1.1E-05  5.1E-02  4.9E-01  8.4E-01  9.4E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  1.217E+09, MASS DISPERSED =  5.074E+07, MASS EVAPORATED =  3.636E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 2.8E+05 M**2, THICKNESS= 4.8E-01 CM, MOLE WT=307.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.2E+04 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 4.3E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.5E+03 BBL, DISPERSION= 1.1E+01 GMS/M*M/HR, EVAP RATE= 7.9E+00 GMS/M*M/HR

STEP SIZE OF  1.498E-01 IS BASED ON CUT   2

TIME =  1.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  14
2.9E-06  3.5E-02  4.6E-01  8.2E-01  9.3E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  1.211E+09, MASS DISPERSED =  5.402E+07, MASS EVAPORATED =  3.864E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 2.9E+05 M**2, THICKNESS= 4.6E-01 CM, MOLE WT=308.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.4E+04 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 4.2E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 8.5E+03 BBL, DISPERSION= 1.1E+01 GMS/M*M/HR, EVAP RATE= 7.3E+00 GMS/M*M/HR

STEP SIZE OF  1.441E-01 IS BASED ON CUT   2

TIME =  1.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  15
7.5E-07  2.5E-02  4.2E-01  8.1E-01  9.3E-01  9.5E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  1.206E+09, MASS DISPERSED =  5.720E+07, MASS EVAPORATED =  4.074E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 3.0E+05 M**2, THICKNESS= 4.5E-01 CM, MOLE WT=309.0
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated RESults at 32 F for Broken Ice Field Weathering.

```
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.7E+04 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 4.0E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.5E+03 BBL, DISPERSION= 1.1E+01 CMS/M*M/HR, EVAP RATE= 6.8E+00 CMS/M*M/HR


STEP SIZE OF  1.390E-01 IS BASED ON CUT  2

TIME =  1.6E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              16
1.6E-07  1.6E-02  3.8E-01  7.9E-01  9.2E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  1.200E+09, MASS DISPERSED =  6.073E+07, MASS EVAPORATED =  4.295E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 3.1E+05 M**2, THICKNESS= 4.3E-01 CM, MOLE WT=309.8
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  6.0E+04 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.9E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.4E+03 BBL, DISPERSION= 1.0E+01 CMS/M*M/HR, EVAP RATE= 6.3E+00 CMS/M*M/HR


STEP SIZE OF  1.340E-01 IS BASED ON CUT  2

TIME =  1.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              17
3.3E-08  1.1E-02  3.5E-01  7.7E-01  9.1E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.511-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  1.195E+09, MASS DISPENSED = 6.416E+07, MASS EVAPORATED =  4.500E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 3.2E+05 M**2, THICKNESS= 4.2E-01 CM, MOLE WT=310.6
WEIGHT IWACI'1OH WATER IN OIL = 7.0E-01, VISCOSITY = 6.3E+04 CENTISTOKES, RISPIWS1ON TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.8E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.4E+03 BBL, DISPERSION= 1.0E+01 CMS/M*M/HR, EVAP RATE= 5.9E+00 CMS/M*M/HR


STEP SIZE OF  1.295E-01 IS BASED ON CUT 2

TIME =  1.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              18
6.9E-09  7.3E-03  3.2E-01  7.5E-01  9.1E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  1.190E+09, MASS DISPERSED =  6.748E+07, MASS EVAPORATED =  4.690E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 3.3E+05 M**2, THICKNESS= 4.1E-01 CM, MOLE WT=311.3
WEIGHT HIACI'1ON WATER IN OIL = 7.0E-01, VISCOSITY =  6.6E+04 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.6E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.3E+03 BBL, DISPERSION= 9.8E+00 CMS/M*M/HR, EVAP RATE= 5.5E+00 CMS/M*M/HR


TIME =  1.9E+01 HOURS, MASS FIIACTION OF EACH CUT REMAINING:                                                             19
0.0E+00  4.8E-03  2.9E-01  7.4E-01  9.0E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  1.184E+09, MASS DISPERSED =  7.081E+07, MASS EVAPORATED = 4.872E+07, SUN =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 3.4E+05 M**2, THICKNESS= 3.9E-01 CM, MOLE WT=312.0
WEIGHT FRACTION WATER IN OIL  = 7.0E-01, VISCOSITY =  6.9E+04 CENTISTOKES, OISPENS1ON TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.5E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.3E+03 BBL, DISPERSION= 9.6E+00 CMS/M*M/HR, EVAP RATE= 5.2E+00 CMS/M*M/HR


TIME =  2.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              20
0.0E+00  3.1E-03  2.6E-01  7.2E-01  9.0E-01  9.3E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  1.179E+09, MASS DISPERSED =  7.414E+07, MASS EVAPORATED =  5.048E+07, sum =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.0E-01, AREA= 3.4E+05 M**2, THICKNESS= 3.8E-01 CM, MOLE WT=312.7
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.2E+04 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.4E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.3E+03 BBL, DISPERSION= 9.4E+00 CMS/M*M/HR, EVAP RATE= 4.9E+00 CMS/M*M/HR


TIME =  2.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              21
0.0E+00  2.0E-03  2.3E-01  7.0E-01  8.9E-01  9.3E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  1.174E+09, MASS DISPERSED =  7.747E+07, MASS EVAPORATED =  5.217E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.0E-01, AREA= 3.5E+05 M**2, THICKNESS= 3.7E-01 CM, MOLE WT=313.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.6E+04 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.3E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.2E+03 BBL, DISPERSION= 9.2E+00 CMS/M*M/HR, EVAP RATE= 4.6E+00 CMS/M*M/HR


TIME =  2.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              22
0.0E+00  1.3E-03  2.1E-01  6.9E-01  8.9E-01  9.3E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  1.169E+09, MASS DISPERSED =  8.080E+07, MASS EVAPORATED =  5.300E+07, SUM =  1.304E+09
```

TABLE 16 (Contined) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

```
MASS/AREA= 3.3E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.2E+03 BBL., DISPERSION= 9.0E+00 CMS/M*M/HR, EVAP RATE= 4.3E+00 CMS/M*M/HR

TIME =  2.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    23
0.0E+00  8.0E-04  1.9E-01  6.7E-01  8.8E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  1.164E+09, MASS DISPERSED =  8.412E+07, MASS EVAPORATED =  5.537E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 3.7E+05 M**2, THICKNESS= 3.5E-01 CM, MOLE WT=314.6
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.3E+04 CENTISTOKES, DISPERSION TERM =  2.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.2E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.1E+03 BBL., DISPERSION= 8.8E+00 CMS/M*M/HR, EVAP RATE= 4.1E+00 CMS/M*M/HR

TIME =  2.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    24
0.0E+00  5.0E-04  1.7E-01  6.6E-01  8.7E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  1.160E+09, MASS DISPERSED = 8.743E+07, MASS EVAPORATED =  5.608E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 3.7E+05 M**2, THICKNESS= 3.5E-01 CM, MOLE WT=315.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.7E+04 CENTISTOKES, DISPERSION TERM =  2.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.1E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.1E+03 BBL., DISPERSION= 8.6E+00 CMS/M*M/HR, EVAP RATE= 3.9E+00 CMS/M*M/HR

TIME =  2.5E+01 HOURS, MASS FRACTION OF EACH cur REMAINING:                                                                    25
0.0E+00  3.1E-04  1.5E-01  6.4E-01  8.7E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  1.155E+09, MASS DISPERSED = 9.074E+07, MASS EVAPORATED =  5.834E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 3.8E+05 M**2, THICKNESS= 3.4E-01 CM, MOLE WT=315.8
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 9.1E+04 CENTISTOKES, DISPERSION TERM =  2.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.0E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.1E+03 BBL., DISPERSION= 8.4E+00 CMS/M*M/HR, EVAP RATE= 3.7E+00 CMS/M*M/HR

TIME = 2.6E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                     26
0.0E+00  1.9E-04  1.4E-01  6.2E-01  8.6E-01  9.1E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  1.150E+09, MASS DISPERSED = 9.403E+07, MASS EVAPORATED =  5.974E+07, sun =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 3.9E+05 M**2, THICKNESS= 3.3E-01 CM, MOLE WT=316.3
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY =  9.5E+04 CENTISTOKES, DISPERSION TERM =  2.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 3.0E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.0E+03 BBL., DISPERSION= 8.2E+00 CMS/M*M/HR, EVAP RATE= 3.5E+00 CMS/M*M/HR

TIME =  2.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    27
0.0E+00  1.1E-04  1.2E-01  6.1E-01  8.5E-01  9.1E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  1.145E+09, MASS DISPERSED =  9.731E+07, MASS EVAPORATED =  6.110E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 3.9E+05 M**2, THICKNESS= 3.2E-01 CM, MOLE WT=316.9
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY =  9.9E+04 CENTISTOKES, DISPERSION TERM =  2.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.9E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.0E+03 BBL., DISPERSION= 8.0E+00 CMS/M*M/HR, EVAP RATE= 3.3E+00 CMS/M*M/HR

STEP SIZE OF  4.346E-01 IS BASED ON CUT  3

TIME =  2.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    28
0.0E+00  6.3E-05  1.1E-01  5.9E-01  8.5E-01  9.1E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  1.141E+09, MASS DISPERSED =  1.009E+08, MASS EVAPORATED =  6.252E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 4.0E+05 M**2, THICKNESS= 3.2E-01 CM, MOLE WT=317.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.0E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.9E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 8.0E+03 BBL., DISPERSION= 7.8E+00 CMS/M*M/HR, EVAP RATE= 3.1E+00 CMS/M*M/HR

STEP SIZE OF  4.237E-01 IS BASED ON CUT  3

TIME =  3.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    29
0.0E+00  3.3E-05  9.1E-02  5.7E-01  8.4E-01  9.0E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  1.135E+09, MASS DISPERSED =  1.049E+08, MASS EVAPORATED =  6.407E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 4.1E+05 M**2, THICKNESS= 3.1E-01 CM, MOLE WT=318.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.1E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.8E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 7.9E+03 BBL., DISPERSION= 7.6E+00 CMS/M*M/HR, EVAP RATE= 2.9E+00 CMS/M*M/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

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STEP SIZE OF  4.137E-01 IS BASED ON CUT   3

TIME =  3.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    30
0.0E+00  1.7E-05  7.8E-02  5.5E-01  8.3E-01  9.0E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  1.130E+09, MASS DISPERSED =  1.088E+08, MASS EVAPORATED =  6.553E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 4.1E+05 M**2, THICKNESS= 3.0E-01 CM, MOLE WT=318.6
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.7E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.9E+03 BBL., DISPERSION= 7.4E+00 GMS/M*M/HR, EVAP RATE= 2.8E+00 GMS/M*M/HR


STEP SIZE OF  4.045E-01 Is BASED ON CUT   3

TIME =  3.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    31
0.0E+00  8.7E-06  6.7E-02  5.3E-01  8.3E-01  9.0E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  1.124E+09, MASS DISPERSED =  1.125E+08, MASS EVAPORATED =  6.609E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.6E-01, AREA= 4.2E+05 M**2, THICKNESS= 3.0E-01 CM, MOLE WT=319.1
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.7E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.9E+03 BBL., DISPERSION= 7.3E+00 GMS/M*M/HR, EVAP RATE= 2.6E+00 GMS/M*M/HR


STEP SIZE OF  3.960E-01 Is BASED ON CUT   3

TIME =  3.4E+01 HOURS, HASS FRACTION OF EACH CUT REMAINING:                                                                    32
0.0E+00  4.5E-06  5.8E-02  5.1E-01  8.2E-01  8.9E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.111-01  9.1E-01
MASS REMAINING =  1.120E+09, MASS DISPERSED =  1.162E+08, MASS EVAPORATED =  6.817E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.6E-01, AREA= 4.3E+05 M**2, THICKNESS= 2.9E-01 CM, MOLE WT=319.7
WEIGHT FRACTION WATER IN 011. =  7.0E-01, VISCOSITY =  1.3E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.6E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.8E+03 BBL., DISPERSION= 7.1E+00 GMS/M*M/HR, EVAP RATE= 2.5E+00 GMS/M*M/HR


STEP SIZE OF  3.881E-01 IS BASED ON CUT 3

TIME  =  3.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                   33
0.0E+00  2.3E-06  5.0E-02  5.0E-01  u.1E-01  8.9E-01  9.0E-01  4.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  1.115E+09, MASS DISPERSED  =  1.197E+08, MASS EVAPORATED  =  6.939E+07, SUN =  1.304E+09
FRACTION (BASED  O N  MASS) REMAINING IN  THE SLICK= 8.5E-01, AREA= 4.4E+05 M**2, THICKNESS= 2.8E-01 CM, MOLE WT=320.1
WEICHT FRACTION WATER IN OIL. = 7.0E-01, VISCOSITY  =  1.3E+05 CENTISTOKES, DISPERSION TERM  =  2.7E-03 WEICHT FRACTI ON/HH
MASS/AREA= 2.6E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 7.8E+03 BBL., DISPERSION= 6.9E+00 CMS/M*M/HR, EVAP RATE= 2.4E+00 CMS/M*M/HR


STEP SIZE OF  3.808E-01 Is BASED ON CUT   3

TIME =  3.6E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    34
0.0E+00  1.2E-06  4.3E-02  4.8E-01  8.0E-01  8.8E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING =  1.110E+09, MASS DISPERSED =  1.232E+08, MASS EVAPORATED =  7.054E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.5E-01, AREA= 4.4E+05 M**2, THICKNESS= 2.8E-01 CM, MOLE WT=320.6
WEICHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  1.4E+05 CENTISTOKES, DISPERSION TERM =  2.7E-03 WEICHT FRACTION/HR
MASS/AREA= 2.5E+03 CMS/M*M, SPCR= 9.0E-01, TOTAL VOLUME= 7.7E+03 BBL., DISPERSION= 6.8E+00 CMS/M*M/HR, EVAP RATE= 2.3E+00 CMS/M*M/HR


STEP SIZE OF  3.739E-01 IS BASED ON CUT   3

TIME =  3.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    35
0.0E+00  6.2E-07  3.7E-02  4.6E-01  8.0E-01  8.8E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING =  1.106E+09, MASS DISPERSED =  1.265E+08, MASS EVAPORATED =  7.163E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.5E-01, AREA= 4.5E+05 M**2, THICKNESS= 2.7E-01 CM, MOLE WT=321.0
WEICHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  1.5E+05 CENTISTOKES, DISPERSION TERM =  [illegible]
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

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STEP SIZE OF  3.675E-01 IS BASED ON CUT   3

TIME =  3.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    36
0.0E+00  3.2E-07  3.1E-02  4.5E-01  7.9E-01  8.8E-01  8.9E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING =  1.101E+09, MASS DISPERSED =  1.298E+08, MASS EVAPORATED =  7.267E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.4E-01, AREA= 4.5E+05 M**2, THICKNESS= 2.7E-01 CM, MOLE WT=321.4
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.5E+05 CENTISTOKES, DISPERSION TERM = 2.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.4E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.7E+03 BBL., DISPERSION= 6.5E+00 GMS/M*M/HR, EVAP RATE= 2.1E+00 GMS/M*M/HR

STEP SIZE OF  3.614E-01 Is BASED on CUT 3

TIME =  3.9E+01 HOURS, MASS FRACTION OF EACH cur REMAINING:                                                                    37
0.0E+00  1.7E-07  2.7E-02  4.3E-01  7.8E-01  8.7E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  1.097E+09, MASS DISPERSED = 1.330E+08, MASS EVAPORATED - 7.367E+07, SUM =  1.304E+09
FRACTION (BASED U N MASS) REMAINING IN THE SLICK= 8.4E-01, AREA= 4.6E+05 M**2, THICKNESS= 2.7E-01 CM, MOLE WT=321.8
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.6E+05 CENTISTOKES, DISPERSION TERM = 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.4E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.7E+03 BBL., DISPERSION= 6.3E+00 GMS/M*M/HR, EVAP RATE= 2.0E+00 GMS/M*M/HR

STEP SIZE 4)4' 3.557E-01 Is BASED O N CUT 3

TIME = 4.0E+01 HOURS, MASS FRACTION OF EACH cur REMAINING:                                                                    38
0.0E+00  8.5E-08  2.3E-02  4.2E-01  7.8E-01  8.7E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  1.093E+09, MASS DISPERSED =  1.361E+08, MASS EVAPORATED =  7.462E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.4E-01, AREA= 4.6E+05 M**2, THICKNESS= 2.6E-01 CM, MOLE WT=322.2
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.7E+05 CENTISTOKES, DISPERSION TERM = 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.4E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.6E+03 BBL., DISPERSION= 6.2E+00 GMS/M*M/HR, EVAP RATE= 1.9E+00 GMS/M*M/HR

STEP SIZE 04' 3.503E-01 1s BASED ON CUT 3 -

TIME = 4.1E+01 00011S, MASS FRACTION OF EACH CUT REMAINING:                                                                    39
0.0E+00  4.4E-08  2.0E-02  4.1E-01  7.7E-01  8.7E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  1.089E+09, MASS DISPERSED =  1.392E+08, MASS EVAPORATED =  7.553E+07, SUM =  1.304E+09
FRACTION (BASED O N MASS) REMAINING IN THE SLICK= 8.4E-01, AREA= 4.7E+05 M**2, THICKNESS= 2.6E-01 CM, MOLE WT=322.6
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.7E+05 CENTISTOKES, DISPERSION TERM = 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.3E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.6E+03 BBL., DISPERSION= 6.1E+00 GMS/M*M/HR, EVAP RATE= 1.8E+00 GMS/M*M/HR

STEP SIZE OF  3.451E-01 IS BASED ON CUT   3

TIME =  4.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    44)
0.0E+00  2.3E-08  1.7E-02  3.9E-01  7.6E-01  8.6E-01  8.8E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  1.085E+09, MASS DISPERSED =  1.421E+08, MASS EVAPORATED =  7.641E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.3E-01, AREA= 4.7E+05 M**2, THICKNESS= 2.5E-01 CM, MOLE WT=322.9
WEIGHT FRACTI ON WATER I N OIL.= 7.0E-01, VISCOSITY = 1.8E+05 CENTISTOKES, DISPERSION TERM , 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.3E+03 GMS/M*M, SPGR= 9.0E-01 , TOTAL VOLUME= 7.6E+03 BBL., DISPERSION= 6.0E+00 GMS/M*M/HR, EVAP RATE= 1.8E+00 GMS/M*M/HR

STEP SIZE OF  3.402E-01 IS BASED ON CUT   3

TIME =  4.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    41
0.0E+00  1.2E-08  1.5E-02  3.8E-01  7.6E-01  8.6E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01
MASS REMAINING =  1.082E+09, MASS DISPERSED =  1.450E+08, MASS EVAPORATED =  7.726E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.3E-01, AREA= 4.8E+05 M**2, THICKNESS= 2.5E-01 CM, MOLE WT=321.3
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.9E+05 CENTISTOKES, DISPERSION TERM = 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.3E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.5E+03 BBL., DISPERSION= 5.8E+00 GMS/M*M/HR, EVAP RATE= 1.7E+00 GMS/M*M/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

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STEP SIZE OF  3.356E-01 IS BASED ON CUT   3

TIME =  4.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  42
0.0E+00  6.1E-09  1.3E-02  3.7E-01  7.5E-01  8.6E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01
MASS REMAINING =  1.078E+09, MASS DISPERSED =  1.478E+08, MASS EVAPORATED =  7.807E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.3E-01, AREA= 4.8E+05 M**2, THICKNESS= 2.5E-01 CM, MOLE WT=323.6
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.0E+05 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.2E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7. 5E+03 BBL. . DISPERSION= 5.7E+00 GMS/M*M/HR, EVAP RATE= 1.7E+00 GMS/M*M/HR

TIME =  4.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  43
0.0E+00 0.0E+00  1.1E-02  3.5E-01  7.4E-01  8.6E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01
MASS REMAINING =  1.074E+09, MASS DISPERSED =  1.506E+08, MASS EVAPORATED =  7.807E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.2E-01, AREA= 4.9E+05 M**2, THICKNESS= 2.4E-01 CM, MOLE WT=323.9
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.0E+05 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.2E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7. 5E+03 m.. DISPERSION= 5.6E+00 GMS/M*M/HR, EVAP RATE= 1.6E+00 GMS/M*M/HR

TIME =  4.6E+01 HOURS, MASS FUACTION OF EACH CUT REMAINING:                                                                  44
0.0E+00  0.0E+00  9.4E-03  3.4E-01  7.4E-01  8.5E-01  8.7E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01
MASS REMAINING =  1.071E+09, MASS DISPERSED =  1. 534E+08 , MASS EVAPORATED =  7.964E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.2E-01, AREA= 4.9E+05 M**2, THICKNESS= 2.4E-01 CM, MOLE WT=324.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.1E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.2E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.5E+03 BBL, DISPERSION= 5.5E+00 GMS/M*M/HR, EVAP RATE= 1.6E+00 GMS/M*M/HR

TIME =  4.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  45
0.0E+00  0.0E+00  8.0E-03  3.3E-01  7.3E-01  8.3E-01  8.7E-01  8.7E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01  8.8E-01
MASS REMAINING =  1.067E+09, MASS DISPERSED =  1.561E+08, MASS EVAPORATED =  8.041E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.2E-01, AREA= 5.0E+05 M**2, THICKNESS= 2.4E-01 CN. MOLE WT=324.6
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.2E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.1E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.4E+03 BBL, DISPERSION= 5.4E+00 GMS/M*M/HR, EVAP RATE= 1.5E+00 GMS/M*M/HR

TIME =  4.8E+01 HOURS, HASS FRACTION OF EACH CUT REMAINING:                                                                  441
0.0E+00  44.0E+00  6.8E-03  3.2E-01  7.3E-01  u.5E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01
HASS REMAINING=  1.064E+09, MASS DISPERSED =  1.588E+08, MASS EVAPORATED =  8.115E+07, SUM =  1.304E+09
FRACTION (BASED  O N  MASS) REMAINING IN THE SLICK= 8.2E-01, AREA= 5.0E+05 M**2, THICKNESS= 2.3E-01 CM, MOLE WT=324.9
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.3E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.1E+03 GMS/M*M, SPGR= 9.01:-01, TOTAL VOLUME= 7.4E+03 BBL, DISPERSION= 5.3E+00 GMS/M*M/HR, EVAP RATE= 1.5E+00 GMS/M*M/HR

TIME =  4.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  47
0.0E+00  44.0E+00  5.8E-03 3. 1E-01  7.2E-01  u 4E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01
MASS REMAINING =  1.060E+09, MASS DISPERSED =  1.615E+08, MASS EVAPORATED =  8.189E+07, SUM =  1.304E+09
FRACTION (BASED  O N  MASS) REMAINING IN THE SLICK= 8.1E-01, AREA= 5.1E+05 M**2, THICKNESS= 2.3E-01 CM, MOLE WT=325.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.4E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.1E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.4E+03 BBL, DISPERSION= 5.2E+00 GMS/M*M/HR, EVAP RATE= 1.4E+00 GMS/M*M/HR

TIME =  5.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  48
0.0E+00  0.0E+00  4.9E-03  3.0E-01  7.1E-01  8.4E-01  8.6E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01
MASS REMAINING =  1.057E+09, MASS DISPERSED =  1.642E+08, MASS EVAPORATED =  8.261E+07, SUM =  1.304E+09
FRACTION (BASED  U N  MASS) REMAINING IN THE SLICK= 8.1E-01, AREA= 5.1E+05 M**2, THICKNESS= 2.3E-01 CM, MOLE WT=325.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.4E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 2.1E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7. 4E+03 BBL . DISPERSION= 5.1E+00 GMS/M*M/HR, EVAP RATE= 1.4E+00 GMS/M*M/HR

TIME =  5.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  49
0.0E+00  0.0E+00  4.2E-03  2.9E-01  7.1E-01  8.4E-01  8.6E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01  8.7E-01
MASS REMAINING =  1.054E+09, MASS DISPERSED =  1.668E+08, MASS EVAPORATED =  8.331E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.1E-01, AREA= 5.2E+05 M**2, THICKNESS= 2.3E-01 CM, MOLE WT=325.7
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.5E+05 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 32°F for Broken Ice Field Weathering.

```
TIME = 6.2E+01 HOURS, MASS FRACTION OF EACH cut REMAINING:                                                                    50
0.0E+00  0.0E+00  7.3E-04  2.0E-01  6.5E-01  8.1E-01  8.4E-01  8.4E-01  8.5E-01  8.5E-01  8.5E-01  8.5E-01  8.5E-01  8.5E-01
MASS REMAINING =  1.022E+09, MASS DISPERSED  =  1.925E+08, MASS EVAPORATED  8.972E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.8E-01, AREA= 5.6E+05 M**2, THICKNESS= 2.0E-01 CM, MOLE WT=320.4
WEIGHT FRACTION WATER IN OIL. = 7.0E-01, VISCOSITY =  3.7E+05 CENTISTOKES, DISPERSION TERM .  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.8E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 7.1E+03 BBL., DISPERSION= 4.2E+00 GMS/M*M/HR, EVAP RATE= 1.1E+00 GMS/M*M/HR


STEP SIZE OF  5.000E-01 IS BASED ON CUT 4

TIME = 7.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    51
0.0E+00  0.0E+00  1.0E-04  1.3E-01  5.9E-01  7.8E-01  8.2E-01  8.3E-01  8.3E-01  8.3E-01  8.3E-01  8.3E-01  8.3E-01  8.3E-01
MASS REMAINING =  9.926E+08, MASS DISPERSED  2.161E+08, MASS EVAPORATED =  9.522E+07, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.6E-01, AREA= 5.9E+05 M**2, THICKNESS= 1.8E-01 CM, MOLE WT=330.7
WEIGHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  5.2E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.7E+03 GMS/M*M, SPGR= 9.0E-01, TOTAL VOLUME= 6.9E+03 BBL., DISPERSION= 3.5E+00 GMS/M*M/HR, EVAP RATE= 8.4E-01 GMS/M*M/HR


STEP SIZE OF  5.000E-01 IS BASED ON CUT 4

TIME = 8.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    52
0.0E+00  0.0E+00  1.3E-03  8.2E-02  5.3E-01  7.5E-01  8.0E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01
MASS REMAINING =  9.674E+08, MASS DISPERSED  =  2.367E+08, MASS EVAPORATED  =  9.979E+07, sum =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.4E-01, AREA= 6.3E+05 M**2, THICKNESS= 1.7E-01 CM, MOLE WT=332.7
WEIGHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  7.1E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.5E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6. 7E+03 BBL , DISPERSION= 3.0E+00 GMS/M*M/HR, EVAP RATE= 6.8E-01 GMS/M*M/HR


STEP SIZE OF  5.000E-01 IS BASED ON CUT  4

TIME =  9.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                    53
0.0E+00  0.0E+00  1.3E-06  5.0E-02  4.0E-01  7.3E-01  7.8E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01
MASS REMAINING =  9.440E+08, MASS DISPERSED =  2.554E+08, MASS EVAPORATED =  1.037E+08, SUM =  1.304E+09
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.2E-01, AREA= 6.6E+05 M**2, THICKNESS= 1.6E-01 CM, MOLE WT=334.4
WEIGHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  9.5E+05 CENTISTOKES, DISPERSION TERM =  1.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.4E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.6E+03 BBL., DISPERSION= 2.6E+00 GMS/M*M/HR, EVAP RATE= 5.6E-01 GMS/M*M/HR


STEP SIZE OF  5.000E-01 IS BASED ON CUT  4

THE CUT NUMBERING BEGINS WITH  2 BASED ON THE ORIGINAL CUT NUMBERS

THE FINAL MASS FRACTIONS FOR THE SLICK AT  1.0E+02 HOURS ARE:                                                                 54
0.000E+00  0.000E+00  1.517E-07  3.181E-02  4.338E-01  7.054E-01  7.682E-01  7.785E-01  7.802E-01  7.803E-01  7.803E-01
7.803E-01  7.803E-01  7.803E-01
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.1E-01, AREA= 6.8E+05 M**2, THICKNESS= 1.5E-01 CM, MOLE WT=334.4
MASS REMAINING =  9.264E+08, MASS DISPERSED =  2.706E+08, MASS EVAPORATED =  1.068E+08, SUM =  1.304E+09

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TABLE 16 (Continued) Illustration of Output From Oil-Weathering Calculation; Characterization of Prudhoe Bay Crude Oil After Weathering in Pools on Top of Ice and Weathering in a Broken Ice Field.

SUMMARY OF TBP CUTS CHARACTERIZATION FOR: PRUDHOE BAY, ALASKA
AFTER:
ICE POOL WEATHERING FOR 2.400E+01 HOURS
BROKEN ICE FIELD WEATHERING FOR 1.000E+02 HOURS

CODE VERSION IS CUTICA OF MAY 84
ITEM 9. SAMPLE 71011

	TB	API	SPGR	VOL	MW	TC	PC	VC	A	B	T10	VIS	NS
1	2.40E+02	5.16E+01	7.60E-01	6.79E-07	1.19E+02	1.07E+03	3.48E+01	5.07E+02	3.41E+00	2.27E-01	5.49E+02	6.73E-01	1
2	3.25E+02	4.76E+01	7.77E-01	1.77E-01	1.34E+02	1.12E+03	3.32E+01	5.65E+02	3.52E+00	2.39E-01	5.86E+02	8.46E-01	1
3	3.70E+02	4.52E+01	7.87E-01	2.37E+00	1.51E+02	1.16E+03	3.16E+01	6.32E+02	3.67E+00	2.50E-01	6.23E+02	1.07E+00	1
4	4.15E+02	4.15E+01	8.04E-01	4.77E+00	1.67E+02	1.21E+03	3.03E+01	6.98E+02	3.80E+00	2.59E-01	6.60E+02	1.38E+00	1
5	4.60E+02	3.78E+01	8.22E-01	5.80E+00	1.85E+02	1.26E+03	2.91E+01	7.67E+02	3.94E+00	2.67E-01	6.98E+02	1.81E+00	1
6	5.05E+02	3.48E+01	8.36E-01	6.12E+00	2.00E+02	1.31E+03	2.84E+01	8.28E+02	4.06E+00	2.74E-01	7.36E+02	1.75E+00	1
7	5.54E+02	3.06E+01	8.58E-01	3.44E+00	2.21E+02	1.35E+03	2.74E+01	9.09E+02	4.22E+00	2.82E-01	7.77E+02	2.48E+00	1
8	6.09E+02	2.91E+01	8.66E-01	7.98E+00	2.52E+02	1.40E+03	2.58E+01	1.03E+03	4.49E+00	2.92E-01	8.26E+02	4.00E+00	1
9	6.62E+02	2.62E+01	8.82E-01	8.35E+00	2.81E+02	1.45E+03	2.47E+01	1.15E+03	4.73E+00	2.99E-01	8.73E+02	7.18E+00	1
10	7.12E+02	2.40E+01	8.94E-01	7.36E+00	3.13E+02	1.49E+03	2.36E+01	1.27E+03	5.00E+00	3.06E-01	9.19E+02	1.36E+01	1
11	7.64E+02	2.25E+01	9.03E-01	9.08E+00	3.51E+02	1.53E+03	2.25E+01	1.43E+03	5.35E+00	3.13E-01	9.68E+02	2.81E+01	1
12	8.50E+02	1.14E+01	9.73E-01	4.46E+01	6.00E+02	1.45E+03	2.47E+01	1.15E+03	4.73E+00	2.99E-01	8.27E-01	1.81E+02	1

	UOP K	CORRELATION INDEX
1	1.19E+01	2.32E+01
2	1.19E+01	2.43E+01
3	1.19E+01	2.32E+01
4	1.19E+01	2.56E+01
5	1.18E+01	2.90E+01
6	1.18E+01	3.15E+01
7	1.17E+01	3.73E+01
8	1.18E+01	3.66E+01
9	1.18E+01	4.02E+01
10	1.18E+01	4.27E+01
11	1.18E+01	4.36E+01
12	1.12E+01	7.21E+01

BULK API GRAVITY = 23.8

TB = NORMAL BOILING TEMPERATURE, DEG F
API = API GRAVITY
VOL = VOLUME PER CENT OF TOTAL CRUDE
MW = MOLECULAR WEIGHT
TC = CRITICAL TEMPERATURE, DEG RANKINE
PC = CRITICAL PRESSURE, ATMOSPHERES
VC = CRITICAL VOLUME, CC/MOLE
A AND B ARE PARAMETERS IN THE VAPOR PRESSURE EQUATION
T10 IS THE TEMPERATURE IN DEG R WHERE THE VAPOR PRESSURE IS 10 MM HG
VIS IS THE KINEMATIC VISCOSITY IN CENTISTOKES AT 122 DEG F
UOP K IS THE U.O.P. K CHARACTERIZATION FACTOR
CORRELATION INDEX IS DEFINED IN (COLEMAN, 1978)
NC = ERROR CODE, SHOULD BE LESS THAN 20
NS = ERROR CODE, SHOULD BE EQUAL TO 1
IGNORE THE ERROR CODES FOR COMPONENT NUMBER 12 IF IT IS A RESIDUUM

MEAN MOLECULAR WEIGHT OF THE CRUDE = 3.358E+02

TABLE 16 (Continued) Output From Oil-Weathering Calculation; Beginning of Calculated Results for Open-Ocean Weathering at 40°F.

```
WEATHERING DATA FOR OIL ON THE OPEN OCEAN
AFTER:
        ICE POOL WEATHERING FOR 2.400E+01 HOURS
        BROKEN ICE FIELD WEATHERING FOR 1.000E+02 HOURS

OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT CODE 2

OVER-ALL MASS-TRANSFER COEFFICIENT FOR CUMENE =  2.590E+01 M/HR

  CUT            M/HR        CM-MOLES/(HR)(ATM)(M**2)
   1          2.685E+01          1.180E+03
   2          2.656E+01          1.168E+03
   3          2.630E+01          1.156E+03
   4          2.609E+01          1.147E+03
   5          2.590E+01          1.139E+03
   6          2.577E+01          1.133E+03
   7          2.562E+01          1.126E+03
   8          2.543E+01          1.118E+03
   9          2.529E+01          1.112E+03
  10          2.517E+01          1.107E+03
  11          2.506E+01          1.101E+03

FOR THIS SPILL OF  6.428E+03 BARRELS, THE MASS IS  9.264E+02 METRIC TONNES

VOLUME FROM SUMMING THE CUTS =  1.0E+03 M**3, OR  6.428E+03 BARRELS

WIND SPEED =  2.000E+01 KNOTS, OR  3.706E+04 M/HR

INITIAL SLICK DIAMETER =  9.315E+02 M, OR AREA =  6.811E+05 M**2

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =  1.1E+01 CENTISTOKES AT 122 DEG F

KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE CUTS =  1.9E+01 AT T =  40.0 DEG F, SCALE FACTOR =  1.7E+00

VISCOSITY ACCORDING TO MASS EVAPORATED: VIS25C = 3.50E+01, ANDRADE = 9.00E+03, FRACT WEATHERED = 1.05E+01, VSLEAD = 3.24E+02 CP

MOUSSE CONSTANTS: MOONEY= 6.20E-01, MAX H20= 0.70, WIND**2= 1.00E-03

THE FRACTIONAL SLICK AREA SUBJECT TO DISPERSION IS  1.4E+01 PER HOUR

COUNT THE CUTS IN THE FOLLOWING OUTPUT FROM LEFT TO RIGHT

THE INITIAL GRAM MOLES IN THE SLICK ARE:
 4.400E-02  1.043E+04  1.258E+05  2.327E+05  2.622E+05  2.600E+05  1.358E+05  2.790E+05  2.662E+05  2.142E+05  2.374E+05
 7.351E+05

THE INITIAL MASSES (GRAMS) IN THE SLICK ARE:
 5.247E+00  1.396E+06  1.897E+07  3.896E+07  4.845E+07  5.208E+07  2.998E+07  7.027E+07  7.407E+07  6.699E+07  8.343E+07
 4.410E+08
THE TOTAL MASS FROM THESE CUTS IS  9.264E+08 GRAMS


 STEP SIZE OF  9.670E-02 IS BASED ON CUT   1

 TIME =  0.0E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          1
 1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
 MASS REMAINING =  9.264E+08, MASS DISPERSED =  0.000E+00, MASS EVAPORATED =  0.000E+00, SUM =  9.264E+08
 FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 1.0E+00, AREA= 6.8E+05 M**2, THICKNESS= 1.5E-01 CM, MOLE WT=335.8
 WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  3.3E+04 CENTISTOKES, DISPERSION TERM =  2.6E-03 WEIGHT FRACTION/HR
 MASS/AREA= 1.4E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.4E+03 BBL, DISPERSION= 3.5E+00 GMS/M*M/HR, EVAP RATE= 0.0E+00 GMS/M*M/HR


 TIME =  1.1E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          2
 5.7E-01  8.9E-01  9.7E-01  9.9E-01  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00  1.0E+00
 MASS REMAINING =  9.231E+08, MASS DISPERSED =  2.517E+06, MASS EVAPORATED =  7.750E+05, SUM =  9.264E+08
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

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FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 1.0E+00, AREA= 6.9E+05 M**2, THICKNESS= 1.5E-01 CM, MOLE WT=336.1
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.4E+04 CENTISTOKES, DISPERSION TERM = 2.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.3E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.4E+03 BBL, DISPERSION= 3.4E+00 GMS/M*M/HR, EVAP RATE= 1.0E+00 GMS/M*M/HR

TIME = 2.1E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              3
3.3E-01  7.8E-01  9.5E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01
MASS REMAINING = 9.199E+08, MASS DISPERSED = 5.019E+06, MASS EVAPORATED = 1.532E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.9E-01, AREA= 7.0E+05 M**2, THICKNESS= 1.5E-01 CM, MOLE WT=336.5
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.5E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.3E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.4E+03 BBL, DISPERSION= 3.4E+00 GMS/M*M/HR, EVAP RATE= 1.0E+00 GMS/M*M/HR

TIME = 3.2E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              4
1.8E-01  6.9E-01  9.3E-01  9.8E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01
MASS REMAINING = 9.167E+08, MASS DISPERSED = 7.504E+06, MASS EVAPORATED = 2.272E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.9E-01, AREA= 7.1E+05 M**2, THICKNESS= 1.4E-01 CM, MOLE WT=336.8
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.7E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.3E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.4E+03 BBL, DISPERSION= 3.3E+00 GMS/M*M/HR, EVAP RATE= 9.8E-01 GMS/M*M/HR

TIME = 4.3E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              5
1.0E-01  6.1E-01  9.0E-01  9.7E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01
MASS REMAINING = 9.135E+08, MASS DISPERSED = 9.973E+06, MASS EVAPORATED = 2.997E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.9E-01, AREA= 7.1E+05 M**2, THICKNESS= 1.4E-01 CM, MOLE WT=337.1
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.8E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.3E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.3E+03 BBL, DISPERSION= 3.2E+00 GMS/M*M/HR, EVAP RATE= 9.5E-01 GMS/M*M/HR

TIME = 5.3E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              6
5.6E-02  5.3E-01  8.8E-01  9.7E-01  9.8E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01  9.9E-01
MASS REMAINING = 9.103E+08, MASS DISPERSED = 1.242E+07, MASS EVAPORATED = 3.706E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.8E-01, AREA= 7.2E+05 M**2, THICKNESS= 1.4E-01 CM, MOLE WT=337.5
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.9E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.3E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.3E+03 BBL, DISPERSION= 3.2E+00 GMS/M*M/HR, EVAP RATE= 9.2E-01 GMS/M*M/HR

TIME = 6.4E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              7
3.1E-02  4.7E-01  8.5E-01  9.6E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING = 9.072E+08, MASS DISPERSED = 1.486E+07, MASS EVAPORATED = 4.401E+06, S4444 = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.8E-01, AREA= 7.3E+05 M**2, THICKNESS= 1.4E-01 CM, MOLE WT=337.8
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 4.1E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.3E+03 4)441., DISPERSION= 3.1E+00 GMS/M*M/HR, EVAP RATE= 8.9E-01 GMS/M*M/HR

TIME = 7.4E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              8
1.7E-02  4.1E-01  8.3E-01  9.5E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING = 9.041E+08, MASS DISPERSED = 1.727E+07, MASS EVAPORATED = 5.082E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.8E-01, AREA= 7.4E+05 M**2, THICKNESS= 1.4E-01 CM, MOLE WT=338.1
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 4.2E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.3E+03 BBL, DISPERSION= 3.1E+00 GMS/M*M/HR, EVAP RATE= 8.6E-01 GMS/M*M/HR

STEP SIZE OF 3.929E-01 IS BASED ON CUT 2

TIME = 8.8E+00 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                              9
7.6E-03  3.5E-01  8.0E-01  9.4E-01  9.7E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING = 9.002E+08, MASS DISPERSED = 2.034E+07, MASS EVAPORATED = 5.935E+06, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.7E-01, AREA= 7.5E+05 M**2, THICKNESS= 1.3E-01 CM, MOLE WT=338.4
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 4.4E+04 CENTISTOKES, DISPERSION TERM = 2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.2E+03 BBL, DISPERSION= 3.0E+00 GMS/M*M/HR, EVAP RATE= 8.4E-01 GMS/M*M/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

```
TIME =  1.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          10
3.8E-03  3.0E-01  7.8E-01  9.4E-01  9.7E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01  9.8E-01
MASS REMAINING =  8.968E+08, MASS DISPERSED =  2.295E+07, MASS EVAPORATED =  6.653E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICE= 9.7E-01, AREA= 7.5E+05 M**2, THICKNESS= 1.3E-01 CM, MOLE WT=338.8
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.6E+04 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.2E+03 BBL., DISPERSION= 2.9E+00 GMS/M*M/HR, EVAP RATE= 8.1E-01 GMS/M*M/HR

STEP SIZE OF  3.835E-01 IS BASED ON CUT 2

TIME =  1.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          11
1.9E-03  2.6E-01  7.5E-01  9.3E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  8.936E+08, MASS DISPERSED =  2.550E+07, MASS EVAPORATED =  7.349E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 7.6E+05 M**2, THICKNESS= 1.3E-01 CM, MOLE WT=339.1
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  4.8E+04 CENTISTOKES, DISPERSION TERM =  2.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.2E+03 BBL., DISPERSION= 2.9E+00 GMS/M*M/HR, EVAP RATE= 7.9E-01 GMS/M*M/HR

STEP SIZE OF  3.783E-01 IS BASED ON CUT  2

TIME =  1.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          12
9.5E-04  2.2E-01  7.3E-01  9.2E-01  9.6E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  8.904E+08 MASS DISPERSED =  2.800E+07, MASS EVAPORATED =  8.023E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 7.7E+05 M**2, THICKNESS= 1.3E-01 CM, MOLE WT=339.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.0E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.2E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.2E+03 BBL., DISPERSION= 2.8E+00 GMS/M*M/HR, EVAP RATE= 7.6E-01 GMS/M*M/HR

STEP SIZE OF  3.732E-01 IS BASED ON CUT  2

TIME =  1.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          13
4.7E-04  1.9E-01  7.1E-01  9.1E-01  9.6E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01  9.7E-01
MASS REMAINING =  8.873E+08, MASS DISPERSED =  3.045E+07, MASS EVAPORATED =  8.677E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.6E-01, AREA= 7.8E+05 M**2, THICKNESS= 1.3E-01 CM, MOLE WT=339.7
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.2E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.1E+03 BBL., DISPERSION= 2.8E+00 GMS/M*M/HR, EVAP RATE= 7.4E-01 GMS/M*M/HR

STEP SIZE OF  3.684E-01 IS BASED ON CUT  2

TIME =  1.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          14
2.4E-04  1.6E-01  6.9E-01  9.1E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  8.843E+08, MASS DISPERSED =  3.284E+07, MASS EVAPORATED =  9.311E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=340.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.4E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.1E+03 BBL., DISPERSION= 2.7E+00 GMS/M*M/HR, EVAP RATE= 7.3E-01 GMS/M*M/HR

STEP SIZE OF  3.638E-01 IS BASED ON CUT  2

TIME =  1.6E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          15
1.2E-04  1.4E-01  6.7E-01  9.0E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  8.813E+08, MASS DISPERSED =  3.517E+07, MASS EVAPORATED =  9.927E+06, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 7.9E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=340.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  5.6E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.1E+03 BBL., DISPERSION= 2.7E+00 GMS/M*M/HR, EVAP RATE= 7.1E-01 GMS/M*M/HR

STEP SIZE OF  3.594E-01 IS BASED ON CUT  2
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40 F for Open-Ocean Weathering.

```
TIME =  1.7E+01 HOURS, MASS FRACTION OF EACH  C U T  REMAINING:                                                          16
5.9E-05  1.2E-01  6.5E-01  8.9E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING = 8.704E+08, MASS DISPERSED  =  3.746E+07, MASS EVAPORATED  =  1.0520E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING  I N  THE SLICK= 9.5E-01, AREA= 8.0E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=340.5
WEIGHT FRACTION WATER IN OIL  =  7.0E-01, VISCOSITY =  5.8E+04 CENTISTOKES, DISPERSION TERM  =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.1E+03 BBL, DISPERSION= 2.6E+00 GMS/M*M/HR, EVAP RATE= 6.9E-01 GMS/M*M/HR


STEP SIZE OF  3.552E-01 IS BASED ON CUT  2

TIME =  1.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                               17
2.9E-05  1.0E-01  6.3E-01  8.9E-01  9.5E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01  9.6E-01
MASS REMAINING =  8.756E+08, MASS DISPERSED =  3.970E+07, MASS EVAPORATED =  1.111E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.5E-01, AREA= 8.1E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=340.8
WEIGHT FRACTION WATER IN OIL  =  7.0E-01, VISCOSITY =  6.0E+04 CENTISTOKES, DISPERSION TERM =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.1E+03 BBL, DISPERSION= 2.6E+00 GMS/M*M/HR, EVAP RATE= 6.8E-01 GMS/M*M/HR


STEP SIZE OF  3.511E-01 Is BASED  o n  CUT 2

TIME =  1.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                               18
1.5E-05 8.9E-02  b.1E-01  8.8E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  8.729E+08, MASS DISPERSED =  4.190E+07, MASS EVAPORATED  =  1.168E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING  I N  THE SLICK= 9.4E-01 , AREA= 8.1E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=341.0
WEIGHT FRACTION WATER IN OIL  =  7.0E-01, VISCOSITY =  6.2E+04 CENTISTOKES, DISPERSION TERM  =  2.4E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.5E+00 GMS/M*M/HR, EVAP RATE= 6.6E-01 GMS/M*M/HR


STEP SIZE OF  3.472E-01 IS BASED ON CUT  2

TIME =  2.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                               19
7.3E-06  7.6E-02  5.9E-01  8.7E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  8.702E+08, MASS DISPERSED =  4.405E+07, MASS EVAPORATED =  1.223E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.4E-01, AREA= 8.2E+05 M**2, THICKNESS= 1.2E-01 CM, MOLE WT=341.3
WEIGHT FRACTION WATER IN OIL  =  7.0E-01, VISCOSITY =  6.4E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.5E+00 GMS/M*M/HR, EVAP RATE= 6.5E-01 GMS/M*M/HR


STEP SIZE OF  3.435E-01  Is  BASED ON CUT 2

TIME =  2.1E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                               20
3.7E-06  6.6E-02  5.7E-01  8.7E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  8.675E+08, MASS DISPERSED  =  4.616E+07, MASS EVAPORATED  =  1.277E+07  sun =  9.264E+08
FRACTION (BASED ON MASS) REMAINING  I N  THE SLICK= 9.4E-01, AREA= 8.3E+05 M**2, THICKNESS= 1 .2E-01 CM, MOLE WT=341.5
WEIGHT FRACTION WATER IN 011. =  7.0E-01, VISCOSITY =  6.6E+04 CENTISTOKES, DISPERSION TERM  =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.1E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.5E+00 GMS/M*M/HR, EVAP RATE= 6.3E-01 GMS/M*M/HR


STEP SIZE OF  3.398E-01 IS BASED ON CUT  2

TIME =  2.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                               21
1.8E-06  5.6E-02  5.5E-01  8.6E-01  9.3E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  8.649E+08, MASS DISPERSED =  4.823E+07, MASS EVAPORATED =  1.330E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 8.3E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=341.0
WEIGHT FRACTION WATER IN OIL  =  7.0E-01, VISCOSITY =  6.8E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.0E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.4E+00 GMS/M*M/HR, EVAP RATE= 6.2E-01 GMS/M*M/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40 F for Open-Ocean Weathering.

```
TIME =  2.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    22
9.1E-07  4.9E-02  5.4E-01  8.5E-01  9.3E-01  9.4E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01  9.5E-01
MASS REMAINING =  8.624E+08, MASS DISPERSED =  5.026E+07, MASS EVAPORATED =  1.302E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 8.4E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=342.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.1E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.0E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.4E+00 GMS/M*M/HR, EVAP RATE= 6.1E-01 GMS/M*M/HR


STEP SIZE OF  3.330E-01 IS BASED ON CUT  2

TIME =  2.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    23
4.6E-07  4.2E-02  5.2E-01  8.5E-01  9.3E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  8.599E+08, MASS DISPERSED =  5.225E+07, MASS EVAPORATED =  1.432E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.3E-01, AREA= 8.4E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=342.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.3E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.0E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 6.0E+03 BBL, DISPERSION= 2.3E+00 GMS/M*M/HR, EVAP RATE= 6.0E-01 GMS/M*M/HR


STEP SIZE OF  3.297E-01 IS BASED ON CUT  2

TIME =  2.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    24
1.8E-07  3.4E-02  5.0E-01  8.4E-01  9.2E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING =  8.566E+08, MASS DISPERSED =  5.485E+07, MASS EVAPORATED =  1.498E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 8.5E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=342.6
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.6E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 1.0E+03 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.9E+03 BBL, DISPERSION= 2.3E+00 GMS/M*M/HR, EVAP RATE= 5.8E-01 GMS/M*M/HR


STEP SIZE OF  3.255E-01 IS BASED ON CUT 2

TIME =  2.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    25
7.1E-08  2.0E-02  4.8E-01  8.3E-01  9.2E-01  9.3E-01  9.4E-01  9.41;-01  9.4E-01  9.4E-01  9.4E-01  9.4E-01
MASS REMAINING=  8.534E+08, MASS DISPERSED =  5.739E+07, MASS EVAPORATED  =  1.562E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 8.6E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=342.8
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 7.9E+04 CENTISTOKES, DISPERSION TERM =  2.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.9E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.9E+03 BBL, DISPERSION= 2.2E+00 GMS/M*M/HR, EVAP RATE= 5.7E-01 GMS/M*M/HR


STEP SIZE OF  3.215E-01 IS BASED ON CUT  2

TIME =  2.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    26
2.8E-08  2.3E-02  4.6E-01  8.2E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  8.503E+08, MASS DISPERSED =  5.987E+07, MASS EVAPORATED =  1.624E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.2E-01, AREA= 8.7E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=343.1
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.2E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.8E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.9E+03 BBL, DISPERSION= 2.2E+00 GMS/M*M/HR, EVAP RATE= 5.5E-01 GMS/M*M/HR


STEP SIZE OF  3.176E-01 IS BASED ON CUT  2

TIME =  2.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                    27
1.1E-08  1.9E-02  4.4E-01  8.2E-01  9.1E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  8.473E+08, MASS DISPERSED =  6.230E+07, MASS EVAPORATED =  1.684E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 8.7E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=343.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.6E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.7E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.9E+03 BBL, DISPERSION= 2.2E+00 GMS/M*M/HR, EVAP RATE= 5.4E-01 GMS/M*M/HR


STEP SIZE OF  3.140E-01 IS BASED ON CUT  2
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

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TIME =  3.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          28
4.4E-09  1.5E-02  4.2E-01  8.1E-01  9.1E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  8.443E+08, MASS DISPERSED =  6.466E+07, MASS EVAPORATED =  1.743E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 8.8E+05 M**2, THICKNESS= 1.1E-01 CM, MOLE WT=343.7
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.9E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.6E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.8E+03 BBL, DISPERSION= 2.1E+00 GMS/M*M/HR, EVAP RATE= 5.3E-01 GMS/M*M/HR

TIME =  3.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          29
0.0E+00  1.2E-02  4.1E-01  8.0E-01  9.1E-01  9.2E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01  9.3E-01
MASS REMAINING =  8.414E+08, MASS DISPERSED =  6.700E+07, MASS EVAPORATED =  1.800E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 8.9E+05 M**2, THICKNESS= 1.0E-01 CM, MOLE WT=344.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  9.3E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.5E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.8E+03 BBL, DISPERSION= 2.1E+00 GMS/M*M/HR, EVAP RATE= 5.2E-01 GMS/M*M/HR

TIME =  3.3E+01 HOURS, MASS FRACTION OF EMU CUT REMAINING:                                                           30
0.0E+00  7.0E-02  3.9E-01  7.9E-01  9.0E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  8.386E+08, MASS DISPERSED =  6.930E+07, MASS EVAPORATED =  1.857E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.1E-01, AREA= 8.9E+05 M**2, THICKNESS= 1.0E-01 CM, MOLE WT=344.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  9.6E+04 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.4E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.8E+03 BBL, DISPERSION= 2.0E+00 GMS/M*M/HR, EVAP RATE= 5.0E-01 GMS/M*M/HR

TIME =  3.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          31
0.0E+00  8.3E-03  3.8E-01  7.9E-01  9.0E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  8.357E+08, MASS DISPERSED =  7.158E+07, MASS EVAPORATED =  1.913E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.0E-01, AREA= 9.0E+05 M**2, THICKNESS= 1.0E-01 CM, MOLE WT=344.5
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.0E+05 CENTISTOKES, DISPERSION TERM =  2.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.3E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.8E+03 BBL, DISPERSION= 2.0E+00 GMS/M*M/HR, EVAP RATE= 4.9E-01 GMS/M*M/HR

TIME =  3.5E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          32
0.0E+00  6.7E-03  3.6E-01  7.8E-01  8.9E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  8.329E+08, MASS DISPERSED =  7.384E+07, MASS EVAPORATED =  1.968E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.0E-01, AREA= 9.1E+05 M**2, THICKNESS= 1.0E-01 CM, MOLE WT=344.8
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.0E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.2E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.8E+03 BBL, DISPERSION= 2.0E+00 GMS/M*M/HR, EVAP RATE= 4.8E-01 GMS/M*M/HR

TIME =  3.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          33
0.0E+00  5.4E-03  3.4E-01  7.7E-01  8.9E-01  9.1E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01  9.2E-01
MASS REMAINING =  8.301E+08, MASS DISPERSED =  7.607E+07, MASS EVAPORATED =  2.022E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 9.0E-01, AREA= 9.1E+05 M**2, THICKNESS= 1.0E-01 CM, MOLE WT=345.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.1E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.1E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.7E+03 BBL, DISPERSION= 1.9E+00 GMS/M*M/HR, EVAP RATE= 4.7E-01 GMS/M*M/HR

TIME =  3.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          34
0.0E+00  4.4E-03  3.3E-01  7.6E-01  8.9E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  8.274E+08, MASS DISPERSED =  7.827E+07, MASS EVAPORATED =  2.076E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 9.2E+05 M**2, THICKNESS= 9.9E-02 CM, MOLE WT=345.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.1E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 9.0E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.7E+03 BBL, DISPERSION= 1.9E+00 GMS/M*M/HR, EVAP RATE= 4.6E-01 GMS/M*M/HR

TIME =  3.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          35
0.0E+00  3.5E-03  3.2E-01  7.5E-01  8.8E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  8.247E+08, MASS DISPERSED =  8.045E+07, MASS EVAPORATED =  2.128E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 9.3E+05 M**2, THICKNESS= 9.8E-02 CM, MOLE WT=345.5
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.9E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.7E+03 BBL, DISPERSION= 1.9E+00 GMS/M*M/HR, EVAP RATE= 4.5E-01 GMS/M*M/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

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0.0E+00  2.8E-03  3.0E-01  7.5E-01  8.8E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  8.220E+08, MASS DISPERSED =  8.261E+07, MASS EVAPORATED =  2.180E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.9E-01, AREA= 9.3E+05 M**2, THICKNESS= 9.7E-02 CM, MOLE WT=345.8
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+05 CENTISTOKES, DISPERSION TERM =  2.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.8E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.7E+03 BBL., DISPERSION= 1.8E+00 GMS/M*M/HR, EVAP RATE= 4.4E-01 GMS/M*M/HR

TIME =  4.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          37
0.0E+00  2.3E-03  2.9E-01  7.4E-01  8.8E-01  9.0E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  8.194E+08, MASS DISPERSED =  8.473E+07, MASS EVAPORATED =  2.231E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 9.4E+05 M**2, THICKNESS= 9.6E-02 CM, MOLE WT=346.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.7E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.7E+03 BBL., DISPERSION= 1.8E+00 GMS/M*M/HR, EVAP RATE= 4.3E-01 GMS/M*M/HR

TIME =  4.3E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          38
0.0E+00  1.8E-03  2.8E-01  7.3E-01  8.7E-01  9.0E-01  9.0E-01  9.0E-01  9.1E-01  9.1E-01  9.1E-01  9.1E-01
MASS REMAINING =  8.168E+08, MASS DISPERSED =  8.684E+07, MASS EVAPORATED =  2.281E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 9.4E+05 M**2, THICKNESS= 9.5E-02 CM, MOLE WT=346.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.3E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.7E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.6E+03 BBL., DISPERSION= 1.8E+00 GMS/M*M/HR, EVAP RATE= 4.2E-01 GMS/M*M/HR

TIME =  4.4E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          39
0.0E+00  1.4E-03  2.6E-01  7.3E-01  8.7E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING = 8.142E+08, MASS DISPERSED = 8.892E+07, MASS EVAPORATED =  2.331E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 9.5E+05 M**2, THICKNESS= 9.4E-02 CM, MOLE WT=346.5
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.3E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.6E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.6E+03 BBL., DISPERSION= 1.7E+00 GMS/M*M/HR, EVAP RATE= 4.1E-01 GMS/M*M/HR

TIME =  4.5E+01 NOUNS. MASS FRACTION OF EACH cur REMAINING:                                                          40
0.0E+00  1.2E-03  2.5E-01  7.2E-01  8.7E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING =  8.117E+08, MASS DISPERSED =  9.090E+07, MASS EVAPORATED =  2.380E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.8E-01, AREA= 9.6E+05 M**2, THICKNESS= 9.3E-02 CM, MOLE WT=346.7
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY =  1.4E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.5E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.6E+03 BBL., DISPERSION= 1.7E+00 GMS/M*M/HR, EVAP RATE= 4.1E-01 GMS/M*M/HR

TIME = 4.7E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                           41
0.0E+00  9.2E-04  2.4E-01  7.1E-01  8.6E-01  8.9E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01
MASS REMAINING =  8.091E+08, MASS DISPERSED =  9.301E+07, MASS EVAPORATED =  2.428E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 9.6E+05 M**2, THICKNESS= 9.2E-02 CM, MOLE WT=347.0
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.4E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.4E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.6E+03 BBL., DISPERSION= 1.7E+00 GMS/M*M/HR, EVAP RATE= 4.0E-01 GMS/M*M/HR

TIME =  4.8E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          42
0.0E+00  7.3E-04  2.3E-01  7.0E-01  8.6E-01  8.9E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  9.0E-01  Y.UK-al
MASS REMAINING =  8.067E+08, MASS DISPERSED =  9.502E+07, MASS EVAPORATED =  2.475E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 9.7E+05 M**2, THICKNESS= 9.2E-02 CM, MOLE WT=347.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.5E+05 CENTISTOKES, DISPERSION TERM =  2.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.3E+02 GMS/M*M, SPGR= 9.1E-01 , TOTAL VOJ .UME= 5.6E+03 BBL., DISPERSION= 1.6E+00 GMS/M*M/HR, EVAP RATE= 3.9E-01 GMS/M*M/HR

TIME =  4.9E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          43
0.0E+00  5.8E-04  2.2E-01  7.0E-01  8.6E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  8.042E+08, MASS DISPERSED =  9.701E+07, MASS EVAPORATED =  2.522E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 9.7E+05 M**2, THICKNESS= 9.1E-02 CM, MOLE WT=347.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.5E+05 CENTISTOKES, DISPERSION TERM =  1.9E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.3E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.6E+03 BBL., DISPERSION= 1.6E+00 GMS/M*M/HR, EVAP RATE= 3.8E-01 GMS/M*M/HR

TIME =  5.0E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          44
0.0E+00  4.6E-04  2.1E-01  6.9E-01  8.5E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01  8.9E-01
MASS REMAINING =  8.010E+08, MASS DISPERSED =  9.898E+07, MASS EVAPORATED =  2.568E+07, SUM =  9.264E+08
```

TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

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FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.7E-01, AREA= 9.8E+05 M**2, THICKNESS= 9.0E-02 CM, MOLE WT=347.7
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.6E+05 CENTISTOKES, DISPERSION TERM = 1.9E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.2E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.5E+03 BBL, DISPERSION= 1.6E+00 GMS/M*M/HR, EVAP RATE= 3.7E-01 GMS/M*M/HR

TIME = 5.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          45
0.0E+00 3.6E-04 2.0E-01 6.8E-01 8.5E-01 8.8E-01 8.9E-01 8.9E-01 8.9E-01 8.9E-01 8.9E-01 8.9E-01
MASS REMAINING = 7.994E+08, MASS DISPERSED = 1.009E+08, MASS EVAPORATED = 2.613E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.6E-01, AREA= 9.8E+05 M**2, THICKNESS= 8.9E-02 CM, MOLE WT=347.9
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 1.7E+05 CENTISTOKES, DISPERSION TERM = 1.9E-03 WEIGHT FRACTION/HR
MASS/AREA= 8.1E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.5E+03 BBL, DISPERSION= 1.6E+00 GMS/M*M/HR, EVAP RATE= 3.7E-01 GMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 3

TIME = 6.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          46
0.0E+00 4.7E-05 1.3E-01 6.2E-01 8.3E-01 8.6E-01 8.7E-01 8.7E-01 8.7E-01 8.7E-01 8.7E-01 8.7E-01
MASS REMAINING = 7.804E+08, MASS DISPERSED = 1.165E+08, MASS EVAPORATED = 2.960E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.4E-01, AREA= 1.0E+06 M**2, THICKNESS= 8.3E-02 CM, MOLE WT=349.6
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 2.2E+05 CENTISTOKES, DISPERSION TERM = 1.8E-03 WEIGHT FRACTION/HR
MASS/AREA= 7.6E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.4E+03 BBL, DISPERSION= 1.4E+00 GMS/M*M/HR, EVAP RATE= 3.1E-01 GMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 3

TIME = 7.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          47
0.0E+00 5.8E-06 8.9E-02 5.7E-01 8.0E-01 8.5E-01 8.6E-01 8.6E-01 8.6E-01 8.6E-01 8.6E-01 8.6E-01
MASS REMAINING = 7.636E+08, MASS DISPERSED = 1.303E+08, MASS EVAPORATED = 3.263E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.2E-01, AREA= 1.1E+06 M**2, THICKNESS= 7.8E-02 CM, MOLE WT=351.1
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 2.8E+05 CENTISTOKES, DISPERSION TERM = 1.7E-03 WEIGHT FRACTION/HR
MASS/AREA= 7.1E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.3E+03 BBL, DISPERSION= 1.2E+00 GMS/M*M/HR, EVAP RATE= 2.7E-01 GMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 3

TIME = 8.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          48
0.0E+00 6.2E-07 5.7E-02 5.2E-01 7.8E-01 8.3E-01 8.4E-01 8.4E-01 8.4E-01 8.4E-01 8.4E-01 8.4E-01
MASS REMAINING = 7.482E+08, MASS DISPERSED = 1.429E+08, MASS EVAPORATED = 3.536E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 8.1E-01, AREA= 1.1E+06 M**2, THICKNESS= 7.4E-02 CM, MOLE WT=352.6
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 3.6E+05 CENTISTOKES, DISPERSION TERM = 1.6E-03 WEIGHT FRACTION/HR
MASS/AREA= 6.8E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.2E+03 BBL, DISPERSION= 1.1E+00 GMS/M*M/HR, EVAP RATE= 2.4E-01 GMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 3

TIME = 9.2E+01 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          49
0.0E+00 5.8E-08 3.6E-02 4.7E-01 7.6E-01 8.2E-01 8.3E-01 8.3E-01 8.3E-01 8.3E-01 8.3E-01 8.3E-01
MASS REMAINING = 7.341E+08, MASS DISPERSED = 1.545E+08, MASS EVAPORATED = 3.707E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.9E-01, AREA= 1.1E+06 M**2, THICKNESS= 7.0E-02 CM, MOLE WT=353.9
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 4.5E+05 CENTISTOKES, DISPERSION TERM = 1.5E-03 WEIGHT FRACTION/HR
MASS/AREA= 6.4E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 5.1E+03 BBL, DISPERSION= 9.4E-01 GMS/M*M/HR, EVAP RATE= 2.1E-01 GMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 3

TIME = 1.0E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          50
0.0E+00 4.9E-09 2.2E-02 4.3E-01 7.4E-01 8.0E-01 8.2E-01 8.2E-01 8.2E-01 8.2E-01 8.2E-01 8.2E-01
MASS REMAINING = 7.211E+08, MASS DISPERSED = 1.651E+08, MASS EVAPORATED = 4.019E+07, SUM = 9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.8E-01, AREA= 1.2E+06 M**2, THICKNESS= 6.7E-02 CM, MOLE WT=355.1
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY = 5.6E+05 CENTISTOKES, DISPERSION TERM = [illegible]
MASS/AREA= 6.1E+02 GMS/M*M, [illegible]
```

TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

```
TIME =  1.1E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          51
0.0E+00  0.0E+00  1.3E-02  3.9E-01  7.2E-01  7.9E-01  8.0E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01  8.1E-01
MASS REMAINING =  7.091E+08, MASS DISPERSED =  1.750E+08, MASS EVAPORATED =  4.235E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.7E-01, AREA= 1.2E+06 M**2, THICKNESS= 6.4E-02 CM, MOLE WT=356.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  7.0E+05 CENTISTOKES, DISPERSION TERM =  1.3E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.9E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.9E+03 BBL, DISPERSION= 7.6E-01 GMS/M*M/HR, EVAP RATE= 1.7E-01 GMS/M*M/HR

TIME =  1.2E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          52
0.0E+00  0.0E+00  7.9E-03  3.5E-01  7.0E-01  7.8E-01  7.9E-01  8.0E-01  8.0E-01  8.0E-01  8.0E-01  8.0E-01
MASS REMAINING =  6.900E+08, MASS DISPERSED =  1.841E+08, MASS EVAPORATED =  4.438E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.5E-01, AREA= 1.2E+06 M**2, THICKNESS= 6.2E-02 CM, MOLE WT=357.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  8.5E+05 CENTISTOKES, DISPERSION TERM =  1.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.6E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.8E+03 BBL, DISPERSION= 6.9E-01 GMS/M*M/HR, EVAP RATE= 1.6E-01 GMS/M*M/HR

TIME =  1.3E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          53
0.0E+00  0.0E+00  4.6E-03  3.1E-01  6.8E-01  7.7E-01  7.8E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01  7.9E-01
MASS REMAINING =  6.876E+08, MASS DISPERSED =  1.926E+08, MASS EVAPORATED =  4.629E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.4E-01, AREA= 1.3E+06 M**2, THICKNESS= 5.9E-02 CM, MOLE WT=358.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.0E+06 CENTISTOKES, DISPERSION TERM =  1.2E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.4E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.7E+03 BBL, DISPERSION= 6.3E-01 GMS/M*M/HR, EVAP RATE= 1.5E-01 GMS/M*M/HR

TIME =  1.4E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          54
0.0E+00  0.0E+00  2.6E-03  2.8E-01  6.6E-01  7.6E-01  7.7E-01  7.8E-01  7.8E-01  7.8E-01  7.8E-01  7.8E-01
MASS REMAINING =  6.770E+08, MASS DISPERSED =  2.005E+08, MASS EVAPORATED =  4.811E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.3E-01, AREA= 1.3E+06 M**2, THICKNESS= 5.7E-02 CM, MOLE WT=359.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.2E+06 CENTISTOKES, DISPERSION TERM =  1.1E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.2E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.7E+03 BBL, DISPERSION= 5.7E-01 GMS/M*M/HR, EVAP RATE= 1.4E-01 GMS/M*M/HR

TIME =  1.5E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          53
0.0E+00  0.0E+00  1.4E-03  2.5E-01  6.4E-01  7.5E-01  7.7E-01  7.7E-01  7.7E-01  7.7E-01  7.7E-01  7.7E-01
MASS REMAINING =  6.687E+08, MASS DISPERSED =  2.079E+08, MASS EVAPORATED =  4.983E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.2E-01, AREA= 1.3E+06 M**2, THICKNESS= 5.5E-02 CM, MOLE WT=360.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.5E+06 CENTISTOKES, DISPERSION TERM =  1.0E-03 WEIGHT FRACTION/HR
MASS/AREA= 5.1E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.6E+03 BBL, DISPERSION= 5.3E-01 GMS/M*M/HR, EVAP RATE= 1.3E-01 GMS/M*M/HR

TIME =  1.6E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          56
0.0E+00  0.0E+00  7.8E-04  2.2E-01  6.2E-01  7.4E-01  7.6E-01  7.6E-01  7.6E-01  7.6E-01  7.6E-01  7.6E-01
MASS REMAINING =  6.602E+08, MASS DISPERSED =  2.148E+08, MASS EVAPORATED =  5.147E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.1E-01, AREA= 1.3E+06 M**2, THICKNESS= 5.4E-02 CM, MOLE WT=361.4
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  1.7E+06 CENTISTOKES, DISPERSION TERM =  9.9E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.9E+02 GMS/M*M, SPGR= 9.1E-01, TOTAL VOLUME= 4.5E+03 BBL, DISPERSION= 4.8E-01 GMS/M*M/HR, EVAP RATE= 1.2E-01 GMS/M*M/HR

TIME =  1.7E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          57
0.0E+00  0.0E+00  4.2E-04  2.0E-01  6.1E-01  7.3E-01  7.5E-01  7.5E-01  7.5E-01  7.5E-01  7.5E-01  7.5E-01
MASS REMAINING =  6.522E+08, MASS DISPERSED =  2.212E+08, MASS EVAPORATED =  5.303E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.0E-01, AREA= 1.4E+06 M**2, THICKNESS= 5.2E-02 CM, MOLE WT=362.3
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.0E+06 CENTISTOKES, DISPERSION TERM =  9.4E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.7E+02 GMS/M*M, SPGR= 9.2E-01, TOTAL VOLUME= 4.5E+03 BBL, DISPERSION= 4.5E-01 GMS/M*M/HR, EVAP RATE= 1.1E-01 GMS/M*M/HR

STEP SIZE OF  5.000E-01 IS BASED ON CUT  4

TIME =  1.8E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                          58
0.0E+00  0.0E+00  2.2E-04  1.7E-01  5.9E-01  7.2E-01  7.4E-01  7.5E-01  7.5E-01  7.5E-01  7.5E-01  7.5E-01
MASS REMAINING =  6.446E+08, MASS DISPERSED =  2.273E+08, MASS EVAPORATED =  5.451E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 7.0E-01, AREA= 1.4E+06 M**2, THICKNESS= 5.0E-02 CM, MOLE WT=363.2
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  2.4E+06 CENTISTOKES, DISPERSION TERM =  9.0E-04 WEIGHT FRACTION/HR
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TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, Time Versus Calculated Results at 40°F for Open-Ocean Weathering.

```
MASS/AREA= 4.6E+02 CMS/M*M, SPCR= 9.2E-01, TOTAL VOLUME= 4.4E+03 BBL, DISPERSION= 4.1E-01 CMS/M*M/HR, EVAP RATE= 1.0E-01 CMS/M*M/HR

STEP SIZE OF  5.000E-01 IS BASED ON CUT   4

TIME =   1.9E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                  59
0.0E+00  0.0E+00  1.1E-04  1.5E-01  5.7E-01  7.1E-01  7.4E-01  7.41-01  7.4E-01  7.4E-01  7.4E-01  7.4E-01
MASS REMAINING =  6.374E+08, MASS DISPERSED  =  2.331E+08, MASS EVAPORATED  =  5.591E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 6.9E-01, AREA= 1.4E+06 M**2, THICKNESS= 4.9E-02 CM, MOLE WT=364.0
WEIGHT FRACTION WATER IN OIL = 7.0E-01, VISCOSITY =  2.7E+06 CENTISTOKES, DISPERSION TERM =  8.6E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.5E+02 CMS/M*M, SPCR= 9.2E-01, TOTAL VOLUME= 4.4E+03 BBL, DISPERSION= 3.8E-01 CMS/M*M/HR, EVAP RATE= 9.7E-02 CMS/M*M/HR

STEP SIZE OF 5.000E-01 IS BASED ON CUT 4

TIME = 2.0E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                   60
0.0E+00  0.0E+00  5.6E-05  1.3E-01  5.6E-01  7.0E-01  7.3E-01  7.3E-01  7.3E-01  7.3E-01  7.3E-01  7.3E-01
MASS REMAINING =  6.307E+08, MASS DISPERSED  =  2.385E+08, MASS EVAPORATED  =  5.725E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 6.8E-01, AREA= 1.4E+06 M**2, THICKNESS= 4.8E-02 CM, MOLE WT=364.8
WEIGHT FRACTION WATER IN OIL =  7.0E-01, VISCOSITY =  3.2E+06 CENTISTOKES, DISPERSION TERM = 8.2E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.4E+02 CMS/M*M, SPCR= 9.2E-01, TOTAL VOLUME= 4.3E+03 BBL, DISPERSION= 3.6E-01 CMS/M*M/HR, EVAP RATE= 9.0E-02 CMS/M*M/HR

STEP SIZE OF  5.000E-01 IS BASED ON CUT 4

TIME =  2.1E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                   61
0.0E+00  0.0E+00  2.8E-05  1.2E-01  5.4E-01  6.9E-01  7.2E-01  7.3E-01  7.3E-01  7.3E-01  7.3E-01  7.3E-01
MASS REMAINING =  6.243E+08, MASS DISPERSED =  2.436E+08, MASS EVAPORATED =  5.852E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 6.7E-01, AREA= 1.5E+06 M**2, THICKNESS= 4.6E-02 CM, MOLE WT=365.6
WEIGHT FRACTION WATER IN OIL. = 7.0E-01, VISCOSITY =  3.6E+06 CENTISTOKES, DISPERSION TERM =  7.8E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.3E+02 CMS/M*M, SPCR=  9.2E-01, TOTAL VOLUME= 4.3E+03 BBL, DISPERSION= 3.3E-01 CMS/M*M/HR, EVAP RATE= 8.5E-02 CMS/M*M/HR

STEP SIZE OF  5.000E-01 IS BASED ON CUT 4

TIME =  2.2E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                   62
0.0E+00  0.0E+00  1.4E-05  1.0E-01  5.3E-01  6.9E-01  7.2E-01  7.2E-01  7.2E-01  7.2E-01  7.2E-01  7.2E-01
MASS REMAINING =  6.102E+08, MASS DISPERSED  =  2.485E+08, MASS EVAPORATED  =  5.973E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 6.7E-01, AREA= 1.5E+06 M**2, THICKNESS= 4.5E-02 CM, MOLE WT=366.4
WEIGHT FRACTION WATER IN OIL.  =  7.0E-01, VISCOSITY =  4.2E+06 CENTISTOKES, DISPERSION TERM  =  7.5E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.2E+02 CMS/M*M, SPCR= 9.2E-01, TOTAL VOLUME= 4.2E+03 BBL, DISPERSION= 3.1E-01 CMS/M*M/HR, EVAP RATE= 7.9E-02 CMS/M*M/HR

STEP SIZE  W  5.000E-01 IS BASED ON CUT 4

TIME =  2.3E+02 HOURS, MASS FRACTION OF EACH CUT REMAINING:                                                                   63
0.0E+00  0.0E+00  6.5E-06  9.0E-02  5.1E-01  6.8E-01  7.1E-01  7.2E-01  7.2E-01  7.2E-01  7.2E-01  7.2E-01
MASS REMAINING =  6.124E+08, MASS DISPERSED =  2.531E+08, MASS EVAPORATED =  6.088E+07, SUM =  9.264E+08
FRACTION (BASED ON MASS) REMAINING IN THE SLICK= 6.6E-01, AREA= 1.5E+06 M**2, THICKNESS= 4.4E-02 CM, MOLE WT=367.1
WEIGHT FRACTION WATER IN OIL. =  7.0E-01, VISCOSITY =  4.7E+06 CENTISTOKES, DISPERSION TERM =  7.2E-04 WEIGHT FRACTION/HR
MASS/AREA= 4.1E+02 CMS/M*M, SPCR= 9.2E-01, TOTAL VOLUME= 4.2E+03 BBL, DISPERSION= 2.9E-01 CMS/M*M/HR, EVAP RATE= 7.5E-02 CMS/M*M/HR

STEP SIZE OF  5.000E-01 IS BASED ON CUT   4

THE CUT NUMBER INC BEGINS WITH  1 BASED ON THE ORIGINAL CUT NUMBERS

THE FINAL MASS FRACTIONS FOR THE SLICK AT  2.4E+02 HOURS ARE:                                                                 64
0.000E+00  0.000E+00  3.419E-06  7.975E-02  4.987E-01  6.735E-01  7.072E-01  7.114E-01  7.116E-01  7.117E-01  7.117E-01
```

TABLE 16 (Continued) Output From Oil-Weathering Calculations; Prudhoe Bay Crude Oil, End of Calculated Result, Including Final Mass Balance.

```
 7.117E-01
 FRACTION (BASED  O N  MASS) REMAINING IN THE SLICK= 6.6E-01,  AREA= 1 .5E+06 M**2,  THICKNESS= 4.3E-02 CM, MOLE WT=367.1
 MASS REMAINING  =   6.077E+08, MASS DISPERSED  =   2.569E+08, MASS EVAPORATED  =   6.181E+07, SUM  =   9.264E+08

*****************************************************************

********* FINAL OVERALL MASS BALANCE FOR PARENT  O I L  ***********

FINAL MASS FRACTIONS OF CUTS:
 0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  1.471E-06  5.619E-02  3.830E-01  5.243E-01  5.518E-01  5.551E-01
 5.553E-01  5.553E-01  5.553E-01  5.553E-01
FRACTION (BASED ON MASS) REMAINING=   4.356E-01
MASS REMAINING= 6.077E+08  M A S S  DISPERSED= 5.275E+08 MASS EVAPORATED=  2.600E+08  MASS DELETED= 1.566E+01 TOTAL= 1.395E+09
ORIGINAL MASS= 1.395E+09
```

explanatory but some care must be taken in order to identify the cuts at each time step. There are cases where the first cuts can be so volatile that they evaporate away immediately (<1 hour). In this case the cut(s) will be deleted from the calculation and the remaining cuts renumbered.

Page 40 illustrates the output where a cut has been deleted because it evaporates too fast to be considered in the calculation. The cut renumbering occurs immediately before the time integration begins and will always be noted on the output before the time = 0 print. The user must know that a cut has been deleted or interpretation of the results will be shifted by one (or more) cut. The deletion of a cut is also noted before the final mass fractions are printed by telling the user the number of the first cut printed. This is illustrated on Page 48 where it is noted that the cut numbering begins with 2.

After pool-weathering and broken-ice field weathering, open ocean weathering at 40"C was chosen. Page 49 shows another intermediate characterization of the oil. Note that in this characterization only twelve cuts are shown. This is because the first three cuts have weathered away. The remaining cuts are renumbered and characterized in the usual manner. Thus, if a user desires to follow a particular cut through a scenario, care must be taken to correctly identify the desired cut. This is most easily accomplished by following the boiling point of the component (which does not change) through the various output.

As with the two previous weathering "compartments", the oil characterization data is followed by the input constants and the results of the weathering calculations (pages 50 through 60). Page 60 presents the end of the weathering calculations and the final overall mass balance for the parent oil. This mass balance serves as a means of checking that the sum of the mass evaporated, mass dispersed, mass remaining, and mass deleted (very volatile cuts) is equal to the original mass.

An example of the 80-column output is presented in Table 17. This output was generated at the same time as the output in Table 16. Note that the

TABLE 17. Illustration of 80-Column Output from Ocean-Ice Oil-Weathering Code; Prudhoe Bay Crude Oil; Weathering of Oil in Pools on Top of Ice at 32°F.

WEATHERING OF OIL IN POOLS ON TOP OF ICE

OIL: PRUDHOE BAY, ALASKA
TEMPERATURE= 32.0 DEG F. WIND SPEED= 10.0 KNOTS
SPILL SIZE= 1.000E+04 BARRELs
MASS-TRANSFER COEFFICIENT CODE= 2

FOR THE OUTPUT THAT FOLLOWS. MOLES=GRAM MOLES
GMS=GRAMS, VP=VAPOR PRESSURE IN ATMOSPHERES
BP=BOILING POINT IN DEG F, API=GRAVITY
MW=MOLECULAR WEIGHT

CUT	MOLES	GMS	VP	BP	API	MW
1	2.74E+05	2.29E+07	4.09E-02	1.50E+02	7.27E+01	83
2	3.13E+05	2.96E+07	1.35E-02	1.90E+02	6.42E+01	93
3	3.91E+05	4.14E+07	3.25E-03	2.35E+02	5.67E+01	105
4	3.67E+05	4.37E+07	7.05E-04	2.80E+02	5.16E+01	119
5	3.43E+05	4.60E+07	1.40E-04	3.25E+02	4.76E+01	133
6	2.92E+05	4.41E+07	2.44E-05	3.70E+02	4.52E+01	150
7	3.30E+05	5.53E+07	3.98E-06	4.15E+02	4.15E+01	167
8	3.41E+05	6.31E+07	5.86E-07	4.60E+02	3.78E+01	184
9	3.34E+05	6.69E+07	8.22E-08	5.05E+02	3.48E+01	200
10	1.74E+05	3.84E+07	8.24E-09	5.54E+02	3.06E+01	220
11	3.58E+05	9.01E+07	4.12E-10	6.09E+02	2.91E+01	251
12	3.41E+05	9.59E+07	2.02E-11	6.62E+02	2.62E+01	281
13	2.73E+05	8.59E+07	8.60E-13	7.12E+02	2.40E+01	312
14	3.04E+05	1.07E+08	1.96E-14	7.64E+02	2.25E+01	351
15	9.42E+05	5.65E+08	0.00E+00	8.50E+02	1.14E+01	600

MOUSSE CONSTANTS: MOONEY= 0.00E+00, MAX H2O=-1.00, WIND**2= 0.00E+00
DISPERSION CONSTANTS: KA= 1.08E-01, KB= 3.00E+01, S-TENSION= 1.00E+00
VIS CONSTANTS: VIS25C= 3.50E+01, ANDRADE = 9.00E+03, FRACT = 1.05E+01

FOR THE OUTPUT THAT FOLLOWS, TIME=HOURS
BBL=BARRELS, SPGR=SPECIFIC GRAVITY, AREA=M*M
THICKNESS=CM, W=PERCENT WATER IN OIL (MOUSSE)
DISP=DISPERSION RATE IN GMS/M*M/HR
ERATE=EVAPORTION RATE IN GMS/M*M/HR
M/A=MASS PER M*M OF OIL IN THE SLICK
I=FIRST CUT WITH GREATER THAN 1% (MASS) REMAINING
J=FIRST CUT WITH GREATER THAN 50% (MASS) REMAINING
DISPEMION WAS TURNED OFF
SPREADING WAS TURNED OFF

TIME	BBL	SPGR	AREA	THICKNESS	W	DISP	ERATE	M/A	I	J
0	1.0E+04	0.88	7.9E+04	2.0E+00	0	0.0E+00	0.0E+00	1.8E+04	1	1
1	9.8E+03	0.88	7.9E+04	2.0E+00	0	0.0E+00	1.7E+02	1.7E+04	1	1
2	9.7E+03	0.88	7.9E+04	1.9E+00	e	0.0E+00	1.3E+02	1.7E+04	1	2
3	9.7E+03	0.88	7.9E+04	1.9E+00	0	0.0E+00	9.5E+01	1.7E+04	1	2
4	9.6E+03	0.88	7.9E+04	1.9E+00	0	0.0E+00	7.5E+01	1.7E+04	1	3
3	9.6E+03	9.89	7.9E+04	1.9E+00	0	0.0E+00	6.2E+01	1.7E+04	1	3
6	9.5E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	5.2E+01	1.7E+04	1	3
7	9.5E+03	0.89	7.9E+04	1.9E+00	0	0.0E+00	4.5E+01	1.7E+04	1	3
8	9.4E+03	0.89	7.9E+04	1.9E+00	0	0.0E+00	4.0E+01	1.7E+04	2	3
9	9.4E+03	0.89	7.9E+04	1.9E+00	o	0.0E+00	3.6E+01	1.7E+04	2	3
10	9.4E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	3.3E+01	1.7E+04	2	3
11	9.4E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	3.0E+01	1.7E+04	2	3
12	9.4E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	2.8E+01	1.7E+04	2	3
13	9.3E+03	0.89	7.9E+04	1.9E+00	0	0.0E+00	2.6E+01	1.7E+04	2	3
14	9.3E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	2.4E+01	1.7E+04	2	3
15	9.3E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	2.2E+01	1.7E+04	2	3
16	9.3E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	2.1E+01	1.7E+04	2	4
17	9.3E+03	0.89	7.9E+04	1.9E+00	e	0.0E+00	2.0E+01	1.7E+04	2	4
18	9.3E+03	0.89	7.9E+04	1.9E+00	0	0.0E+00	1.9E+01	1.6E+04	2	4
19	9.2E+03	0.89	7.9E+04	1.8E+00	0	0.0E+00	1.8E+01	1.6E+04	2	4
20	9.2E+03	9.89	7.9E+04	1.8E+00	e	0.0E+00	1.7E+01	1.6E+04	2	4
21	9.2E+03	0.89	7.9E+04	1.8E+00	e	0.0E+00	1.6E+01	1.6E+04	2	4
22	9.2E+03	0.89	7.9E+04	1.8E+00	0	0.0E+00	1.6E+01	1.6E+04	2	4
23	9.2E+03	0.89	7.9E+04	1.8E+00	0	0.0E+00	1.5E+01	1.6E+04	2	4

TABLE 17 (Continued).

WEATHERING OF OIL IN A BROKEN ICE FIELD
AFTER ICE POOL WEATHERING FOR 2.400E+01 HOURS

OIL: PRUDHOE BAY, "ALASKA
TEMPERATURE= 32.0 DEG F, WIND SPEED= 12.0 KNOTS
SPILL SIZE= 9.195E+03 BARRELS
MASS-TRANSFER COEFFICIENT CODE=2

FOR THE OUTPUT THAT FOLLOWS, MOLES=GRAM MOLES
GMS=GRAMS, VP=VAPOR PRESSURE IN ATMOSPHERES
BP=BOILING POINT IN DEG F, API=GRAVITY
MW=MOLECULAR WEIGHT

CUT	MOLES	GMS	VP	BP	API	MW
1	1.87E-01	1.57E+01	5.99E-02	1.50E+02	7.27E+01	83
2	3.11E+03	2.92E+05	2.06E-02	1.90E+02	6.42E+01	93
3	1.31E+05	1.38E+07	5.42E-03	2.35E+02	5.67E+01	105
4	2.90E+05	3.46E+07	1.24E-03	2.80E+02	5.16E+01	119
5	3.28E+05	4.39E+07	2.59E-04	3.25E+02	4.76E+01	133
6	2.90E+05	4.37E+07	4.81E-05	3.70E+02	4.52E+01	150
7	3.30E+05	5.52E+07	8.33E-06	4.15E+02	4.15E+01	167
8	3.41E+05	6.31E+07	1.31E-06	4.60E+02	3.78E+01	184
9	3.34E+05	6.69E+07	1.95E-07	5.05E+02	3.48E+01	200
10	1.74E+05	3.84E+07	2.12E-08	5.54E+02	3.06E+01	220
11	3.58E+05	9.01E+07	1.17E-09	6.09E+02	2.91E+01	231
12	3.41E+05	9.59E+07	6.39E-11	6.62E+02	2.62E+01	281
13	2.73E+05	8.59E+07	3.03E-12	7.12E+02	2.40E+01	312
14	3.04E+05	1.07E+08	7.87E-14	7.64E+02	2.25E+01	351
15	9.42E+05	5.65E+08	0.00E+00	8.50E+02	1.14E+01	600

MOUSSE CONSTANTS: MOONEY=6.20E-01, MAX H20= 0.70, WIND**2= 1.00E-02
K4=1.000E+01
DISPERSION CONSTANTS: KA=1.08E-01, K B = 5.00E+01, S-TENSION= 3.00E+01
KC=1.000E+01
FRACTION OF ICE COVER=6.600E-01
VIS CONSTANTS: VIS25C= 3.50E+01, ANDRADE = 9.00E+03, FRACT = 1.05E+01

FOR THE OUTPUT THAT FOLLOWS. TIME=HOURS
BBL=BARRELS, SPGR=SPECIFIC GRAVITY, AREA=M*M
THICKNESS=CM, W=PERCENT WATER IN OIL (MOUSSE)
DISP=DISPERSION RATE IN GMS/M*M/HR
ERATE=EVAPORTION RATE IN GMS/M*M/HR
M/A=MASS PER H*M OF OIL IN THE SLICK
I=FIRST CUT WITH GREATER THAN 1% (MASS) REMAINING
J=FIRST CUT WITH GREATER THAN 50% (MASS) REMAINING
CUT 1 GOES AWAY IN MINUTES, THEREFORE IT WAS DELETED AND TRE CUTS RENUMBERED

TIME	BBL	SPGR	AREA	THICKNESS	W	DISP	ERATE	M/A	I	J
0	9.2E+03	0.89	7.9E+04	1.8E+00	0	7.6E+01	0.0E+00	1.6E+04	1	1
1	9.1E+03	0.89	1.1E+05	1.3E+00	29	7.3E+01	2.5E+01	1.2E+04	1	1
2	9.0E+03	9.89	1.4E+05	1.1E+00	48	4.4E+01	2.3E+01	9.5E+03	1	2
3	9.0E+03	0.89	1.6E+05	9.2E-01	60	2.8E+01	2.1E+01	8.2E+03	1	2
4	8.9E+03	0.89	1.7E+05	8.2E-01	66	1.9E+01	1.9E+01	7.3E+03	1	2
5	8.9E+03	0.89	1.9E+05	7.4E-01	69	1.5E+01	1.7E+01	6.7E+03	1	3
6	8.8E+03	0.89	2.0E+05	6.9E-01	70	1.3E+01	1.5E+01	6.1E+03	1	3
7	8.8E+03	0.89	2.2E+05	6.4E-01	70	1.3E+01	1.3E+01	5.7E+03	2	3
8	8.7E+03	0.90	2.3E+05	5.9E-01	70	1.2E+01	1.2E+01	5.3E+03	2	3
9	8.7E+03	0.90	2.5E+05	5.6E-01	70	1.2E+01	1.1E+01	5.0E+03	2	3
10	8.6E+03	0.90	2.6E+05	5.3E-01	70	1.2E+01	9.6E+00	4.8E+03	2	3
11	8.6E+03	0.90	2.7E+05	5.1E-01	70	1.1E+01	8.7E+00	4.5E+03	2	3
12	8.5E+03	0.90	2.8E+05	4.8E-01	70	1.1E+01	7.9E+00	4.3E+03	2	4
13	8.5E+03	0.90	2.9E+05	4.6E-01	70	1.1E+01	7.3E+00	4.2E+03	2	4
14	8.5E+03	0.90	3.0E+05	4.5E-01	70	1.1E+01	6.8E+00	4.0E+03	2	4
16	8.4E+03	0.90	3.1E+05	4.3E-01	70	1.0E+01	6.3E+00	3.9E+03	2	4
17	8.4E+03	0.90	3.2E+05	4.2E-01	70	1.0E+01	5.9E+00	3.8E+03	2	4

TABLE 17 (Continued).

18	8.3E+03	0.90	3.3E+05	4.1E-01	70	9.8E+00	5.5E+00	3.6E+03	3	4
19	8.3E+03	0.90	3.4E+05	3.9E-01	70	9.6E+00	5.2E+00	3.5E+03	3	4
20	8.3E+03	0.90	3.4E+05	3.8E-01	70	9.4E+00	4.9E+00	3.4E+03	3	4
21	8.2E+03	0.90	3.5E+05	3.7E-01	70	9.2E+00	4.6E+00	3.3E+03	3	4
22	8.2E+03	0.90	3.6E+05	3.6E-01	70	9.0E+00	4.3E+00	3.3E+03	3	4
23	8.1E+03	0.90	3.7E+05	3.5E-01	70	8.8E+00	4.1E+00	3.2E+03	3	4
24	8.1E+03	0.90	3.7E+05	3.5E-01	70	8.6E+00	3.9E+00	3.1E+03	3	4
25	8.1E+03	0.90	3.8E+05	3.4E-01	70	8.4E+00	3.7E+00	3.0E+03	3	4
26	8.0E+03	0.90	3.9E+05	3.3E-01	70	8.2E+00	3.5E+00	3.0E+03	3	4
27	8.0E+03	0.90	3.9E+05	3.2E-01	70	8.0E+00	3.3E+00	2.9E+03	3	4
28	8.0E+03	0.90	4.0E+05	3.2E-01	70	7.8E+00	3.1E+00	2.9E+03	3	4
29	7.9E+03	0.90	4.1E+05	3.1E-01	70	7.6E+00	2.9E+00	2.8E+03	3	4
31	7.9E+03	0.90	4.1E+05	3.0E-01	70	7.4E+00	2.8E+00	2.7E+03	3	4
32	7.9E+03	0.90	4.2E+05	3.0E-01	70	7.3E+00	2.6E+00	2.7E+03	3	4
33	7.8E+03	0.90	4.3E+05	2.9E-01	70	7.1E+00	2.5E+00	2.6E+03	3	4
34	7.8E+03	0.90	4.4E+05	2.8E-01	70	6.9E+00	2.4E+00	2.6E+03	3	5
35	7.7E+03	0.90	4.4E+05	2.8E-01	70	6.8E+00	2.3E+00	2.5E+03	3	5
37	7.7E+03	0.90	4.5E+05	2.7E-01	70	6.6E+00	2.2E+00	2.5E+03	3	5
38	7.7E+03	0.90	4.5E+05	2.7E-01	70	6.5E+00	2.1E+00	2.4E+03	3	5
39	7.7E+03	0.90	4.6E+05	2.7E-01	70	6.3E+00	2.0E+00	2.4E+03	3	5
40	7.6E+03	0.90	4.6E+05	2.6E-01	70	6.2E+00	1.9E+00	2.4E+03	3	5
41	7.6E+03	0.90	4.7E+05	2.6E-01	70	6.1E+00	1.8E+00	2.3E+03	3	5
42	7.6E+03	0.90	4.7E+05	2.5E-01	70	6.0E+00	1.8E+00	2.3E+03	3	5
43	7.5E+03	0.90	4.8E+05	2.5E-01	70	5.8E+00	1.7E+00	2.3E+03	3	5
44	7.5E+03	0.90	4.8E+05	2.5E-01	70	5.7E+00	1.7E+00	2.2E+03	3	5
45	7.5E+03	0.90	4.9E+05	2.4E-01	70	5.6E+00	1.6E+00	2.2E+03	3	5
46	7.5E+03	0.90	4.9E+05	2.4E-01	70	5.5E+00	1.6E+00	2.2E+03	4	5
47	7.4E+03	0.90	5.0E+05	2.4E-91	70	5.4E+00	1.5E+00	2.1E+03	4	5
48	7.4E+03	0.90	5.0E+05	2.3E-01	70	5.3E+00	1.5E+00	2.1E+03	4	5
49	7.4E+03	0.90	5.1E+05	2.3E-01	70	5.2E+00	1.4E+00	2.1E+03	4	5
50	7.4E+03	0.90	5.1E+05	2.3E-01	70	5.1E+00	1.4E+00	2.1E+03	4	5
51	7.3E+03	0.90	5.2E+05	2.3E-01	70	5.0E+00	1.4E+00	2.0E+03	4	5
61	7.1E+03	0.90	5.6E+05	2.0E-01	70	4.2E+00	1.1E+00	1.8E+03	4	5
71	6.9E+03	0.90	5.9E+05	1.8E-01	70	3.5E+00	8.4E-01	1.7E+03	4	5
81	6.7E+03	0.91	6.3E+05	1.7E-01	70	3.0E+00	6.8E-01	1.5E+03	4	5
91	6.6E+03	0.91	6.6E+05	1.6E-01	70	2.6E+00	5.6E-01	1.4E+03	4	6

TABLE 17 (Continued).

OPEN oCEAN WEATHERING
AFTER :
ICE POOL WEATHERINC FOR 2.400E+01HOURS
BROKEN ICE FIELD WEATHERINC FOR 1.000E+02 HOURS

OIL: PRUDHOE BAY, ALASKA
TEMPERATURE= 40.6 DEG F, WIND SPEED= 20.0 KNOTS.
SPILL SIZE= 6.428E+03 BARRELS
MASS-TRANSFER COEFFICIENTT CODE= 2

FOR THE OUTPUT THAT FOLLOWS. MOLES=GRAM MOLES
GMS=GRAMS,VP=VAPOR PRESSURE IN ATMOSPHERES
BP=BOILINC POINT IN DEC F, API=GRAVITY
MW=MOLECULAR WEIGHT

CUT	MOLES	GMS	VP	BP	API	MW
1	4.40E-02	5.25E+00	1.77E-03	2.80E+02	5.16E+01	119
2	1.04E+04	1.40E+06	3.84E-04	3.25E+02	4.76E+01	1 3 3
3	1.26E+05	1.90E+07	7.40E-05	3.70E+02	4.52E+01	150
4	2.33E+05	3.90E+07	1.33E-05	4.15E+02	4.15E+01	1 6 7
5	2.62E+05	4.84E+07	2.18E-06	4.60E+02	3.78E+01	1 8 4
6	2.60E+05	5.21E+07	3.40E-07	5.05E+02	3.48E+01	200
7	1.36E+05	3.00E+07	3.86E-08	5.54E+02	3.06E+01	220
8	2.79E+05	7.03E+07	2.29E-09	6.09E+02	2.91E+01	251
9	2.66E+05	7.49E+07	1.33E-10	6.62E+02	2.62E+01	281
10	2.14E+05	6.70E+07	6.76E-12	7.12E+02	2.40E+01	312
11	2.37E+05	8.34E+07	[illegible]	[illegible]	2.25E+01	351
12	7.35E+05	4.41E+08	0.00E+00	8.50E+02	1.14E+01	600

MOUSSE CONSTANTS: MOONEY= 6.20E-01, MAX H20= 0.70, WIND**2=1.00E-03
DISPERSION CONSTANTS: KA= 1.08E-01, KB= 5.00E+01, S-TENSION= 3.00E+01
VIS CONSTANTS: VIS25C=3.50E+01, ANDRADE = 9.00E+03,FRACT=1.05E+01

FOR THE OUTPUT THAT FOLLOWS, TIME=HOURS
BBL=BARRELS, SPGR=SPECIFIC GRAVITY, AREA=M*M
THICKNESS=CM,W=PERCENT WATER [N OIL (MOUSSE)
DISP=DISPERSION RATE IN GMS/M*M/HR
ERATE=EVAPORTION RATE IN GMS/M*M/HR
M/A=MASS PER M*II OF OIL IN THE SLICK
I=FIRST CUT WITH GREATER THAN 1% (MASS) REMAINING
J=FIRST CUT WITH GREATER THAN 50%(MASS)REMAINING

TIME	BBL	SPGR	AREA	THICKNESS	W	DISP	ERATE	M/A	I	J
0	6.4E+03	0.91	6.8E+05	1.5E-01	70	3.5E+00	0.0E+00	1.4E+03	1	1
1	6.4E+03	0.91	6.9E+05	1.5E-01	70	3.4E+00	1.0E+00	1.3E+03	1	1
2	6.4E+03	0.91	7.0E+05	1.5E-01	70	3.4E+00	1.0E+00	1.3E+03	1	2
3	6.4E+03	0.91	7.1E+05	1 .4E-01	70	3.3E+00	9.8E-01	1.3E+03	1	2
4	6.3E+03	0.91	7.1E+05	1.4E-01	70	3.2E+00	9.5E-01	1.3E+03	1	2
5	6.3E+03	0.91	7.2E+05	1.4E-01	70	3.2E+00	9.2E-01	1.3E+03	1	2
6	6.3E+03	0.91	7.3E+05	1.4E-01	70	3.1E+00	8.9E-01	1.2E+03	1	3
7	6.3E+03	0.91	7.4E+05	1.4E-01	70	3.1E+00	8.6E-01	1.2E+03	1	3
8	6.2E+03	0.91	7.5E+05	1.3E-01	70	3.0E+00	8.4E-01	1.2E+03	2	3
9	6.2E+03	0.91	7.5E+05	1.3E-01	70	2.9E+00	8.1E-01	1.2E+03	2	3
11	6.2E+03	0.91	7.6E+05	1.3E-01	70	2.9E+00	7.9E-01	1.2E+03	2	3
12	6.2E+03	0.91	7.7E+05	1.3E-01	70	2.8E+00	7.6E-01	1.2E+03	2	3
13	6.1E+03	0.91	7.8E+05	1.3E-01	70	2.8E+00	7.4E-01	1.1E+03	2	3
14	6.1E+03	0.91	7.9E+05	1.2E-01	70	2.7E+00	7.3E-01	1.1E+03	2	3
13	6.1E+03	6.91	7.9E+05	1.2E-01	70	2.7E+00	7.1E-01	1.1E+03	2	3
16	6.1E+03	0.91	8.0E+05	1.2E-01	70	2.6E+00	6.9E-01	1.1E+03	2	3
17	6.1E+03	0.91	8.1E+05	1.2E-01	70	2.6E+00	6.8E-01	1.1E+03	2	3
18	6.0E+03	0.91	8.1E+05	1 .2E-01	70	2.5E+00	6.6E-01	1.1E+03	2	3
19	6.0E+03	0.91	8.2E+05	1,2E-01	70	2.5E+00	6.5E-01	1.1E+03	2	3
20	6.0E+03	0.91	8.3E+05	1.2E-01	70	2.5E+00	6.3E-01	1.1E+03	2	3
21	6.0E+03	0.91	8.3E+05	1.1E-01	70	2.4E+00	6.2E-01	1.0E+03	2	3
22	6.0E+03	0.91	8.4E+05	1.111-01	70	2.4E+00	6.1E-01	1.0E+03	2	3
23	6.0E+03	0.91	8.4E+05	1.1E-01	70	2.3E+00	6.0E-01	1.0E+03	2	3

TABLE 17 (Continued).

25	5.9E+03	0.91	8.5E+05	1.1E-01	70	2.3E+00	5.8E-01	1.0E+03	2	4
26	5.9E+03	0.91	8.6E+05	1.1E-01	70	2.2E+00	5.7E-01	9.9E+02	2	4
27	5.9E+03	0.91	8.7E+05	1.1E-01	70	2.2E+00	5.5E-01	9.8E+02	2	4
29	5.9E+03	0.91	8.7E+05	1.1E-01	70	2.2E+00	5.4E-01	9.7E+02	2	4
30	5.8E+03	0.91	8.8E+05	1.1E-01	70	2.1E+00	5.3E-01	9.6E+02	2	4
31	5.8E+03	0.91	8.9E+05	1.0E-01	70	2.1 E+00	5.2E-01	9.5E+02	2	4
32	5.8E+03	0.91	8.9E+05	1.0E-01	70	2.0E+00	5.0E-01	9.4E+02	2	4
34	5.8E+03	0.91	9.0E+05	1.0E-01	70	2.0E+00	4.9E-01	9.3E+02	3	4
35	5.8E+03	0.91	9.1E+05	1.0E-01	79	2.0E+00	4.8E-01	9.2E+02	3	4
36	5.7E+03	0.91	9.1E+05	1.0E-01	70	1.9E+00	4.7E-01	9.1E+02	3	4
37	5.7E+03	0.91	9.2E+05	9.9E-02	70	1.9E+00	4.6E-01	9.0E+02	3	4
39	5.7E+03	0.91	9.3E+05	9.8E-02	70	1.9E+00	4.5E-01	8.9E+02	3	4
40	5.7E+03	0.91	9.3E+05	9.7E-02	70	1.8E+00	4.4E-01	8.8E+02	3	4
41	5.7E+03	0.91	9.4E+05	9.6E-02	70	1.8E+00	4.3E-01	8.7E+02	3	4
42	5.6E+03	0.91	9.4E+05	9.5E-02	70	1.8E+00	4.2E-01	8.7E+02	3	4
44	5.6E+03	0.91	9.5E+05	9.4E-02	70	1.7E+00	4.1E-01	8.6E+02	3	4
43	5.6E+03	0.91	9.6E+05	9.3E-02	70	1.7E+00	4.1E-01	8.5E+02	3	4
46	5.6E+03	0.91	9.6E+05	9:2E-02	70	1.7E+00	4.0E-01	8.4E+02	3	4
47	5.6E+03	0.91	9.7E+05	9.2E-02	70	1.6E+00	3.9E-01	8.3E+02	3	4
49	5.6E+03	0.91	9.7E+05	9.1 E-02	70	1.6E+00	3.8E-01	8.3E+02	3	4
50	5.5E+03	0.91	9.8E+05	9.0E-02	70	1.6E+00	3.7E-01	8.2E+02	3	4
51	5.5E+03	0.91	9.8E+05	8.9E-02	70	1.6E+00	3.7E-01	8.1E+02	3	4
62	5.4E+03	0.91	1.0E+06	8.3E-02	7e	1.4E+00	3.1E-01	7.6E+02	3	4
72	5.3E+03	0.91	1.1E+06	7.8E-02	70	1.2E+00	2.7E-01	7.1E+02	3	4
82	5.2E+03	0.91	1.1E+06	7.4E-02	70	1.1E+00	2.4E-01	6.8E+02	3	4
92	5.1E+03	0.91	1.1E+06	7.0E-02	70	9.4E-01	2.1E-01	6.4E+02	3	s
102	5.0E+03	9.91	1.2E+06	6.7E-02	70	8.4E-01	1.9E-01	6.1E+02	3	5
112	4.9E+03	0.91	1.2E+06	6.4E-02	70	7.6E-01	1.7E-01	5.9E+02	3	s
122	4.8E+03	0.91	1.2E+06	6.2E-02	70	6.9E-01	1.6E-01	5.6E+02	4	5
132	4.7E+03	0.91	1.3E+06	5.9E-02	70	6.3E-01	1.5E-01	5.4E+02	4	5
142	4.7E+03	0.91	1.3E+06	5.7E-02	70	5.7E-01	1.4E-01	5.2E+02	4	5
152	4.6E+03	0.91	1.3E+06	5.5E-02	70	5.3E-01	1.3E-01	5.1E+02	4	5
162	4.5E+03	0.91	1.3E+06	5.4E-02	70	4 .8E-$31	1.2E-01	4.9E+02	4	5
172	4.5E+03	0.92	1.4E+06	5.2E-02	70	4.5E-01	1.1E-01	4.7E+02	4	5
182	4.4E+03	0.92	1.4E+06	5.0E-02	70	4.1E-01	1.0E-01	4.6E+02	4	5
192	4.4E+03	0.92	1.4E+06	4.9E-02	70	3.8E-01	9.7E-02	4.5E+02	4	5
202	4.3E+03	0.92	1.4E+06	4.8E-02	70	3.6E-01	9.0E-02	4.4E+02	4	s
212	4.3E+03	0.92	1.5E+06	4.6E-02	70	3.3E-01	8.5E-02	4.3E+02	4	3
222	4.2E+03	0.92	1.5E+06	4.5E-02	70	3.1E-01	7.9E-02	4.2E+02	4	3
232	4.2E+03	0.92	1.5E+06	4.4E-02	70	2.9E-01	7.5E-02	4.1E+02	4	3

output in Table 17 is essentially a condensed, self-contained, version of the calculated results in Table 16.

Table 18 presents the results of the calculations of the input parameters for the Mackay evaporation equation.

$$\frac{dF}{d\theta} = \frac{V_\ell}{RT} \exp \left[\frac{\Delta Hv}{R} \left(\frac{1}{T_b} - \frac{1}{T_1} \right)\right]$$

which is described in detail in Mackay (1982). The constraints required as input to the Mackay model are calculated, if requested, using the TBP data which are input to the ocean-ice oil-weathering code.

Page 68 represents the beginning of the results of a one-plate batch distillation of Prudhoe Bay crude oil. The results of this distillation are data for fraction distilled vs temperature as presented on Page 74. A linear correlating of these data plus values for bulk oil density, bulk molar volume, and mean Trouton's Rule constant are all combined to give the final Mackay evaporation model equation (all on Page 74).

Computer Installation/Access

Currently, the Ocean-Ice Oil-Weathering Code resides on a VAX 8650 computer at SAIC in San Diego, CA and has been delivered to the NOAA OCSEAP office in Anchorage. Due to frequent changes in operating commands and software upgrades, it is not practical to set up open access to the model. Interested parties can call SAIC to obtain username, password, and code execution information.

TABLE 18. Illustration of Output From Ocean-Ice Oil-Weathering Code; Mackay Parameter Calculations; Beginning of One-Plate Batch Distillation Results Using TBP Data as Input.

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*************** MACKAY PARAMETER CALCULATIONS ******************

THE MACKAY EVAPORATION MODEL IS DESCRIBED IN
(MACKAY, 1982)
THE FOLLOWING ARE THE RESULTS OF A CALCULATION OF THE
INPUT PARAMETERS FOR THE MACKAY MODEL FOR PRUDHOE BAY. ALASKA
AT 3.200E+01 DECREES F

SIMULATED ONE-PLATE BATCH DISTILLATION;
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F	TEMP(F)	Y sun
0.000E+00	2.918E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	2.740E+04	8.107E+00	4.128E-01
2	3.148E+04	4.589E+00	2.685E-01
3	3.907E+04	2.378E+00	1.727E-01
4	3.668E+04	1.202E+00	8.197E-02
5	3.433E+04	5.857E-01	3.736E-02
6	2.923E+04	2.710E-01	1.472E-02
7	3.304E+04	1.189E-01	7.300E-03
8	3.414E+04	4.918E-02	3.120E-03
9	3.340E+04	1.937E-02	1.202E-03
10	1.741E+04	6.130E-03	1.983E-04
11	3.576E+04	1.363E-03	9.054E-05
12	3.412E+04	2.932E-04	1.859E-05
13	2.745E+04	5.957E-05	3.039E-06
14	3.042E+04	9.128E-06	5.160E-07

F	TEMP(F)	Y SUM
2.334E-02	3.088E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	1.734E+04	9.879E+00	3.390E-01
2	2.418E+04	5.681E+00	2.687E-01
3	3.398E+04	3.002E+00	1.995E-01
4	3.414E+04	1.552E+00	1.037E-01
5	3.313E+04	7.762E-01	5.030E-02
6	2.874E+04	3.704E-01	2.082E-02
7	3.279E+04	1.680E-01	1.078E-02
a	3.403E+04	7.201E-02	4.793E-03
9	3.335E+04	2.940E-02	1.918E-03
10	1.740E+04	1.014E-02	3.449E-04
11	3.575E+04	2.381E-03	1.665E-04
12	3.412E+04	5.414E-04	3.614E-05
13	2.745E+04	1.166E-04	6.264E-06
14	3.042E+04	1.919E-05	1.142E-06

F	TEMP (FJ	Y sum
4.734E-02	3.295E+02	1.000E+00

1	MOLES I	VP(I)	Y(I)
1	9.992E+03	1.240E+01	2.559E-01

TABLE 18 (Continued). Mackay Parameter Calculations; One-Plate Batch Distillation Results.

a	1.703E+04	7.262E+00	2.554E-01
3	2.807E+04	3.921E+00	2.272E-01
4	3.087E+04	2.080E+00	1.325E-01
5	3.147E+04	1.071E+00	6.956E-02
6	2.803E+04	5.287E-01	3.060E-02
7	3.241E+04	2.490E-01	1.666E-02
8	3.385E+04	1.111E-01	7.769E-03
9	3.328E+04	4.730E-02	3.250E-03
10	1.738E+04	1.740E-02	6.245E-04
11	3.573E+04	4.511E-03	3.329E-04
12	3.412E+04	1.093E-03	7.698E-05
13	2.743E+04	2.517E-04	1.427E-05
14	3.042E+04	4.492E-05	2.821E-06

F	TEMP (F)	Y sum
7.226E-02	3.538E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	5.011E+03	1.597E+01	1.750E-01
2	1.058E+04	9.536E+00	2.206E-01
3	2.139E+04	5.272E+00	2.465E-01
4	2.662E+04	2.872E+00	1.672E-01
5	2.910E+04	1.526E+00	9.706E-02
6	2.694E+04	7.816E-01	4.603E-02
7	3.179E+04	3.831E-01	2.663E-02
8	3.355E+04	1.787E-01	1.311E-02
9	3.315E+04	7.964E-02	5.772E-03
10	1.736E+04	3.089E-02	1.172E-03
11	3.573E+04	9.123E-03	7.127E-04
12	3.411E+04	2.370E-03	1.768E-04
13	2.745E+04	5.878E-04	3.528E-05
14	3.042E+04	1.148E-04	7.632E-06

F	TEMP(F)	Y SUM
9.848E-02	3.807E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	2.442E+03	2.079E+01	1.179E-01
2	5.586E+03	1.266E+01	1.643E-01
3	1.439E+04	7.173E+00	2.398E-01
4	2.125E+04	4.016E+00	1.983E-01
5	2.573E+04	2.200E+00	1.315E-01
6	2.324E+04	1.169E+00	6.856E-02
7	3.076E+04	5.966E-01	4.263E-02
8	3.302E+04	2.911E-01	2.233E-02
9	3.290E+04	1.359E-01	1.039E-02
10	1.731E+04	5.573E-02	2.240E-03
11	3.570E+04	1.818E-02	1.507E-03
12	3.410E+04	5.275E-03	4.179E-04
13	2.745E+04	1.412E-03	9.005E-05
14	3.042E+04	3.025E-04	2.138E-05

F	TEMP(F)	Y SUM
1.261E-01	4.117E+02	1.000E+00

TABLE 18 (Continued). Mackay Parameter Calculations; One-Plate Batch Distillation Results.

I	MOLES I	VP(I)	Y(I)
1	8.554E+02	2.759E+01	5.848E-02
2	2.646E+03	1.718E+01	1.126E-01
3	8.239E+03	9.980E+00	2.042E-01
4	1.520E+04	5.748E+00	2.165E-01
5	2.127E+04	3.252E+00	1.713E-01
6	2.273E+04	1.795E+00	1.011E-01
7	2.910E+04	9.540E-01	6.879E-02
8	3.211E+04	4.873E-01	3.877E-02
9	3.246E+04	2.389E-01	1.922E-02
10	1.720E+04	1.039E-01	4.429E-03
11	3.562E+04	3.660E-02	3.231E-03
12	3.408E+04	1.235E-02	1.043E-03
13	2.744E+04	3.588E-03	2.440E-04
14	3.042E+04	8.484E-04	6.394E-05

F	TEMP(F)	Y SUM
1.556E-01	4.437E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	6.865E+01	3.680E+01	6.706E-03
2	1.131E+03	2.341E+01	7.031E-02
3	4.014E+03	1.396E+01	1.487E-01
4	9.255E+03	8.271E+00	2.032E-01
5	1.579E+04	4.827E+00	2.024E-01
6	1.917E+04	2.764E+00	1.407E-01
7	2.650E+04	1.528E+00	1.075E-01
8	3.056E+04	8.162E-01	6.621E-02
9	3.165E+04	4.197E-01	3.527E-02
10	1.701E+04	1.934E-01	8.734E-03
11	3.547E+04	7.364E-02	6.934E-03
12	3.403E+04	2.687E-02	2.427E-03
13	2.743E+04	9.159E-03	6.669E-04
14	3.041E+04	2.392E-03	1.931E-04

F	TEMP(F)	Y SUM
1.874E-01	4.794E+02	1.000E+00

I	MOLES I	VP([)	Y(I)
1	0.000E+00	4.794E+01	0.000E+00
2	1.853E+02	3.112E+01	1.648E-02
3	2.003E+03	1.899E+01	1.088E-01
4	4.648E+03	1.155E+01	1.534E-01
5	9.969E+03	6.931E+00	1.975E-01
6	1.452E+04	4.099E+00	1.702E-01
7	2.261E+04	2.347E+00	1.517E-01
8	2.799E+04	1.303E+00	1.042E-01
9	3.020E+04	6.983E-01	6.029E-02
10	1.663E+04	3.388E-01	1.610E-02
11	3.514E+04	1.383E-01	1.389E-02
12	3.391E+04	5.412E-02	5.245E-03
13	2.739E+04	2.041E-02	1.598E-03
14	3.040E+04	6.125E-03	5.323E-04

F	TEMP(F)	Y SUM

TABLE 18 (Continued). Mackay Parameter Calculations; One-Plate Batch Distillation Results.

2.213E-01	5.145E+02	1.000E+00

I	MOLES 1	VP(I)	Y([)
1	0.000E+00	6.194E+01	0.000E+00
2	0.000E+00	4.100E+01	0.000E+00
3	5.399E+02	2.560E+01	4.280E-02
4	2.206E+03	1.595E+01	1.089E-01
5	5.207E+03	9.833E+00	1.586E-01
6	9.468E+03	5.995E+00	1.758E-01
7	1.749E+04	3.545E+00	1.920E-01
8	2.416E+04	2.039E+00	1.526E-01
9	2.784E+04	1.136E+00	9.791E-02
10	1.596E+04	5.778E-01	2.855E-02
11	3.453E+04	2.518E-01	2.692E-02
12	3.366E+04	1.053E-01	1.098E-02
13	2.731E+04	4.260E-02	3.603E-03
14	3.037E+04	1.482E-02	1.394E-03

F	TEMP(F)	Y SUM
2.577E-01	5.506E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	0.000E+00	7.918E+01	0.000E+00
2	0.000E+00	5.340E+01	0.000E+00
3	0.000E+00	3.407E+01	0.000E+00
4	7.403E+02	2.173E+01	5.433E-02
5	2.436E+03	1.374E+01	1.131E-01
6	5.072E+03	8.622E+00	1.477E-01
7	1.167E+04	5.252E+00	2.070E-01
8	1.894E+04	3.123E+00	1.998E-01
9	2.421E+04	1.801E+00	1.472E-01
10	1,482E+04	9.564E-01	4.789E-02
11	3.338E+04	4.428E-01	4.992E-02
12	3.316E+04	1.970E-01	2.207E-02
13	2.714E+04	8.512E-02	7.802E-03
14	3.030E+04	3.202E-02	3.277E-03

F	TEMP(F)	Y SUM
2.967E-01	5.878E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	0.000E+00	1.001E+02	0.000E+00
2	0.000E+00	6.873E+01	e. 000E+00
3	0.000E+00	4.476E+01	0.000E+00
4	9.394E+00	2.920E+01	1.019E-03
5	9.150E+02	1.891E+01	6.429E-02
6	2.359E+03	1.219E+01	1.069E-01
7	6.341E+03	7.637E+00	1.799E-01
8	1.276E+04	4.681E+00	2.219E-01
9	1.910E+04	2.786E+00	1.977E-01
10	1.301E+04	1.539E+00	7.443E-02
11	3.134E+04	7.532E-01	8.770E-02
12	3.220E+04	3.549E-01	4.245E-02
13	2.678E+04	1.630E-01	1.621E-02
14	3.013E+04	6.601E-02	7.391E-03

TABLE 18 (Continued). Mackay Parameter Calculations; One-Plate Batch Distillation Results

F	TEMP(F)	Y SUM
3.386E-01	6.266E+02	1.000E+00

I	MOLES [	VP(1)	Y(I)
1	0.000E+00	1.257E+02	0.000E+00
2	0.000E+00	8.782E+01	0.000E+00
3	0.000E+00	5.836E+01	0.000E+00
4	0.000E+00	3.890E+01	0.000E+00
5	3.004E+01	2.579E+01	5.327E-03
6	9.216E+02	1.707E+01	6.492E-02
7	2.921E+03	1.098E+01	1.324E-01
8	6.901E+03	6.925E+00	1.973E-01
9	1.284E+04	4.246E+00	2.250E-01
10	1.035E+04	2.433E+00	1.039E-01
11	2.787E+04	1.254E+00	1.443E-01
12	3.039E+04	6.230E-01	7.816E-02
13	2.604E+04	3.031E-01	3.258E-02
14	2.977E+04	1.317E-01	1.618E-02

F	TEMP (F)	Y sun
3.839E-01	6.670E+02	1.000E+00

1	MOLES I	VP(1)	Y(I)
1	0.000E+00	1.567E+02	0.000E+00
2	0.000E+00	1.113E+02	0.000E+00
3	0.000E+00	7.540E+01	0.000E+00
4	0.000E+00	5.132E+01	0.000E+00
5	0.000E+00	3.480E+01	0.000E+00
6	4.814E+01	2.361E+01	5.278E-03
7	1.140E+03	1.558E+01	8.248E-02
8	3.129E+03	1.010E+01	1.467E-01
9	6.783E+03	6.369E+00	2.006E-01
10	6.931E+03	3.776E+00	1.215E-01
11	2.241E+04	2.042E+00	2.125E-01
12	2.714E+04	1.066E+00	1.343E-01
13	2.458E+04	5.470E-01	6.244E-02
14	2.900E+04	2.538E-01	3.417E-02

F	TEMP(F)	Y SUM
4.328E-01	7.083E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	0.000E+00	1.933E+02	e.000E+00
2	0.000E+00	1.395E+02	0.000E+00
3	0.000E+00	9.629E+01	0.000E+00
4	0.000E+00	6.686E+01	0.000E+00
5	0.000E+00	4.632E+01	0.000E+00
6	0.000E+00	3.219E+01	0.000E+00
7	3.032E+01	2.176E+01	3.501E-03
8	1.135E+03	1.447E+01	8.868E-02
9	3.056E+03	9.367E+00	1.519E-01
10	3.617E+03	5.732E+00	1.100E-01
11	1.517E+04	3.240E+00	2.608E-01
12	2.192E+04	1.770E+00	2.058E-01

TABLE 18 (Continued). Mackay Parameter Calculations; End of One-Plate Distillation; Heat of Vaporization and Trouton's Rule Calculations.

13	2.192E+04	9.541E-01	1.110E-01
14	2.742E+04	4.705E-01	6.843E-02

F	TEMP(F)	Y SUM
4.853E-01	7.524E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	0.000E+00	2.380E+02	0.000E+00
2	0.000E+00	1.745E+02	0.000E+00
3	0.000E+00	1.227E+02	0.000E+00
4	0.000E+00	8.688E+01	0.000E+00
5	0.000E+00	6.147E+01	0.000E+00
6	0.000E+00	4.374E+01	0.000E+00
7	0.000E+00	3.029E+01	0.000E+00
8	0.000E+00	2.066E+01	0.000E+00
9	1.013E+03	1.372E+01	8.594E-02
10	1.631E+03	8.654E+00	8.730E-02
11	7.922E+03	5.107E+00	2.503E-01
12	1.483E+04	2.913E+00	2.672E-01
13	1.758E+04	1.646E+00	1.790E-01
14	2.446E+04	8.604E-01	1.302E-01

F	TEMP(F)	Y sun
5.413E-01	8.052E+02	1.000E+00

I	MOLES I	VP(I)	Y(I)
1	0.000E+00	2.995E+02	0.000E+00
2	0.000E+00	2.235E+02	0.000E+00
3	0.000E+00	1.603E+02	0.000E+00
4	e. 000E+00	1.161E+02	0.000E+00
5	0.000E+00	8.406E+01	0.000E+00
6	0.000E+00	6.140E+01	0.000E+00
7	0.000E+00	4.365E+01	0.000E+00
8	0.000E+00	3.062E+01	0.000E+00
9	0.000E+00	2.091E+01	0.000E+00
10	4.561E+02	1.364E+01	4.612E-02
11	3.467E+03	8.433E+00	2.168E-01
12	7.013E+03	5.038E+00	2.620E-01
13	1.094E+04	2.995E+00	2.429E-01
14	1.880E+04	1.666E+00	2.322E-01

	DELTAH	DELTAH/TB
1	1.203E+04	1.976E+01
2	1.324E+04	2.040E+01
3	1.448E+04	2.086E+01
4	1.564E+04	2.117E+01
S	1.678E+04	2.141E+01
6	1.791E+04	2.160E+01
7	1.904E+04	2.179E+01
8	2.019E+04	2.197E+01
9	2.098E+04	2.176E+01

wHERE:
DELTAH IS THE ENTHALPY OF VAPOR1ZATIOR IN BTU/LBMOLE
DELTAH/TB IS TBE TROUTONS RULE CONSTANT [N BTU/LBMOLE*DEG R

TABLE 18 (Continued). Mackay Parameter Calculations; Distillation Curve Correlation; Bulk Oil Properties; Final Mackay Evaporation Equation.

LEASI' SQUARES OF B.P. VS. FRACTION EVAPORATED:

SLOPE: 9.690E+02 DEG R/FRACTION EVAPORATED
INITIAL B.P.: 2.912E+02 DEG F
CORRELATION COEFFICIENT: 9.991E-01

BULK OIL DENSITY: 8.820E-01 GRAMS/CC
BULK MOLAR VOLUME OF OIL: 2.940E+02 CC/MOLE
MEAN TROUTONS RULE CONSTANT: 2.119E+01 BTU/LBMOLE*DEG R

AFTER SIMPLIFICATION AND COMBINING TERMS, THE MACKAY EVAPORATION MODEL BECOMES:

DELTA-F = DELTA-THETA * EXP(6.400E+00 - 2.324E-02 (7.502E+02 + 9.690E+02(F))

OR

DELTA-F = DELTA-THETA * EXP(-1.103E+01 - 2.251E+01(F))

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APPENDIX A

CODE LISTING FOR OCEAN-ICE OIL-WEATHERING MODEL

```
C        ***** OILICE.FOR *****
      INCLUDE 'VARI.FOR'
C
C        THIS IS THE OPEN-OCEAN OIL-WEATHERING CODE AND
C        THE OIL PHASE IS CONSIDERED WELL-STIRRED ALL THE
C        TIME.
C
C        THIS CODE ALSO ALLOWS FOR WEATHERING IN THE PRESENCE OF
C        SEA ICE.
C
C        ANOTHER OPTION AVAILABLE IN THIS CODE IS THE CALCULATION
C        OF THE INPUT PARAMETERS FOR THE MACKAY EVAPORATION
C        MODEL.
C
C        AUGUST, 1986
C
C        GET YOUR OUTPUT FROM OILICE.OUT/FILE:FORTRAN
C        THE PLOT FILE IS OILICE.PLT
C        THE TYPE FILE IS OILICE.TYP/FILE:FORTRAN
C        THE MACKAY CONSTANTS GO INTO MACKAY.DAT
C
      DIMENSION FMF(30)
      DATA (ANAMEL(1,J,J=1,5)/'PRUDH','OE BA','Y, AL','ASKA'
     1,'    '/
      DATA(ANAMEL(2,J),J=1,5)/'COOK ● ,"INLET',', ALA', 'SKA.
     1,'    '/
      DATA (ANAMEL(3,J),J=1,5)/'WILMI ','NGTON',', CAL','IFORN'
     1,'1A    '/
      DATA (ANAMEL(4,J),J=1,5)/'MURBA' ,'N, AB','U DHA','BI '
     1,'    '/
      DATA (ANAMEL(5,J),J=1,5)/'LAKE ','CHICO', 'T, LO', 'UISIA'
     1,*NA    '/
      oATA (ANAMEL(6,J),J=1,5)/'LIGHT ● ,' DIES', 'EL CU','T',
     1'    '/
      DATA APIBL/27.,35.4,19.4,40.5,54. 7,38.9/
      DATA ITEML/9,7,94,99999,221,1/
      DATA ISAMPL/71011,72025,71052,99999 ,54862,2/
      DATA NCTS/15,16,13,16,16,11/
C
C        FOR CRUDE OIL THE RESIDUUM CUT IS ASSIGNED A NORMAL
C        BOILING POINT OF .
C
      DATA(TBL(1,J),J=1,30)/150.,190. ,235. ,280. ,325. ,370.
     1,415.,460.,505.,554.,609.,662.,712.,764.,850.,15*0./
      DATA (TBL(2,J),J=1,20)/110.,145 ., 190. ,235. ,280. ,325.
     1,370.,415.,460.,505.,554.,609. ,662.,712.,764.,85(3.
     2,4*0./
      DATA (TBL(3,J),J=1,20)/195.,235.,280.,325.,370.,415.
     1,460.,505.,554.,609.,662.,712.,850.,7*0./
      O ATA (TBL(4,J),J=1,20)/110.,145.,190. ,235. ,280. ,325.
     1,378. ,415. ,460.,505. ,554. ,609.,662.,712.,764.,850.
     2,4*0./
      DATA (TBL(5,J),J=1,20)/110.,145.,190. ,235. ,280. ,325.
     1,370.,415.,460.,505.,554.,609. ,662.,712.,764.,850.
     2,4*0./
      DATA (TBL(6,J),J=1,11)/313.,342 . ,366.,395.,415.,438.,461 .
     1,479.,581.,518.,538./
      DATA (APIL(1,J),J=1,30)/72.7,64.2 ,56.7,51 .6,47.6,45.2
     1,41.5,37.8,34.8,30.6,29.  1,26.2,24.,22.5,11.4,15*0  ./
      DATA (APIL(2,J),J=1,20)/89.2,77. 2,65. ,59.5,55.4,50.8
```

```
6100          1 ,46.5,43.,39.6,37.,32.8,37 .3,28.7,26.6,25.,11.6,4*0./
6200           DATA (APIL(3,J),J=1,20)/68.6,58. 7,53. ,4S.1 ,43.2,38.8
6300          1,35.4,32.3,26.8,24.5,22 .3,20.3,8.9,7*0./
6400           DATA (APIL(4,J),J=1,20)/96.7,86. 2,7e.6,62.3,55.7 ,51.6
6500          1,48.5,45. 6,43. ,40. ,35.8,34. ,30.,28.4,26.6,16.7,4*0./
6600           DATA (APIL(5,J),J=1,20)/92.4,81 . ,68.9,62.1,57.2,52.5
6700          1,48.8,45.2,41 .7,38.2,34.4,33. 2,30.6, 28.9,26 .1,18.1,4*0./
6800           DATA (APIL(6,J),J=1,11)/49.6,47 .3,46. ,44.,38.6,38.8,37.2
6900          1,35.4,33.9,33.1,32.2/
7000           DATA (VOLL(1,J),J=1,30)/2.1,2. 6,3.5, 3.6,3.7,3.5,4.3,4.8
7100          1,5. ,2.8,6.5,6.8, 6.0,7.4,36.3,15*0./
7290           DATA(VOLL(2,J),J=1,20)/2.4,2 .5,5.9,6. 1,5.1,5.2.4.9
7300          1,5.1,5.2,5.,3.3,5.2,7.,4. 2,4.2,25.6,4*0./
7400           DATA (VOLL(3,J),J=1,20)/2.3,2.4 ,2.4,2. 5,2.8,3.6,4.4
7500          1,5.3,4.7,6.3,4.1,5.5,53. 3,7*0./
7600           DATA (VOLL(4,J),J=1,20)/1.7,2.9 ,4.9,6. ,6.8,6.5,5.7
77ee          1,5.6,6.,4.9,5.7,5.6,6.5, 6.,5.6,19.3,4*0./
7800           DATA (VOLL(5,J),J=1,20)/7.5,8.2,9 .7, 11.,9.1,8.3,7.2
7900          1,7.2.7.4,6.9,3.5,3.,1.6, 1.4,1.9,2.,4*0./
8000           DATA(VOLL(6,J),J=1,11)/4.78,9.57,9.09,9.57,9.57,9 ,57
8100          1,9.57,9.57,9.57,9.57,9.57/
8200    c
8300    c        C1L, C2L, AND C4L ARE THE MOUSSE FORMATION CONSTANTS.
8400    c        CIL IS THE VISCOSITY CONSTANT.
8500    c        C2L IS THE INVERSE OF THE MAXIMUM WATER IN OIL WEIGHT
8600    c        FRACTION.  C4L IS THE WATER INCORPORATION RATE.
8700    c
8800           DATA C1L/0.62,0.62,0.63,0.64,0.65,0.65/
8900           DATA C2L/1.42,3.33,1.43,5.,-1.,-1./
9000           DATA C4L/0.001,0.001,0.01,0.001,0.,0./
9100    c
9200    c        FOR THE DISPERSION PROCESS, KA IS THE CONSTANT IN THE
9300    c        SEA SURFACE DISPERSION EQUATION, KB IS THE CONSTANT IN
94ee    c        THE DROPLET FRACTION EQUATION.  STENL(6) IS THE LIBRARY
9500    c        OIL-WATER SURFACE TENSION IN DYNES/CM.
9600    c
9700           DATA KA,KB,STENL/0.108,50.,30.,30.,30.,30.,30.,30./
9800           DATA VISZL/35.,35.,195.,15.,13.5, 11.5/
9900           DATA MK3L/9000.,9000.,9000.,9000.,9000.,3000./
I 0000         DATA MK4L/10.5,7.4,15.3,10.5,2. ,2./
10100          OPEN(UNIT=32,file='OILICE.OUT',status='new')
1 0200
1 0300         OPEN(UNIT=34,file='OILICE.PLT',status='new')
10400          OPEN(UNIT=35,file='OILICE.TYP',status='new')
1 0500         IOU-32
1 0600         IPU=34
1 0700         ITY=35
I 0800  C
10900   C        FILL IN SOME LIBRARY IDENTIFICATIONS.
11000   c
11100   10     TYPE 20
11200   20     FORMAT(1X,'ENTER THE NUMBER OF TBP CUTS TO BE CHARACTERIZED
I 1300         1 ON 12')
11400          TYPE 30
11500   30     FORMAT(1X,'IF YOU HAVE NO INPUT DATA JUST ENTER 99')
11600          TYPE 40
11700   40     FORMAT(1X,'A 99 ENTRY WILL USE A LIBRARY EXAMPLE')
I lace         ICODE=1
11900          ACCEPT 50, NCUTS
12eee   se     FORMAT(I2)
```

```
12100          LSWTCH=NCUTS
12200    C
12300    C       LSWTCH=99 IS USED TO INDICATE THAT A LIBRARY CRUDE WAS
12400    c       CHOSEN .
125ee    C
126ee          IF(NCUTS.NE.99) GO TO 120
127ee    C
128ee    C       USING A LIBRARY CRUDE.
12900    c
13eee          IFLE=2
13100          TYPE 60
13200    60    FORMAT(IX, *CHOOSE A CRUDE ACCORDING TO:')
13300          DO 80 I=1,6
134ee          TYPE 70, I,(ANAMEL(I,J),J=1,5)
135ee    70    FORMAT(1X,I1,' = ',5A5)
13600    80    CONTINUE
137ee          ACCEPT 90,IC
138ee    90    FORMAT(I1)
13900          APIB=APIBL(IC)
14eee          ITEM=ITEML(IC)
14100          ISAMP=ISAMPL(IC)
142ee          NCUTS=NCTS(IC)
1 43ee         ICODE=2
1 44ee         DO 100 J=1,5
145ee          ANAME(J)=ANAMEL(IC,J)
146ee    1 00  CONTINUE
147ee          TYPE 110, (ANAME(J),J=1 ,5)
14800    110   FORMAT(/,1X,'YOU CHOSE: ',5A5)
149ee          GO TO 250
15000    C
15100    C       USER IS ENTERING THE CRUDE DATA OR READING HIS OWN FILE
15200    C
15300    120   TYPE 130
154ee    130   FORMAT(1X,'IS THE CRUDE ON A FILE ?*)
155ee          IFLE=1
15600          ACCEPT 140, ANS
157ee    140   FORMAT(A1)
15800          IF(ANS.EQ. 'N') GO TO 170
159ee          TYPE 150
16000    150   FORMAT(IX,'WHAT IS THE FILE NAME?')
16050          ACCEPT 151,FNAME
16e75    151   FORMAT(A10)
16100          OPEN(UNIT=36, file=FNAME,STATUS='OLD')
162ee          IFLE=2
16300          READ(36,550)(ANAME(J),J=1,5)
164ee          READ(36,560) ITEM,ISAMP,NCUTS
16500          READ(36,570) APIB
166ee          DO 160 J=1,NCUTS
16700          READ (36,580) TB(J),API(J),VOL(J)
16aee    16e   CONTINUE
169ee          GO TO 330
170ee    C
17100    170   TYPE 180
172ee    180   FORMAT(1X,'ENTER THE NAME OF THE CRUDE')
173ee          ACCEPT 190, (ANAME(I),I=1 ,5)
174ee    I 90  FORMAT(10A5)
17500          TYPE 200
176ee    200   FORMAT(IX, "ENTER AN IDENTIFICATION NUMBER FOR
177ee         1 THIS CRUDE ON I5')
17800          ACCEPT 210, ITEM '
```

```
17900   210    FORMAT(I5)
18000          TYPE 220 "
18100   22e    FORMAT(IX,'ENTER A SAMPLE NUMBER ON I5')
18200          ACCEPT 210,ISAMP
18300          TYPE 230
18400   23e    FORMAT(IX,'ENTER THE BULK API GRAVITY')
18500          ACCEPT 280,APIB
18600          TYPE 240
18700   24e    FORMAT(/,1X,'YOU MUST ENTER THE TRUE BOILING POINT
18800         1 CUT DATA STARTING',/,1X,'WITH THE MOST VOLATILE CUT
18900         2 AND GOING TO THE BOTTOM OF THE BARREL',/)
19000   c
19100   c        CALCULATE THE BULK DENSITY OF THE CRUDE AT 60/60.
19200   c
19300   25e    DCRUDE=141.5/(APIB+131.5)
19400          DCRUDE=0.983*DCRUDE
19500   c
196ee   c        TRANSFER CRUDE INPUT DATA TO THE VARIABLES USED IN
19700   c        THE CALCULATIONS.
1980e   c
19900          DO 320 I=1,NCUTS
20000          Go To (260,310), ICODE
20100   26e    TYPE 270, I
20200   c
20300   c        ENTER THE CRUDE CUT DATA.
20400   c
20500   27e    FORMAT(1X,'ENTER THE BOILING POINT AT 1 ATM IN DEG F
20600         1 FOR CUT',I3)
20700          ACCEPT 280, TB(I)
20800   28e    FORMAT(F10.0)
20900          TYPE 290, I
21000   29e    FORMAT(IX,'ENTER API GRAVITY FOR CUT" ,13)
21100          ACCEPT 280,API(I)
21200          TYPE 300,I
21300   300    FORMAT(IX,'ENTER VOLUME PER CENT FOR CUT' ,13)
21400          ACCEPT 280, VOL(I)
21500          GO To 32e
21600   c
21700   c        TRANSFER CRUDE CUT INPUT DATA FROM THE LIBRARY.
21800   c
21900   310    TB(I)=TBL(IC,I)
22000          API(I)=APIL(IC,I)
22100          VOL(I)=VOLL(IC,I)
22200   32e    CONTINUE
22300   C
22400   C        DISPLAY THE CUTS BACK TO THE USER.
22500   c
22600   330    TYPE 340
22700   34e    FORMAT(/,1X,'CUT',5X,'TB' ,IOX,'API ',8X, 'VOL')
22800          DO 360 I=1,NCUTS
22900          TYPE 35e, I,TB(I),API(I),VOL(I)
23000   350    FORMAT(1X,I2,5X,F5.1,7X,F4.1,6X,F5.1)
23100   36e    CONTINUE
23200          TYPE 370
23300   37e    FORMAT(1X,'DO YOU WANT TO CHANGE ANY?')
23400   38e    ACCEPT 390,ANS
23500   39e    FORMAT(AI)
23600          IF(ANS.EQ. 'N*) GO TO 47e
23700   c
23800   c        ALLOW THE INPUT TO BE CHANGED.
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23900   c
24000          TYPE 400
24100   400    FORMAT(IX,'ENTER THE CUT NUMBER TO BE CHANGED ON 12')
24200          ACCEPT 50, N
24300          TYPE 410
24400   410    FORMAT(1X,'ENTER 1 TO CHANGE TB, 2 FOR AP1, 3 FOR VOL%')
24500          ACCEPT 420, IC
24600   42e    FORMAT(I1)
24700          TYPE 43e
24800   430    FORMAT(1X,'ENTER THE CHANGED DATA')
24900          GO TO( 440,450,460),IC
25000   440    ACCEPT 280, TB(N)
25100          GO TO 330
25200   450    ACCEPT 280, API(N)
25300          GO TO 33e
25400   46e    ACCEPT 28e, VOL(N)
25500          GO TO 330
25600   470    DO 480 I=2,NCUTS
25700          [MI-I-1
25800          IF(TB(I).LT.TB(IM1)) GO TO 490
25900   48e    CONTINUE
26000          GO TO 510
261 00  49e    TYPE 500,I,IM1
26200   500    FORMAT(/,1X,'THE BOILING POINT OF CUT ',I2
26300           ' IS LESS THAN CUT ',I2,/,1X,'AND THIS ORDER IS NOT
26400         I'Acceptable, so START OVER',/)
26500          GO TO 10
26600   C
26700   C        ALWAYS RENORMALIZE THE INPUT VOLUMES TO 100%.
26800   C
26900   510    VTOTAL=0.
27000          00 52e I=1,NCUTS
27100          VTOTAL=VTOTAL+VOL( 1)
27200   52e    CONTINUE
27300          0 0 530 I=1,NCUTS
27400          VOL(I)=100.*VOL(I)/VTOTAL
27500   530    CONTINUE
27600   c
27700   c        IF YOU READ IT IN, DO NOT RESAVE IT
27800   c
27900          IF(IFLE.EQ.2) GO TO 590
28000          TYPE 540
28100   540    FORMAT(1X,'THIS CRUDE WILL NOW BE WRITTEN TO A FILE. WHAT
28200         1 WOULD YOU LIKE TO CALL IT?")
28250           ACCEPT 541,FNAME
28275   541    FORMAT(A10)
28300          OPEN(UNIT=38,file=FNAME,STATUS='NEW')
28400          WRITE( 38,550) (ANAME(J),J=1,5)
28500   55e    FORMAT( 5A5)
28600          WRITE(38,560) ITEM, ISAMP,NCUTS
28700   560    FORMAT( 315)
28800          WRITE( 38,570)APIB
28900   57e    FORMAT(1X,F6.1)
29000          DO 590 J=1,NCUTS
29100          WRITE( 38,580)TB(),API(J),VOL(J)
29200   580    FORMAT( 3(1X,1PE10.3)
29300   590    CONTINUE
29400   C
29500   C        NOW CHARACTERIZE THE PARENT OIL
29600   C
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29700          CALL DOCHAR
29800    c
29900    c       CALCULATE THE INITIAL MASS, MOLES, DENSITY FOR EACH CUT
30000    c
30100          BBL=1000.
30200          BM=0.159*BBL
30300          TMOLES=0.
30400          DO 600I=1,NCUTS
30500          AMASS=1582.*SPGR(I)*BBL*VOL(I)
30600          MOLES(I)=AMASS/MW( I)
30700          MOLS(I)=MOLES( 1)
30800          TMOLES=TMOLES+MOLES  (I)
30900          RHO(I)=100*MOLES(I)/(BM*VOL( I))
31000    600   CONTINUE
31100          WTMOLE=0.
31200          DO 610I=1,NCUTS
31300          WTMOLE=WTMOLE+MW(I)*MOLES(I)/TMOLES
314ee    610   CONTINUE
31500          TYPE 620
31600    62e   FORMAT(1X,'DO YOU WANT THE MACKAY CONSTANTS?')
31700          ACCEPT 39e, ANS
31800          IF(ANS.EQ. 'N*) GO TO 650
31900          TYPE 63e
32000    63e   FORMAT(1X,'AT WHAT TEMPERATURE, DEG F?')
32100          ACCEPT 280,TE
32200          TE=TE+459.
32300          CALL VPIF(TE,NC1)
32400          OPEN(UNIT=40,file='MACKAY.DAT',STATUS='NEW')
32500          TYPE 640
32600    64e   FORMAT(/,1X,'PLEASE WAIT')
32700    C
32800    c       SUBROUTINE MACK CALCULATES THE PARAMETERS NEEDED FOR INPUT
32900    c       INTO THE EVAPORATION MODEL DEVELOPED BY DR. MACKAY
33000    c       THIS DATA IS PUT INTO A FILE CALLED MACKAY.DAT
33100    c
33200          CALL MACK
33300    650   CONTINUE
33400    C
33500    C       NZSWI=0 INDICATES THAT NO PREVIOUS WEATHERING HAS TAKEN
33600    C       PLACE SO A NEW INITIAL OIL THICKNESS IS NEEDED.
33700    C       NZSWI=1 INDICATES THAT PREVIOUS WEATHERING HAS TAKEN
33800    C       PLACE SO THE PREVIOUS THICKNESS CAN BE CARRIED OVER
33900    C
34000          NZSWI=0
34100    C
34200    c       NIP=0 INDICATES ICE POOL WEATHERING HAS NOT TAKEN PLACE
34300    c       NIP=1 INDICATES ICE POOL WEATHERING HAS TAKEN PLACE
344ee    C
34500    C       NBI=0 INDICATES THAT BROKEN ICE FIELD WEATHERING HAS NOT
34600    C       TAKEN PLACE
34700    C       NBI=1 INDICATES THAT BROKEN ICE FIELD WEATHERING HAS
34800    C       TAKEN PLACE
34900    C
35000          NIP=0
35100          NBI=0
35200    c
35300    c       NG COUNTS THE NUMBER OF CUTS THAT HAVE BEEN WEATHERED AWAY
35400    c
35500          NG=0
35600    c
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35700   c       NQUIT=0 MEANS SLICK HAS NOT DECREASED TO 10% OF ORIGINAL MOLES
35800   c       NQUIT=1 MEANS SLICK HAS DECREASED TO 10% of ORIGINAL MOLES
35900   C
36000           NQUIT=0
36100           TYPE 660
36200   660     FORMAT(1X,'DO YOU WANT TO WEATHER THIS OIL?')
36300           ACCEPT 390,ANS
36400           IF(ANS.EQ. 'N') GO TO 4550
36500           TYPE 670
36600   670     FORMAT(1X,'WHAT IS THE SPILL SIZE IN BARRELS?')
36700           ACCEPT 280,BBL
36860   c
36900   c       CALCULATE AND SAVE INITIAL MASSES FOR OVERALL MASS BALANCE
37000   C
37100           BM=.159*BBL
37200           MOLSAV=0.
37300           TMASAV=0.
37400           DO 680 I=1,NCUTS
37500           MASSAV(I)=1582.*SPGR(I)*BBL*VOL(I)
37600           MLSAV(I)=MASSAV(I)/MW(I)
37700           MOLSAV=MOLSAV+MLSAV (I)
37800           TMASAV=TMASAV+MASSAV(I)
37900   680     CONTINUE
38000   c
38100   C       DELMAS 1S THE MASS OF CUTS THAT ARE DELETED BECAUSE THEY
38200   C       EVAPORATE TOO QUICKLY
38300   c
38400           DELMAS=0.
38500   c
38600   c       TME IS THE TOTAL MASS EVAPORATED
38700   c       TMD IS THE TOTAL MASS DISPERSED
38800   c
38900           TME=0.
39000           TMD=0.
39100   c
39200   c       FE IS THE FRACTION (BASED ON MASS) EVAPORATED
39300   c
39400           FE=0.
39500   c
39600   C       MOUSWI=0 INDICATES THAT MOUSSE FORMATION HAS NOT BEEN STARTED
39700   C       MOUSWI=1 INDICATES THAT MOUSSE FORMATION HAS STARTED SUCH THAT
39800   c       NEW MOUSSE CONSTANTS MUST MATCH THE EXISTING CONDITIONS
39900   c
40000           MOUSWI=0
40100   c
40200   C       HOUMOU IS THE NUMBER OF HOURS THAT MOUSSE FORMATION HAS BEEN
40300   C       IN EFFECT
40400   c
40500           HOUMOU=0.
40600           TYPE 690
40700   690     FORMAT(1X,'WILL THE WEATHERING SCENARIO INCLUDE SEA ICE?')
40800           ACCEPT 390,ANS
40900           IF (ANS.EQ.'N') GO TO 3e6e
41000           TYPE 7ee
41100   700     FORMAT(IX,'WHEN THE OIL REACHES THE OIL SURFACE,')
412ee           TYPE 710
41300   710     FORMAT(1X,'WILL IT WEATHER IN POOLS ON TOP OF THE ICE?")
41400           ACCEPT 390,ANS
41500           IF(ANS.EQ. 'N') GO TO 1660
416ee           TYPE 72e
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41700   72e   FORMAT(1X,'AT WHAT TEMPERATURE. DEG F?')
41800         ACCEPT 280,XSAVE
41900         SPRFAC=1.
42000         NIP=1
42100         NCC1=NC1
42200         TK=(XSAVE-32.)/1.8+273.
42300         XPRINT=XSAVE
42400         XSAVE=XSAVE+459 .
42500   c
42600   C       SUBROUTINE VPIF CALCULATES THE VAPOR PRESSURE OF EACH CUT
42700   c       AT A SPECIFIED TEMPERATURE
42800   c
42900         CALL VPIF(XSAVE,NCC1)
43000         TYPE 730
43100   73e   FORMAT(1X,'FOR HOW MANY HOURS?*)
43200         ACCEPT 280,X2
43300   C
43400   C       NHIP IS THE NUMBER OF HOURS OF ICE POOL WEATHERING
43500   C
43600         NHIP=X2
43700         TYPE 740
43800   740   FORMAT(1X,'HOW DEEP WILL THE POOLS BE IN CM? TRY 2')
43900         ACCEPT 280,Z
44000         NZSWI=1
44100         Z=Z/100
44200   c
44300   c       SET C2=-1. SINCE MOUSSE CANNOT BE FORMED
44400   c
44500         C2=-1.
44600   C
44700   c       SET STEN TO 1. TO AVOID DIVIDE BY ZERO PROBLEMS LATER
44800   c
44900   750   STEN=1.0
45000   76e   TYPE 770
45100   77e   FORMAT(1X,'ENTER THE MASS-TRANSFER COEFFICIENT CODE: 1
45200        1, 2, OR 3 WHERE:')
45300         TYPE 78e
45400   780   FORMAT(1X,'1=USER SPECIFIED OVER-ALL MASS-TRANSFER COEF
45500        1FICIENT')
45600         TYPE 790
45700   79e   FORMAT(1X,'2=CORRELATION MASS-TRANSFER COEFFICIENT BY
45800        1 MACKAY & MATSUGU')
45900         TYPE 800
46000   800   FORMAT(1X,'3=INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS*)
46100         ACCEPT 42e, KMTC
46200   c
46300   c       NOW ENTER THE WIND SPEED IN KNOTS AND CONVERT TO METER/SEC
46400   C       AND METER/HOUR.
46500   C
46600         TYPE 81e
46700   810   FORMAT(1X,'ENTER THE WIND SPEED IN KNOTS')
46800         ACCEPT 280, WINDS
46900   c
47000   c       NEVER LET THE WIND SPEED DROP BELOW 2 KNOTS.  A ZERO WIND
47100   c       SPEED DESTROYS THE MASS-TRANSFER CALCULATION AND WILL
47200   C       YIELD A ZERO MASS-TRANSFER COEFFICIENT.
47300   C
47400         IF(WINDS.LT.2.) WINDS-2.
47500         WINDMS=0.514*WINDS
47600         WINDMH=1853.● WINDS
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C
C       NOW CALCULATE THE INITIAL GRAM MOLES FOR EACH COMPONENT 'O
c       GET THE INTEGRATION STARTED.
c
820     BM=0.159*BBL
        TMOLES=0.
        DO 830 I=1,NCUTS
        AMASS=1582.*SPGR(I)*BBL*VOL(1)
        MOLES(I)=AMASS/MW(I)
        MOLS(I)=MOLES(I)
        TMOLES=TMOLES+MOLES(I)
c
C       RHO IS THE DENSITY IN GM MOLES/CUBIC METER.
C
        RHO(I)=100.*MOLES(I)/(BM*VOL(I))
830     CONTINUE
C
c       CALCULATE THE MEAN MOLECULAR WEIGHT OF THE CRUDE
c
        WTMOLE=0.
        DO 840 I=1,NCUTS
        WTMOLE=WTMOLE+MW(I)*MOLES(I)/TMOLES
84e     CONTINUE
        WRITE(IOU,850)WTMOLE
850     FORMAT(/,1X,'MEAN MOLECULAR WEIGHT OF THE CRUDE =',1PE10.3)
c
c       SET SPREADING TO ZERO.
C
860     SPREAD=0.
c
C       CALCULATE AN AREA IN SAME WAY IT WILL BE CALCULATED
C       AS THE SLICK WEATHERS.  Z=THICKNESS IN METERS.
c
87e     VOLUM=0.
        DO 880 I=1,NCUTS
        VOLUM=VOLUM+MOLES(1)/RHO(I)
880     CONTINUE
c
C       CALCULATE THE INITIAL AREA AND DIAMETER.
C
        AREA=VOLUM/Z
        DIA=SQRT(AREA/0.785)
c
c       THE MASS-TRANSFER COEFFICIENT CAN BE CALCULATED ACCORDING TO:
c
C             1.  A USER-SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT.
C
c             2.  THE MASS-TRANSFER COEFFICIENT CORRELATION ACCORDING
c                 TO MACKAY AND MATSUGU, 1973, CAN. J. CHE, V51,
C                 P434-439.
C
C             3.  INDIVIDUAL OIL- AND AIR-PHASE MASS-TRANSFER COEFFI-
C                 CIENTS BASED ON SOME REAL ENVIRONMENTAL DATA SUCH
c                 AS THAT OF LISS AND SLATER.  SCALE THE AIR-PHASE
c                 VALUE WITH RESPECT TO WIND SPEED ACCORDING TO
c                 GARRATT, 1977, MONTHLY WEATHER REVIEW,V105,
C                 P915-920.
C
c       TEMP IS R*T AND USED TO CHANGE THE UNITS ON THE MASS-
C       TRANSFER COEFFICIENT.
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53700   C
53800   890   TEMP=(8.2E-05)*TK
53900         GO TO (900,950,1040), KMTC
54000   c
54100   c       USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT.
54200   C
54300   900   TYPE 910
54400   910   FORMAT(IX,'ENTER THE OVER-ALL MASS-TRANSFER COEFFICIENT
54500        1, CM/HR, TRY 10')
54600         ACCEPT 280,UMTC
54700         WRITE(IOU,920)
54800   92e   FORMAT( 1H1,'DATA FOR WEATHERING OF OIL IN POOLS ON ICE*)
54900         WRITE( IOU,930)UMTC
55000   930   FORMAT( /,'OVER-ALL MASS-TRANSFER COEFFICIENT WAS USER
55100        I-SPECIFIED AT ',1PE10.3,*CM/HR BY INPUT CODE 1')
55200   C
55300   c       CONVERT CM/HR TO GM-MOLES/(HR)(ATM)(M**2) SINCE VAPOR
55400   c       PRESSURE IS THE DRIVING FORCE FOR MASS TRANSFER.
55500   c
55600         UMTC=UMTC/TEMP/100.
55700         0 0 940 I=1,NC1
55800         MTC(I)=UMTC
55900   94e   CONTINUE
56000         GO TO I12e
56100   c
56200   c       USE THE MACKAY ANO MATSUGU MASS-TRANSFER COEFFICIENT.
56300   c
56400   950   TERM1=0.015*WINDMH**0.78
56500   c
56600   C       THE SLICK DOES NOT SPREAD, SO BASE THE DIAMETER DEPENDENCE
56700   C       ON 1000 METERS AND DIVIDE THE RESULT BY 0.7
56800   c
56900   960   TERM2=0.65
57000   C
57100   c       KH INCLUDES THE SCHMIDT NUMBER FOR CUMENE.
57200   c
57300   97e   KH=TERM1*TERM2
57400         WRITE(IOU,980)
57500   98e   FORMAT 1H1,'WEATHERING OF OIL IN POOLS ON TOP OF ICE')
57600         WRITE (IOU,990) KMTC
57700   990   FORMAT( /,1X,'OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT
57800        1 CODE',I2)
57900         WRITE(IOU,1000) KH
58000   1000 FORMAT /,1X,'OVER-ALL MASS-TRANSFER COEFFICIENT FOR CUMENE='
58100        1,1PE10.3,' M/HR',/)
58200         WRITE(IOU,1010)
58300   1010 FORMAT(3X,'CUT',12X,'M/HR',7X,'GM-MOLES/(HR)(ATM)(M**2)')
58400         Do 1030 I=1,NC1
58500   c
58600   c       THE MASS-TRANSFER COEFFICIENT IS CORRECTED FOR THE
58700   c       DIFFUSIVITY OF COMPONENT I IN AIR.  THE SQRT IS USED
58800   c       (I.E. LISS AND SLATER), BUT THE 1/3 POWER COULD ALSO
58900   c       BE USED (I.E. THE SCHMIDT NUMBER).
59000   c
59100         MTCA(I)=KH*0.93*SQRT((MW(I)+29. )/'MW(I))
59200   c
59300   c       MTC(I) IS THE OVER-ALL MASS-TRANSFER COEFFICIENT DIVIDED
59400   c       BY R*T.  R=82.06E-06 (ATM)(M**3)/(G-MOLE)(DEG K)
59500   c
59600         MTC(I)=MTCA(I)/TEMP
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59700          WRITE( IOU,1020)I,MTCA(I),MTC(I)
59800    1020 FORMAT(2X, 13,2( 10X,1PE10.3))
59900    1030 CONTINUE
60000          GO TO 1120
60100    c
60200    c        USER SPECIFIED INDIVIDUAL-PHASE MASS-TRANSFER
60300    c        COEFFICIENTS.
60400    c
60500    1040  TYPE 1050
60600    1050 FORMAT(1X,'ENTER THE OIL-PHASE MASS-TRANSFER COEFFICIENT
60700         1 IN CM/HR, TRY 10')
60800          ACCEPT 280, KOIL
60900          TYPE 1060
61000    1060 FORMAT(1X,'ENTER THE AIR-PHASE MASS-TRANSFER coefficient
61100         1IN cM/HR, TRY 1000')
61200          ACCEPT 280, KAIR
61300          TYPE 1070
6 14ee   1070 FORMAT(IX,'ENTER THE MOLECULAR WEIGHT OF THE COMPOUND
61 see         1 FOR K-AIR ABOVE, TRy 200')
61600          ACCEPT 280. DATAMW
61700    c
618@0    c        SCALE K-AIR ACCORDING TO WIND SPEED (GARRATT, 1977),
61900    c        SO THAT AS THE WIND SPEED GOES UP THE MASS TRANSFER
62000    c        GOES UP, I.E., THE CONDUCTANCE INCREASES.
62100    c
62200          KAIR=KAIR*(1.+0.089*WINDMS)
62300          RKAIR=1./KAIR
624ee    c
62500    c        CALCULATE R*T IN ATM*CM**3/GM-MOLE
62600    c
62700          RT=82.06*TK
62800          HTERM=WTMOLE/(DCRUDE*RT)
62900          WRITE (IOU,990) KMTC
63000    c
63100    c        WRITE THE USERS INPUT, WIND SPEED, AND HENRYS LAW
63200    C        TERM TO THE OUTPUT.
63300    C
63400          WRITE( IOU,1080)KAIR,KOIL,DATAMW
63500    1080  FORMAT /,1X,'K-AIR =',1PE10.3,',AND K-OIL =',1PE10.3
63600         1,* CM/HR, BASED ON A MOLECULAR WEIGHT OF ',1PE10.3)
63700          WRITE( IOU,1090) WINDMS
63800    1 e9e  FORMAT 1X,'WIND SPEED = ',1PE1O.3,' M/S')
63900          WRITE( IOU,1100)HTERM
64000    1100  FORMAT( 1X,'THE HENRYS LAW CONVERSION TERM FOR OIL = '
64100         1,1PE10.3,' I/ATM')
64200          WRITE (IOU,1010)
64300    c
64400    C        CALCULATE THE OVER-ALL MASS-TRANSFER COEFFICIENT BASED
64500    C        ON GAS-PHASE CONCENTRATIONS FOR EACH CUT.
64600    C
64700          Do 1110 I=1,NC1
64800          HLAW(I)=HTERM*VP(I)
64900          MTCA(I)=RKAIR+HLAW(I)/KOIL
65000    c
65100    C        NOW TAKE THE INVERSE TO OBTAIN CM/HR AND THEN MULTIPLY
65200    C        By 0.01 To GET M/HR.
65300    c
65400          MTCA(I)=0.01/MTCA(I)
65500    C
65500    C        CORRECT FOR MOLECULAR WEIGHT ACCORDING TO LISS & SLATER,
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C        1974, NATURE, V247,P181-184.
C
      MTCA(I)=MTCA(I)*SQRT(DATAMW/MW( I))
      MTC(I)=MTCA(I)/TEMP
c
c        AND WRITE THE OVER-ALL MASS-TRANSFER COEFFICIENT
C        IN M/HR AND MOLE/HR*ATM*M*M.
C
      WRITE (IOU,1020) I,MTCA(I),MTC(I)
1110  cONTINUE
1120  SPGRB=141.5/(APIB+131.5)
      MASS=0.1582*BBL*SPGRB
      WRITE( IOU,1130)BBL,MASS
1130  FORMAT( /,1X,'FOR THIS SPILL OF ',1PE10.3,' BARRELS, THE
     1 MASS IS ',1PE10.3,' METRIC TONNES')
      VOLUMB=VOLUM/0 .159
      WRITE( IOU,1140)VOLUM,VOLUMB
1140 FORMAT(/,1X,'VOLUME FROM SUMMING THE CUTS =',1PE8.1,' M**3
     1, OR ',1PE10.3," BARRELS')
      GO TO (1170,1150,1170), KMTC
1150  WRITE( IOU,1160)WINDS,WINDMH
1160 FORMAT(/,1X,'WIND SPEED = ',1PE1O.3,' KNOTS, OR ',1PE10.3
     1,' M/HR')
1170  WRITE (IOU,1180) DIA,AREA
1180 FORMAT /,1X,'INITIAL SLICK DIAMETER = ',1PE10.3,' M, OR AREA
     1 = ',1PE10.3,' M**2')
      WRITE(IOU,1190)
1190 FORMAT /,1X,'THIS SLICK DOES NOT SPREAD FOR THIS calculation*)
c
c        CALCULATE THE KINEMATIC VISCOSITY OF THE CRUDE AT 122
c        DEG F AND THE ENTERED ENVIRONMENTAL TEMPERATURE.
c        USE THE VISCOSITY MIXING RULE OF (MOLE FRACTION)*(LOG).
c        SEE PAGE 46e OF REID, PRAUSNITZ & SHERWOOD IN '
c        THE BOOK 'THE PROPERTIES OF GASES AND LIQUIDS"
c
1200  VISMIX=0.
      DO 1210 I=1,NCUTS
      VISMIX=VISMIX+MOLES(I)*VLOGK(I)/TMOLES
1210 CONTINUE
      VISMIX=EXP(VISMIX)
      WRITE( IOU,1220)VISMIX
1220 FORMAT(/,1X,'KINEMATIC VISCOSITY OF THE BULK CRUDE FROM
     1 THE CUTS = ',1PE8.1,' CENTISTOKES AT 122 DEG F')
      VISMIX=0.
C
C        SCALE THE VISCOSITY WITH TEMPERATURE ACCORDING TO
c        ANDRADE.
c
      XSAVE=XSAVE+459.
      EXPT=EXP(1923.*(1./XSAVE-0.001721 ))
      DO 1230 I=1,NCUTS
      VIS(I)=VISK(I)*EXPT
      VLOG(I)=ALOG(VIS(I))
      VISMIX=VISMIX+MOLES(I)*VLOG(I)/TMOLES
123e CONTINUE
      XPRINT=32.
      VISMIX=EXP(VISMIX)
      WRITE IOU,1240) VISMIX, XPRINT,EXPT
1240 FORMAT(/,1X,'KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE
     1 CUTS =',1PE8. 1,' AT T = ',0PF5.1,' OEG F, SCALE
```

```
6100          2 FACTOR = ',1PE8.1)
62ee    c
6300    c        IMPORTANT NOTE:  THE VISCOSITY PREDICTION OF THE WHOLE
6400    C        CRUDE FROM CUT INFORMATION IS NOT GOOD AT ALL.  SO THE
6500    C        VISCOSITY INFORMATION CALCULATED ABOVE IS NOT USED IN
6600    C        THIS VERSION OF THE CODE. BUT IT COULD BE IF A GOOD
6700    c        MIXING RULE IS EVER DETERMINED.
6800    C        THEREFORE. FOR THE TIME BEING. THE VISCOSITY OF THE WHOLE
69ee    C        WEATHERED"CRUDE IS CALCULATED-ACCORDING TO MACKAY.
7000    c
7100    c        NOW LOAD THE VISCOSITY INFORMATION IN THE FORM
72ee    c        OF THREE CONSTANTS:
7300    c             1.  THE VISCOSITY IN CP AT 25 DEG C
7400    C             2.  THE ANDRADE-VISCOSITY-SCALING CONSTANT
75ee    C                 WITH RESPECT TO TEMPERATURE, SEE GOLD &
7600    c                 OGLE, 1969, CHEM.ENG., JULY 14, P121-123
7700    C             3.  THE VISCOSITY AS AN EXPONENTIAL FUNCTION OF
7800    c                 THE FRACTION OF OIL WEATHERED
79ee    C
8000          IF(LSWTCH.EQ.99) GO TO 1260
8100          TYPE 1250
82ee    1250  FORMAT(1X,'SINCE A LIBRARY CRUDE WAS NOT USED
8300         1,*,/,1X,'ENTER THE FOLLOWING THREE VISCOSITY CONSTANTS')
84ee          GO TO 1280
85ee    126e  TYPE 1270
86ee    1270  FORMAT(1X,'DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?')
87ee          ACCEPT 390, ANS
8800          IF(ANS.EQ. 'N') GO TO 1320
89ee    128e  TYPE 129e
9000    1290  FORMAT(1X,'1. ENTER THE BULK CRUDE VISCOSITY
9100         1 AT 25 DEG C, CENTIPOISE, TRY 35.')
9200          ACCEPT 28e, VISZ
9300          TYPE 1300
94ee    1300  FORMAT(1X,'2. ENTER THE VISCOSITY TEMPERATURE SCALING
9500         1 CONSTANT (ANDRADE), TRY 9000.')
96ee          ACCEPT 28e. MK3
9700          TYPE 1310
98ee    1310  FORMAT(1X,'3. ENTER THE VISCOSITY-FRACTION-OIL
99ee         I-WEATHERED CONSTANT, TRY 10.5')
10000         ACCEPT 28e, MK4
10100         GO TO 133e
1 e2ee  C
1e3ee   C        USE THE LIBRARY VISCOSITY DATA
10400   c
1e5ee   1320  VISZ=VISZL(IC)
1 e6ee        MK3=MK3L(IC)
1 e7ee        MK4=MK4L(IC)
1 e8ee  c
10900   c        INSERT VISCOSITY CALCULATION ACCORDING TO MASS
1ee e   c        FRACTION EVAPORATED.  THIS IS THE VISCOSITY
11100   c        MODIFICATION RELATIVE TO CUTVP1
11200   c
11300   1330  VSLEAD=VISZ*EXP(MK3*(1./TK-0.003357))
11400         WRITE IOU,1340) VISZ,MK3,MK4,VSLEA0
11500   1 34e FORMAT(/,1X,'VISCOSITY ACCORDING TO MASS EVAPORATED:
11600        1 VIS25C=',1PE9.2,', ANDRADE =',1PE9.2
11700        2,*, FRACT WEATHERED =',1PE9.2', VSLEAD =',1PE9.2
11 8ee       3,' CP')
11 9ee        C2P=1./C2
12eee         WRITE (IOU,1500)C1,C2P,C4
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12100          NEQ=NCUTS
12200          FRACTS=0.
12300    c
12400    c        SPECIFY NO DISPERSION
12500    C
12600    1350  WRITE( IOU,1360)FRACTS
12700    1360 FORMAT( /,IX, 'THE FRACTIONAL SLICK AREA SUBJECT TO
12800         1 DISPERSION IS ',1PE8.1,' PER HOUR')
12900    c
13000    c        PRINT EVERY XP TIME INCREMENT (HOURS).
13100    c        X1 IS THE STARTING TIME = e.
132ee    c        X2 IS THE NUMBER OF HOURS FOR WEATHERING TO OCCUR.
133ee    C
134ee    1370  XP=1.
135ee          X1=0.
13600          MOLS(NCUTS+1)=AREA
137ee    c
1380e    C        PRINT AN OUTPUT FILE FOR 80 COLUMN OUTPUT, THIS IS
139ee    C        THE OILICE.TYP FILE.
14eee    c
14100          WRITE(ITY,1380)
14200    1380 FORMAT( 1X,'WEATHERING OF OIL IN POOLS ON Top OF ICE')
143ee          WRITE( ITY,1390)(ANAME(J),J=1,5)
14400    1390 FORMAT( /,1X,'OIL:',5A5)
1450e          WRITE( ITY,1400) XPRINT,WINDS
146ee    1400 FORMAT( IX,'TEMPERATURE= ',F5.1,' DEG F, WIND SPEED= '
147ee         1,F5.1,' KNOTS')
1 4800         WRITE (ITY,1410)  BBL
14900    1410 FORMAT 1X,'SPILL SIZE= ',1PE10.3,'BARRELS')
15e0e          WRITE (ITY,1420) KMTC
15100    1420 FORMAT(IX,'MASS-TRANSFER COEFFICIENT CODE=',13)
1520e          WRITE(ITY,1430)
153ee    1430 FORMAT(/,1X, 'FOR THE OUTPUT THAT FOLLOWS, MOLES
1540e         1=GRAM MOLES')
15500          WRITE(ITY,1440)
15600    1440 FORMAT(1X,'GMS=GRAMS, VP=VAPOR PRESSURE IN Atmospheres')
157ee          WRITE(ITY,1450)
15aee    1450 FORMAT( 1X,'BP=BOILING POINT IN DEG F, API-GRAVITY')
1 5900         WRITE(ITY,1460)
16000    1460 FORMAT (IX,'MW=MOLECULAR WEIGHT')
16100          WRITE(ITY,1470)
162ee    1470 FORMAT(/,2X,'CUT',3X,'MOLES',6X,'GMS',8X,'VP',8X,'BP'
163ee         1,7X,'API ',5X, 'MW')
164ee          Do 1490 I=1,NCUTS
1 6500         GMS=MOLES(I)*MW(I)
16600          IMW=MW(I)
167ee          WRITE( ITY,1480)I,MOLES(I),GMS,VP(I),TB(I),API(I),IMW
168e0    1480 FORMAT(3X,I2,5(1X,1PE9.2),1X,I3)
169ee    1490     CONTINUE
17eee          WRITE( ITY,1500) C1,C2P,C4
17100    1500 FoRMAT /,1X,'MOUSSE CONSTANTS: MOONEY=',1PE9.2
1 72ee         1,', MAX H20=',0PF5.2,',WIND**2=',1PE9.2)
173ee          WRITE (ITY,151O) KA,KB,STEN
17400    1510 FORMAT (IX,'DISPERSION CONSTANTS: KA=',1PE9.2
175e0         1,'. KB=',1PE9.2.'. S-TENSION=',1PE9.2)
17600          W    RI( TE  ITY,1520) VISZ,MK3,MK4
177ee    1520 FoRMAT( 1X,'VIS CONSTANTS: VIS25C=',1PE9.2
1 7800         1,', ANDRADE =',1PE9.2,',FRACT=',1PE9.2)
1 7900         WRITE(ITY,1530)
18000    1530 FORMAT /,1X,'FOR THE OUTPUT THAT FOLLOWS, TIME-HOURS')
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18100          WRITE(ITY,1540)
18200    1540  FORMAT 1X,'BBL=BARRELS,SPGR=SPECIFIC GRAVITY, AREA=M*M')
18300          WRITE(ITY,1550)
18400    1550  FORMAT 1X,'THICKNESS=CM, W-PERCENT WATER IN OIL (
18500         1MOUSSE)')
18600          WRITE (ITY,1560)
1870e    156e  FORMAT(1X,'DISP=DISPERSION RATE IN GMS/M*M/HR')
18800          WRITE (ITY,1570)
18900    1570  FORMAT(1X,'ERATE=EVAPORTION RATE IN GMS/M*M/HR')
19000          WRITE (ITY,1580)
19100    158e  FORMAT(1X,'M/A=MASS PER M*M OF OIL IN THE SLICK')
192e0          WRITE (ITY,1590)
19300    1590  FORMAT(1X,'I=FIRST CUT WITH GREATER THAN 1% (MASS)
19400         1 REMAINING')
19500          WRITE(ITY,1600)
196e0    1600  FORMAT 1X,'J=FIRST CUT WITH GREATER THAN 50% (MASS)
19700         1 REMAINING')
198e@          WRITE(ITY,1610)
19900    1610  FORMAT 1X,'DISPERSION WAS TURNED OFF')
20000          WRITE(ITY,1620)
20100    1620  FORMAT 1X,'SPREADING WAS TURNED OFF')
20200    163e  TCODE=KMTC
20300          TYPE 1640
20400    1640  FORMAT(/,1X,'PLEASE WAIT')
20500   c
20600   c        SUBROUTINE BRKG4 DOES THE INTEGRATION
20700   c
20800          CALL BRKG4(MOLS,X1,X2,XP,NEQ,NDEL)
20900   c
21000   c        ND IS THE NUMBER OF CUTS THAT WEATHERED COMPLETELY AWAY
21100   c
21200          ND=0
21300          DO 1650 I=1,NEQ
21400          IF (YM(I).NE.0.) GO TO 1650
21500          ND=ND+1
21600    1650  CONTINUE
21700   C
21 see  C        NDEL IS THE NUMBER OF CUTS THAT WERE DELETED BECAUSE THEY
21900   c        EVAPORATE TO QUICKLY
22000   c
22100          NEW=NDEL+ND
22200          IF(NQUIT.EQ.1) GO TO 4460
22300    1660  TYPE     1670 '
22400    167e  FORMAT(1X,'WILL THE OIL NOW WEATHER IN THE BROKEN ICE FIELD?')
22500          ACCEPT 390,ANS
22600          IF(NIP.EQ.0) GO TO 1710
22700          TV=0.
22800   C
22900   C        NOW CALCULATE NEW VALUES FOR VOLUME PERCENT FOR EACH
23000   c        CUT AND SHIFT THE ARRAYS FOR VOLUME PERCENT, BOILING POINT,
23100   c        AND API TO ELIMINATE CUTS THAT ARE GONE
23200   c
23300          DO 1680 I=1,NEQ-ND
23400          TV=TV+(YM(ND+I)* YMsAvE(ND+I)/SPGR(NEW+I))
23500          VOL(I)=YM(ND+I)* MOLES(NEW+I)* MW(NEW+I)/(SPGR(NEW+I)
23600         1*(BBL*1582.))
23700          TB(I)=TB(NEW+I)
23800          API(I)=API(NEW+I)
23900    1680  CONTINUE
24000          BBL=TV/158200.
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24100          NCUTS=NCUTS-(ND+NDEL)
24200          NEQ=NCUTS
24300    c
24400    C       ALWAYS RENORMALIZE THE INPUT VOLUMES TO lee%.
24500    C
24600          VTOTAL=0.
24700          DO 169e I=1,NCUTS
24800          VTOTAL=VTOTAL+VOL( I)
24900    1690  CONTINUE
25000          Do 1700 I=1,NCUTS
25100          VOL(I)=100.*VOL(I)/VTOTAL
25200    1700  CONTINUE
25300          IS=0
25400          APISWI=1
25500          CALL DOCHAR
25600    1710  IF(ANS.EQ. 'N') GO TO 3e6e
25700          NG=NG+NEW
25800          NBI=1
25900          TYPE 172e
26000    1720  FORMAT(1X,'FOR HOW MANY HOURS?')
26100          ACCEPT 280,X2
26200    c
26300    c       NHBI IS THE NUMBER OF HOURS OF BROKEN ICE FIELD WEATHERING
26400    c
26500          NHBI=X2
26600          TYPE 1730
26700    1730  FORMAT(1X,'AT WHAT TEMPERATURE, DEG F?')
26800          ACCEPT 280,XSAVE
26900          TYPE 1740
27000    1740  FORMAT(1X,'ENTER THE FRACTION OF ICE COVER, I.E.0.7')
27100          ACCEPT 280,FRACIC
27200          TK=(xsAvE-32. )/1.8+273.
27300          XPRINT=XSAVE
27400          XSAVE=XSAVE+459 .
27500          NCC1=NC1
27600          CALL VPIF(XSAVE,NCC1)
27700          TEMP=(8.2E-05)*TK
27800          FACMOU=1.
27900    c
28000    c       THE FUNCTIONAL DEPENDENCE OF MOUSSE FORMATION RATE WITH
28100    c       FRACTION OF ICE COVER IS NOT KNOWN. FOR NOW THE VARIABLE
28200    c       FACMOU WILL BE THE FACTOR WHICH WILL DETERMINE THE
28300    c       AMOUNT OF INCREASE OF FORMATION RATE. IF MOUSSE
28400    c       CONSTANTS ARE NOT INPUT BY THE USER, FACMOU=10
28500    c
28600          IF(LSWTCH.EQ.99) GO TO 177e
28700          TYPE 1750
28800    1750  FORMAT(1X,'SINCE YOU DID NOT USE A LIBRARY CRUDE,')
28900          TYPE 1760
29000    1760  FORMAT(1X,'YOU MUST ENTER THE FOLLOWING FOUR MOUSSE
29100         1 FORMATION CONSTANTS")
29200          GO TO 1790
29300    1770  TYPE 1780
29400    178e  FORMAT(1X,'DO YOU WANT TO ENTER NEW MOUSSE FORMATION CONS
29500         1TANTS?')
29600          ACCEPT 390, ANS
29700          IF(ANS.EQ. 'N') GO TO 186e
29800    C
29900    C       To SPECIFY NO MOUSSE, ENTER c2 = e
30000    C
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30100   1790 TYPE 1800
30200   1800  FORMAT(1X,'1. ENTER THE MAXIMUM WEIGHT FRACTION WATER
30300        1 IN OIL')
30400         ACCEPT 28e, C2
30500         IF(C2.GT.0.) GO TO 182e
30600   c
30700   c        SET C2=-1. IF A MOUSSE CANNOT BE FORMED AND LOOP OUT.
30800   c
30900         C2=-1.
31000         TYPE 181e
31100   1810 FORMAT(/,1X,'SINCE A 0% WATER CONTENT WAS SPECIFIED
31200        1, THE REMAINING THREE MOUSSE',/,IX,'CONSTANTS ARE NOT
31300        2 NEEDED')
31400         GO TO 1870
31500   162e C2=1./C2
31600         TYPE 183e
317ee   1830FORMAT(1X,'2. ENTER THE MOUSSE-VISCOSITY CONSTANT
31800        1, TRY 0.65')
31900         ACCEPT 28e. CI
32000         TYPE 1840
32100   1840FORMAT(1X,'3. ENTER THE WATER INCORPORATION RATE CONSTANT
32200        1, TRY 0.001')
32300         ACCEPT 280, C4
32400         TYPE 1850
32500   1850  FORMAT(1X, '4. ENTER THE BROKEN ICE FIELD MULTIPLIER FOR MOUSSE
32600        1 FORMATION')
32700         ACCEPT 280,FACMOU
32800         GO TO 187e
32900   1860  C1=C1L(IC)
33000         C2=C2L(IC)
33100         C4=C4L(IC)
33200         FACMOU=10.
33300   187e CONTINUE
33400         C4=C4*FACMOU
33500         IF(LSWTCH.EQ.99) GO To 1900
33600         TYPE 188e
33700   1880FORMAT(/,1X,'YOU MUST ALSO ENTER AN OIL-WATER SURFACE
33800        1 TENSION (DYNES/CM')
33900         TYPE 189e
34000   1890 FORMAT(1X,'FOR DISPERSION, TRY 30.')
34100         GO TO 1930
34200   1900 TYPE 1910
34300   1910FORMAT(1X,'DO You WANT To ENTER A NEW OIL-WATER SURFACE
34400        1 TENSION (DYNES/CM)?')
34500         ACCEPT 390, ANS
34600         IF(ANS.EQ.'N') GO TO 1940
34700         TYPE 192e
34800   192e FORMAT(1X,'TRY 30.')
34900   193e ACCEPT 28e, STEN
35000         GO TO 1950
35100   194e STEN=STENL(IC)
35200   C
35300   C        START THE MASS-TRANSFER COEFFICIENT SPECIFICATION.
35400   C
35500   1950 TYPE 1960
35600   1960FORMAT(1X,'ENTER THE MASS-TRANSFER COEFFICIENT CODE:1
35700        1, 2, OR 3 WHERE:')
35800         TYPE 197e
35900   197e FORMAT(1X,*I=USER SPECIFIED OVER-ALL MASS-TRANSFER COEF
36000        1FICIENT')
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36100          TYPE 1980
36200    1980  FORMAT(1X,'2=CORRELATION MASS-TRANSFER COEFFICIENT BY
36300         1 MACKAY & MATSUGU')
36400          TYPE 1990
36500    1990  FORMAT(IX, '3=INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS')
36600          ACCEPT 42e, KMTC
36700    c
36800    c       NOW ENTER THE WIND SPEED IN KNOTS AND CONVERT TO METER/SEC
36900    c       ANO METER/HOUR.
37000    c
37100          TYPE 2000
37200    2000  FORMAT(1X, *ENTER THE WIND SPEED IN KNOTS')
37300          ACCEPT 28e, WINDS
37400    c
37500    c       NEVER LET THE WIND SPEED DROP BELOW 2 KNOTS.  A ZERO WIND
37600    c       SPEED DESTROYS THE MASS-TRANSFER CALCULATION AND WILL
37700    c       YIELD A ZERO MASS-TRANSFER COEFFICIENT.
37800    c
37900          IF(WINDS.LT.2.) WINDS-2.
38000          WINDMS=0.514*WINDS
38100          WINDMH=1853. *WINDS
38200    c
38300    C       NOW CALCULATE THE INITIAL GRAM MOLES FOR EACH COMPONENT TO
38400    C       GET THE INTEGRATION STARTED.
38500    c
38600    2010  BM=0.159*BBL
38700          TMOLES=0.
38800          DO 2e2e I=1,NCUTS
38900          AMASS="1582. *SPGR( I)*BBL*VOL(I)
39000          MOLES(I)=AMASS/MW( 1)
39100          MOLS(I)=MOLES( 1)
39200          TMOLES=TMOLES+MOLES(  I)
39300    c
39400    C       RHO IS THE DENSITY IN GM MOLES/CUBIC METER.
39500    C
39600          RHO(I)=100.*MOLES(I)/(BM*VOL( I))
39700    2e2e  CONTINUE
39800    c
39900    c       CALCULATE THE MEAN MOLECULAR WEIGHT OF THE CRUDE
40000    c
40100          WTMOLE=0.
40200          DO 2e3e I=1,NCUTS
40300          WTMOLE=WTMOLE+MW(I)*MOLES(I)/TMOLES
40400    2030  CONTINUE
40500          WRITE( IOU,2040) WTMOLE
40600    2040  FORMAT /,1X,'MEAN MOLECULAR WEIGHT OF THE CRUDE =',1PE10.3)
40700    c
40800    c       SPECIFY SLICK SPREADING.
40900    c
41000    2e5e  SPREAD=0.
41100          TYPE 2e6e
41200    2060  FORMAT(1X,'DO YOU WANT THE SLICK TO SPREAD?')
413ee          ACCEPT 39e, ANs
414ee          IF(ANS.EQ. 'N') GO TO 2e7e
41500          SPREAD-I.
41600          GO TO 2100
417ee    c
418ee    c       CALCULATE AN AREA IN SAME WAY IT WILL BE CALCULATED
419ee    c       AS THE SLICK WEATHERS.  Z=THICKNESS IN METERS.
42000    c
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42100   2070  IF(NZSWI.EQ.1) GO TO 2e9e
42200         TYPE 2e8e
42300   2080  FORMAT(1X,'SINCE THE SLICK DOES NOT SPREAD, ENTER
42400        1 A STARTING THICKNESS IN CM")
42500         ACCEPT 280,Z
42600   2090  Z=Z/100.
42700         GO TO 2110
42800   C
42900   C       THE SLICK ALWAYS STARTS AT 2-CM THICKNESS.
43000   C
43100   2100  IF (NZSWI.NE.0) GO TO 2110
43200         Z=0 .02
43300   2110  VOLUM=0.
43400         DO 2120 I=1,NCUTS
43500         VOLUM=VOLUM+MOLES( I)/RHO(1)
43600   2120  CONTINUE
43700         NZSWI=1
43800   C
43900   C       CALCULATE THE INITIAL AREA AND DIAMETER.
44000   C
44100         AREA=VOLUM/Z
44200         DIA=SQRT(AREA/0 .785)
44300   C
44400   C       THE FUNCTIONAL DEPENDENCE OF SPREADING WITH FRACTION OF ICE
44500   C       COVER IS NOT KNOWN.  FOR NOW, A LINEAR DEPENDENCE IS ASSUMMED
44600   C
447ee         SPRFAC=1.-FRACIC
44800   C
44900   C       THE MASS-TRANSFER COEFFICIENT CAN BE CALCULATED ACCORDING TO:
45000   C
45100   C            1.  A USER-SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT.
45200   C
45300   C            2.  THE MASS-TRANSFER COEFFICIENT CORRELATION ACCORDING
45400   C                TO MACKAY AND MATSUGU, 1973, CAN. J. CHE, V51,
45500   C                P434-439.
45600   C
45700   C            3.  INDIVIDUAL OIL- ANO AIR-PHASE MASS-TRANSFER COEFFI-
45800   C                CIENTS BASED ON SOME REAL ENVIRONMENTAL DATA SUCH
45900   C                AS THAT OF LISS AND SLATER.  SCALE THE AIR-PHASE
46000   C                VALUE WITH RESPECT TO WIND SPEED ACCORDING TO
46100   C                GARRATT, 1977, MONTHLY WEATHER REvIEW, V105,
46200   C                P915-920.
46300   C
46400   C      TEMP IS R*T AND USEO TO CHANGE THE UNITS ON THE MASS-
46500   C      TRANSFER COEFFICIENT.
46600   C
46700   2130  TEMP=(8.2E-05)*TK
46800         Go To (2140,2180,2290), KMTC
46900   C
47000   C       USER SPECIFIED OVÉR-ALL MASS-TRANSFER COEFFICIENT.
47100   C
47200   2140  TYPE 2150
47300   2150  FORMAT(1X,'ENTER THE OVER-ALL MASS-TRANSFER COEFFICIENT
47400        I, CM/HR, TRY 10')
47500         ACCEPT 280, UMTC
47600         WRITE (IOU,2160) UMTC
47700   216e  FORMAT(1H1,'OVER-ALL MASS-TRANSFER COEFFICIENT WAS USER
47800        I-SPECIFIED AT ',1PE10.3,'CM/HR BY INPUT CODE 1')
47900   c
48000   c       CONVERT CM/HR TO GM-MOLES/(HR)(ATM)(M**2) SINCE VAPOR
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48100   C        PRESSURE IS THE DRIVING FORCE FOR MASS TRANSFER.
48200   c
48300          UMTC*UMTC/TEMP/ 100.
48400          DO 2170I=1,NC1
48500          MTC(I)=UMTC
48600   2170   CONTINUE
48700          GO TO 2370
48800   C
48900   C        uSE THE MACKAY ANO MATSUGU MASS-TRANSFER COEFFICIENT,
49000   C
49100   2180   TERM1=0.015*WINDMH**0.78
49200          IF(SPREAD.EQ.0.) GO TO 2190
49300          TERM2=DIA**(-0. 11)
49400          GO TO 22ee
49500   C
49600   c        IF THE SLICK DOES NOT SPREAD BASE THE DIAMETER DEPENDENCE
49700   c        ON 1000 METERS AND DIVIDE THE RESULT BY 0.7
49800   c
49900   2190   TERM2=0.65
50000   c
50100   c        KH INCLUDES THE SCHMIDT NUMBER FOR CUMENE.
50200   c
50300   22ee   KH=TERM1*TERM2
50400          WRITE(IOU,2210)
50500   2210   FORMAT(1H1 'WEATHERING DATA FOR OIL IN A BROKEN ICE FIELD')
50600          IF(NIP.NE.1) GO TO 2230
50700          WRITE(IOU,2220)NHIP
50800   222e   FORMAT( 1X,'AFTER ICE POOL WEATHERING FOR ',1PE9.3,' HOURS')
50900   223e   WRITE (IOU,2240) KMTC
51000   224e   FORMAT( /,1X,'OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT
51100         1 CODE' ,12)
512ee          WRITE (IOU,2250) KH
51300   2250   FORMAT /,1X,'OVER-ALL MASS-TRANSFER coefficient FOR CUMENE = '
51400         1,1PE10.3,' M/HR',/)
51500          WRITE(IOU,2260)
5160e   226e   FORMAT(3X,'CUT',12X,'M/HR',7X,'GM-MOLES/(HR)(ATM)(M**2)')
51700          DO 2280I=1,NC1
51800   c
51900   C        THE MASS-TRANSFER COEFFICIENT IS CORRECTED FOR THE
52000   C        DIFFUSIVITY OF COMPONENT I IN AIR.  THE SQRT IS USED
52100   c        (I.E. LISS AND SLATER),BUT THE 1/3 POWER COULD ALSO
52200   c        BE USED (I.E. THE SCHMIDT NUMBER).
52300   c
52400          MTCA(I)=KH*0.93*SQRT((MW(I)+29.)/MW(I))
52500   c
52600   c        MTC(I) IS THE OVER-ALL MASS-TRANSFER COEFFICIENT DIVIDED
52700   c        BY R*T.  R=82.06E-06(ATM)(M**3)/(G-MOLE)(DEG K)
52800   c
52900          MTC(I)=MTCA(I)/TEMP
53000          WRITE( IOU,2270)I,MTCA(I),MTC(I)
53100   227e   FORMAT( 2X, 13,2(163X, 1PE10.3))
53200   228e   CONTINUE
53300          GO TO 2370
53400   c
53500   c        USER SPECIFIED INDIVIDUAL-PHASE MASS-TRANSFER
53600   c        COEFFICIENTS.
53700   c
53800   229e   TYPE 23ee
53900   23ee   FORMAT(IX,'ENTER THE OIL-PHASE MASS-TRANSFER COEFFICIENT
54000         1 IN CM/HR, TRY 10')
```

```
54100          ACCEPT 280, KOIL
54200          TYPE 2310
54300   2310 FORMAT(1X,'ENTER THE AIR-PHASE MASS-TRANSFER COEFFICIENT
54400       1 IN CM/HR, TRY 1000')
54500          ACCEPT 280, KAIR '
54600          TYPE 2320
54700   232e FORMAT(1X,'ENTER THE MOLECULAR WEIGHT OF THE COMPOUND
54800       1 FOR K-AIR ABOVE, TRY 200')
54900          ACCEPT 280, DATAMW
55000   c
55100   c        SCALE K-AIR ACCORDING TO WIND SPEED (GARRATT, 1977),
55200   C        SO THAT AS THE WIND SPEED GOES UP THE MASS TRANSFER
55300   C        GOES UP, I.E., THE CONDUCTANCE INCREASES.
55400   c
55500          KAIR=KAIR*(1.+0.089*WINDMS)
55600          RKAIR=1./KAIR
55700   c
55800   C        CALCULATE R*T IN ATM*CM**3/GM-MOLE
55900   C
56900          RT=82.06*TK
56100          HTERM=WTMOLE/(DCRUDE*RT)
56200          wRITE (IOU,2240) KMTc
56300   C
56400   C        WRITE THE USERS INPUT, WIND SPEED, AND HENRYS LAW
56500   c        TERM TO THE OUTPUT.
56600   c
56700          WRITE( IOU,2330)KAIR,KOIL,DATAMW
56800   233e FORMAT(/,1X,'K-AIR = ● ',1PE1O.3,', AND K-OIL =',1PE10.3
56900       1,' CM/HR, BASED ON A MOLECULAR WEIGHT OF ',1PE10.3)
57000          WRITE (IOU,2340) WINDMS
57100   234e FORMAT( 1X,'WIND SPEED = ',1PE10.3,' M/S ')
57200          WRITE( IOU,2350) HTERM
57300   2350 FORMAT 1X,'THE HENRYS LAW CONVERSION TERM FOR OIL = '
57400       1,1PE10.3,' I/ATM')
57500          WRITE (IOU,2260)
57600   c
57700   c        CALCULATE THE OVER-ALL MASS-TRANSFER COEFFICIENT BASED
57800   c        ON GAS-PHASE CONCENTRATIONS FOR EACH CUT.
57900   c
58000          DO 236e I=1,NC1
58100          HLAW(I)=HTERM*VP(I)
58200          MTCA(I)=RKAIR+HLAW(I)/KOIL
58300   C
58400   c        NOW TAKE THE INVERSE TO OBTAIN CM/HR AND THEN MULTIPLY
58500   c        BY 0.01 TO GET M/HR.
58600   c
58700          MTCA(I)=0.01/MTCA(I)
58800   c
58900   c        CORRECT FOR MOLECULAR WEIGHT ACCORDING TO LISS & SLATER,
59000   c        1974, NATURE, V247,P181-184.
59100   c
59200          MTCA(I)=MTCA(I)*SQRT(DATAMW/MW( 1))
59300          MTC(I)=MTCA(I)/TEMP
59400   C
59500   C        AND WRITE THE OVER-ALL MASS-TRANSFER COEFFICIENT
59600   c        IN M/HR AND MOLE/HR*ATM*M*M.
59700   c
59800          WRITE (IOU,2270)I,MTCA(I),MTC(I)
59900   2360 CONTINUE
60000   237e SPGRB=141.5/(APIB+131.5)
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60100          MASS=0.1582*BBL*SPGRB
60200          WRITE( IOU,2380)BBL,MASS
60300    2380  FORMAT /,1X,'FOR THIS SPILL OF',1PE10.3,* BARRELS, THE
60400         1 MASS IS ',1PE10.3,' METRIC TONNES')
66500          VOLUMB=VOLUM/0 .159
60600          WRITE( IOU,2390)VOLUM,VOLUMB
60700    239e FORMAT(/,1X,'VOLUME FROM SUMMING THE CUTS =',1PE8.1,* M**3
60800         1, OR ',1PE10.3," BARRELS')
60900          GO TO (2420,2400,2420), KMTC
61000    2400  WRITE (IOU,2410) WINDS,WINDMH
61100    2410 FORMAT(/,1X,'WIND SPEED = ',1PE1O.3,' KNOTS, OR ',1PE10.3
61200         1,' M/HR')
61300    2420 WRITE( IOU,2430)DIA,AREA
61400    243e foRMAT /,1X,'INITIAL SLICK DIAMETER = ',1PE10.3,' M, OR AR EA
61500         1 = ',1PE10.3,' M**2')
61600          IF(SPREAD.GT.0.) GO TO 245e
61700          WRITE(IOU,2440)
61800    244e FORMAT /,1X,'THIS SLICK DOES NOT SPREAD FOR THIS calculation*)
61900    c
62000    c        CALCULATE THE KINEMATIC VISCOSITY OF THE CRUDE AT 122
62100    c        DEG F AND THE ENTERED ENVIRONMENTAL TEMPERATURE.
62200    c        USE THE VISCOSITY MIXING RULE OF (MOLE FRACTION)*(LOG),
62300    c        SEE PAGE 460 OF REID, PRAUSNITZ & SHERWOOD IN
62400    C        THE BOOK 'THE PROPERTIES OF GASES AND LIQUIDS'
62500    C
62600    245e VISMIX=0.
62700          DO 2460 I=1,NCUTS
62800          VISMIX=VISMIX+MOLES(I)*VLOGK(I)/TMOLES
62900    246e CONTINUE
63000          VISMIX=EXP(VISMIX)
63100          WRITE( IOU,2470)VISMIX
63200    2470 FoRMAT /,1X,'KINEMATIC VISCOSITY OF THE BULK CRUDE FROM
63300         1 THE CUTS = ',1PE8.1,' CENTISTOKES AT 122 DEG F*)
63400          VISMIX=0.
63500    c
63600    c        SCALE THE VISCOSITY WITH TEMPERATURE ACCORDING TO
63700    c        ANDRADE.
63800    c
63900          EXPT=EXP(1923. ● (1./XSAVE-e.00I72I ))
64000          DO 2480 I=1,NCUTS
64100          VIS(I)=VISK(I)*EXPT
64200          VLOG(I)=ALOG(VIS(I))
64300          VISMIX=VISMIX+MOLES(I)*VLOG(I)/TMOLES
64400    2480 CONTINUE
64500          VISMIX=EXP(VISMIX)
64600          WRITE (IOU,2490) VISMIX,XPRINT,EXPT
64700    2490 FORMAT /,1X,'KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE
64800         1 CUTS =',1PE8.1,' AT T = ',0PF5.1,'DEG F, SCALE
64900         2 FACTOR = ',1PE8.1)
65000    c
65100    C        IMPORTANT NOTE:  THE VISCOSITY PREDICTION OF THE WHOLE
65200    C        CRUDE FROM CUT INFORMATION IS NOT GOOD AT ALL.  SO THE
65300    c        VISCOSITY INFORMATION CALCULATED ABOVE IS NOT USED IN
65400    C        THIS VERSION OF THE CODE, BUT IT COULD BE IF A GOOD
65500    C        MIXING RULE IS EVER DETERMINED.
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C        THEREFORE, FOR THE TIME BEING, THE VISCOSITY OF THE WHOLE
C        WEATHERED CRUDE IS CALCULATED ACCORDING TO MACKAY.
C
C        NOW LOAD THE VISCOSITY INFORMATION IN THE FORM
C        OF THREE CONSTANTS:
C             1.  THE VISCOSITY IN CP AT 25 DEG C
C             2.  THE ANDRADE-VISCOSITY-SCALING CONSTANT
c                 WITH RESPECT TO TEMPERATURE, SEE GOLD &
C                 OGLE, 1969, CHEM.ENG., JULY 14, P121-123
c             3.  THE VISCOSITY AS AN EXPONENTIAL FUNCTION OF
c                 THE FRACTION OF OIL WEATHERED
C
      IF(LSWTCH.EQ.99) GO TO 2510
      TYPE 25ee
2500  FORMAT(1X,'SINCE A LIBRARY CRUDE WAS NOT USED
     1,',/,1X,'ENTER THE FOLLOWING THREE VISCOSITY CONSTANTS')
      GO TO 2530
2510  TYPE 252e
2520  FORMAT(1X,'DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?')
      ACCEPT 390, ANS
      IF(ANS.EQ. 'N') GO TO 257e
2530  TYPE 2540
2540  FORMAT(1X,'1. ENTER THE BULK CRUDE VISCOSITY
     1 AT 25 DEG C, CENTIPOISE, TRY 35.')
      ACCEPT 280. VISZ
      TYPE 255e "
2550  FORMAT(1X,'2. ENTER THE VISCOSITY TEMPERATURE SCALING
     1 CONSTANT (ANDRADE), TRY 9000.')
      ACCEPT 280, MK3
      TYPE 256e
2560  FORMAT(1X,'3. ENTER THE VISCOSITY-FRACTION-OIL
     I-WEATHERED CONSTANT, TRY 10.5')
      ACCEPT 28e, MK4
      GO TO 258e
c
c        USE THE LIBRARY VISCOSITY OATA
c
2570  VISZ=VISZL(IC)
      MK3=MK3L(IC)
      MK4=MK4L(IC)
c
c        INSERT VISCOSITY CALCULATION ACCORDING TO MASS
C        FRACTION EVAPORATED.  THIS IS THE VISCOSITY
C        MODIFICATION RELATIVE TO CUTVP1
C
258e  VSLEAD=VISZ*EXP(MK3*(1./TK-0.003357))
      WRITE IOU,2590) VISZ,MK3,MK4,VSLEAD
2590  FORMAT /,1X,'VISCOSITY ACCORDING TO MASS EVAPORATED:
     1  VIS25C =',1PE9.2,', ANDRADE =',1PE9.2
     2,'* FRACT WEATHERED =',1PE9.2',VSLEAD=',1PE9.2
     3,' CP')
      C2P=1./C2
      WRITE (IOU,2850)C1,C2P,C4
      NEQ=NCUTS
c
c        SET UP THE OISPERS1ON PROCESS CONSTANTS.
C        CALCULATE THE FRACTION OF THE SEA SURFACE SUBJECT TO
C        DISPERSIONS/HOUR .
C
c        THE FUNCTIONAL DEPENDENCE OF DISPERSION RATE WITH FRACTION
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6100   c        OF ICE COVER IS NOT KNOWN. FOR NOW, THE VARIABLE FACDIS WILL
6200   c        BE USED TO INCREASE THE DISPERSION RATE.  ITS DEFAULT VALUE
6300   c        WILL BE 10.
6400   C
6500          FACDIS=10.
6600          TYPE 2600
6700   2600 FORMAT(1X,'DO YOU WANT THE WEATHERING TO OCCUR WITH
6800        1 DISPERSION?')
6900          ACCEPT 390, ANS
7000          FRACTS=0.
7100          IF(ANS.EQ. 'N') GO TO 2670
7200          IF (LSWTCH.NE.99) GO TO 262e
7300          TYPE 2610
7400   2610 FORMAT(1X,'DO YOU WANT TO ENTER NEW DISPERSION
7500        1 CONSTANTS?')
7600          ACCEPT 390, ANS
7700          IF(ANS.EQ. 'N'] GO TO 2660
7800   2620 TYPE 2630
7900   263e FORMAT(IX,'ENTER THE WIND SPEED CONSTANT, TRY 0.1')
8000          ACCEPT 280, KA
8100          TYPE 2640
8200   2640 FORMAT(IX,'ENTER THE CRITICAL DROPLET SIZE CONSTANT
8300        1, TRY 50')
8400          ACCEPT 280. KB
8500          TYPE 2650'
8600   265e FORMAT(1X,'ENTER THE BROKEN ICE FIELD DISPERSION MULTIPLIER')
8700          ACCEPT 280,FACDIS
8800   2660 FRACTS=KA*(1.+WINDMS)**2
8900   2670 CONTINUE
9000          FRACTS=FRACTS*FACDIS
9100          WRITE( IOU,2680)FRACTS
9200   2680 FORMAT /,1X,'THE FRACTIONAL SLICK AREA SUBJECT TO
9300        1 DISPERSION IS ',1PE8. 1,' PER HOUR')
9400          IF(ANS.EQ. *N') GO TO 2700
9500          WRITE( IOU,2690)KA,KB,STEN
9600   269e FORMAT 1X,'THE DISPERSION PARAMETERS USED:  KA = '
9700        1,1PE9.2,',KB = ',1PE9.2,', SURFACE TENSION = ',1PE9.2
9800        2,' DYNES/CM')
9900   c
10000  c        PRINT EVERY XP TIME INCREMENT (HOURS).
10100  C        XI IS THE STARTING TIME = e.
10200  C        X2 IS THE NUMBER OF HOURS FOR WEATHERING TO OCCUR.
103ee  c
10400  27ee XP=1.
10500         X1=0.
106ee         MOLS(NCUTS+1)-AREA
10700  C
10800  C        PRINT AN OUTPUT FILE FOR 80 COLUMN OUTPUT, THIS IS
10900  c        THE CUTVP2.TYP FILE.
11000  c
11100         WRITE(ITY,2710)
11200  2710 FORMAT(IH1, 'WEATHERING OF OIL IN A BROKEN ICE FIELD')
113ee         IF(NIP.NE.1) GO TO 2730
11400         WRITE(ITY,2720) NHIP
11500  2720 FORMAT (1X,'AFTER ICE POOL WEATHERING FOR ',1PE9.3,' HOURS')
116ee  273e WRITE ITY,2740)(ANAME(J),J=1,5)
11700  274e FORMAT( /,1X,'OIL:',5A5)
11800         WRITE( ITY,2750)XPRINT,WINDS
11900  275e FORMAT 1X,'TEMPERATURE=',F5.1,* DEG F, WIND SPEED='
12ee0       1,F5.1,' KNOTS')
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12100          WRITE (ITY.2760) BBL
12200    276e  FORMAT 1X,'SPILLSIZE=',1PE10.3,' BARRELS')
12300          WRITE (ITY,2770) KMTC
12400    277e  FORMAT IX,'MASS-TRANSFER COEFFICIENT CODE=' ,13)
12500          WRITE(ITY,2780)
12600    2780  FORMAT /,1X,'FOR THE OUTPUT THAT FOLLOWS, MOLES
12700         1=GRAM MOLES')
12800          WRITE (ITY,2790)
12900    279e  FORMAT(1X,'GMS=GRAMS, VP=VAPOR PRESSURE IN ATMOSPHERES")
13000          WRITE (ITY,2800)
13100    2800  FORMAT(1X,'BP=BOILING POINT IN DEG F, API-GRAVITY')
13200          WRITE (ITY,2810)
13300    2810  FORMAT(1X,'MW=MOLECULAR WEIGHT')
13400          WRITE (ITY,2820)
13500    2820  FORMAT(/,2X,'CUT",3X, 'MOLES',6X,'GMS' ,8X, 'VP',8X,'BP'
136e0         1,7X, 'API ',5X, 'MW')
13700          DO 2840 I=1,NCUTS
138@e          GMS=MOLES(I)*MW(I)
13900          IMW=MW(I)
140ee          WRITE (ITY,2830) I,MOLES( I),GMS,VP(I),TB(I ),API(I),IMW
14100    283e  FORMAT(3X, I2,5(1X,1PE9.2),1X,I3)
14200    2840  CONTINUE
14300          WRITE( ITY,2850)C1,C2P,C4
14400    285e  FOR MAT /,1X,'MOUSSE CONSTANTS:MOONEY=',1PE9.2
145ee         1,', MAX H20=',0PF5.2,',WIND**2=',1PE9.2)
14600          WRITE(ITY,2860) FACMOU
14700    2860  FORMAT( 20X, 'K4=',1PE9.3)
148e0          WRITE( ITY,2870)KA,KB,STEN
14900    287e  FORMAT( 1X,'DISPERSION CONSTANTS: KA=',1PE9.2
15000         1,'. KB=',1PE9.2,', S-TENSION=',1PE9.2)
15100          WRITE(ITY,2880)FACDIS
15200    2880  FORMAT(24X,'KC=',1PE9.3)
15300          WRITE(ITY,2890)FRACIC
15400    289e  FORMAT 1X,'FRACTION OF ICE COVER=',1PE9.3)
15500          WRITE (ITY,2900) VISZ,MK3,MK4
156e0    2900  FORMAT( 1X,'VIS CONSTANTS: VIS25C=',1PE9.2
157e0         1,', ANDRADE =',1PE9.2,', FRACT =',1PE9.2)
158e0          WRITE(ITY,2910)
1590e    2910  FORMAT(/,1X,'FOR THE OUTPUT THAT FOLLOWS, TIME=HOURS')
16000          WRITE (ITY,2920)
16100    2920  FORMAT 1X,'BBL=BARRELS,SPGR=SPECIFIC GRAVITY, AREA=M*M')
1620e          WRITE(ITY,2930)
16300    293e  FORMAT 1X,'THICKNESS=CM,W=PERCENT WATER IN OIL (
1640e         1MOUSSE)')
165e0          WRITE(ITY,2940)
166ee    2940  FORMAT 1X.'DISP=DISPERSION RATE IN GMS/M*M/HR')
167e0          WRITE(ITY,2950)
16800    2950  FORMAT 1X,'ERATE=EVAPORTION RATE IN GMS/M*M/HR')
169ee          WRITE(ITY,2960)
17000    2960  FORMAT 1X,'M/A=MASS PER M*M OF OIL IN THE SLICK')
17100          WRITE(ITY.2970)
17200    297e  FORMAT(1X,'I=FIRST CUT WITH GREATER THAN  1% (MASS)
173ee         1 REMAINING')
17400          WRITE(ITY,2980)
175ee    298e  FORMAT(1X,'J=FIRST CUT WITH GREATER THAN 50% (MASS)
176ee         1 REMAINING')
177ee          IF(FRACTS.NE.0.) GO TO 3000
17800          WRITE (  ITY,2990)
17900    299e  FORMAT( 1X,'DISPERSION WAS TURNED OFF')
18eee    3000  IF(SPREAD.NE.0.) GO TO 3020
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18100          WRITE(ITY,301O)
18200    3010 FORMAT(1X,'SPREADING WAS TuRNED OFF')
18300    3020  TCODE=KMTC
18400          TYPE 3e3e
18500    3030 FORMAT(/,1X,'PLEASE WAIT')
18600          CALL BRKG4(MOLS,X1,X2,XP,NEQ,NDEL)
18700          IF (C3.EQ.-1.) GO TO 3040
18800    c
189ee    C        CHECK TO SEE IF MOUSSE HAS BEEN MADE.  IF IT HAS, SAVE THE
19e0e    c        RATE CONSTANT SO THAT FURTHER WEATHERING CAN TAKE THIS INTO
19100    c        ACCOUNT
19200    c
19300          MOUSWI=1
194e0          C3SAVE=C3
19500    3040 CONTINUE
19600          ND=e
19700          0 0 3050 I=1,NEQ
1900e          IF (YM(I).NE.0.) GO TO 3050
199ee          ND=ND+1
20000    3050 CONTINUE
20100          NEW=NDEL+ND
20200          IF(NQUIT.EQ.1) GO TO 4460
20300    3060 TYPE 3070
20400    3e7e FORMAT(1X,'WILL OPEN OCEAN WEATHERING NOW OCCUR?")
20500          ACCEPT 390,ANS
20600          IF(NBI.EQ.0)GO TO 3110
20700          TV=0.
20800          0 0 3080 I=1,NEQ-ND
20900          TV=TV+(YM(ND+I)* YMSAVE(NO+I)/SPGR(NEW+I))
21000          VOL(I)=YM(ND+I)* MOLES(NEW+I)* MW(NEW+I)/(SPGR(NEW+I)
21100         1*(BBL*1582.))
21200          TB(I)=TB(NEW+I)
21300          API(I)=API(NEW+I)
2i4ee    3080 CONTINUE
2i5ee          BBL=TV/158200.
21600          NCUTS=NCUTS-(ND+NDEL)
21700          NEQ=NCUTS
21800    c
21900    c        ALWAYS RENORMALIZE THE INPUT VOLUMES TO 100%.
22000    c
22100          VTOTAL=0.
22200          DO 3090 I=1,NCUTS
22300          VTOTAL=VTOTAL+VOL( I)
22400    3090 CONTINUE
22500          DO 3100 I=1,NCUTS
22600          VOL(I)=100.*VOL(I)/VTOTAL
22700    3100 CONTINUE
22800          IS=0
22900          APISWI=1
23000          CALL DOCHAR
23100    3110 CONTINUE
23200          SPRFAC=I.
23300          IF(ANS.EQ. 'N') GO TO 4460
23400          NG=NG+NEW
23500          TYPE 3120
23600    3120 FORMAT(1X,'FOR HOW MANY HOURS?')
23700          ACCEPT 280,X2
23800          TYPE 3130
23900    3130 FORMAT(1X,'AT WHAT TEMPERATURE, DEG F?')
24000          ACCEPT 280,XSAVE
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24100          XPRINT=XSAVE
24200          XSAVE=XSAVE+459 .
24300          NCC1=NC1
24400          CALL VPIF(XSAVE.NCC1)
24500          TK=(XSAVE-491.)/1.8+273.
24600          IF(LSWTCH.EQ.99) GO TO 3160
24700          TYPE 3140
24800   3140 FORMAT(1X,'SINCE You DID NOT USE A LIBRARY CRUDE,')
24900          TYPE 3150
25000   3150 FORMAT(1X,'YOU MUST ENTER THE FOLLOWING THREE MOUSSE
25100        1 FORMATION CONSTANTS')
25200          GO TO 3180
25300   3160 TYPE 3170
25400   3170 FORMAT(1X,'DO YOU WANT TO ENTER NEW MOUSSE FORMATION CONS
25500        1TANTS?')
25600          ACCEPT 390, ANS
25700          IF(ANS.EQ. 'N') GO TO 3240
25800   c
25900   c        TO SPECIFY NO MOUSSE, ENTER C2 = 0
26000   c
26100   3180 TYPE 3190
26200   3190 FORMAT(1X, '1. ENTER THE MAXIMUM WEIGHT FRACTION WATER
26300        1 IN OIL'),
26400          ACCEPT 280, C2
26500          IF(C2.GT.0.) GO TO 3210
26600   c
26700   C        SET C2=-1. IF A MOUSSE CANNOT BE FORMED AND LOOP OUT.
26800   C
26900          C2=-1.
27000          TYPE 3200
27100   3200 FORMAT(/,1X,'SINCE A 0% WATER CONTENT WAS SPECIFIED
27200        1, THE REMAINING TWO MOUSSE',/,1X,'CONSTANTS ARE NOT
27300        2 NEEDED')
27400          GO TO 3250
27500   3210   C2=1./C2
27600          TYPE 3220
27700   322e FORMAT(1X, *2. ENTER THE MOUSSE-VISCOSITY CONSTANT
27800        1, TRY 0.65')
27900          ACCEPT 280, CI
28000          TYPE 3230
28100   323e FORMAT(1X,'3. ENTER THE wATER INCORPORATION RATE CONSTANT
28200        1. TRY 0.001')
28300          ACCEPT 280,C4
28400          GO TO 3250
28500   3240   C1=C1L(IC)
28600          C2=C2L(IC)
28700          C4=C4L(IC)
28800   3250 IF(LSWTCH.EQ.99) GO TO 3280
28900          TYPE 3260
29000   3260 FORMAT(/,1X,'YOU MUST ALSO ENTER AN OIL-WATER SURFACE
29100        1 TENsIoN (DYNES/CM')
29200          TYPE 3270
29300   3270 FORMAT(1X,'FOR DISPERSION, TRY 30.')
29400          GO TO 3310
29500   3280 TYPE 3290
29600   3290 FORMAT(1X,'DO YOU WANT TO ENTER A NEW OIL-WATER SURFACE
29700        1 TENSION (DYNES/CM)?')
29800          ACCEPT    390, ANS' ' "
29900          IF(ANS.EQ. 'N') GO TO 3320
30000          TYPE 3300
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30100   3300 FORMAT(1X,'TRY 30.')
30200   3310 ACCEPT 28e, STEN
30300        GO TO 3330
30400   332e STEN=STENL(IC)
30500   c
30600   c       START THE MASS-TRANSFER COEFFICIENT SPECIFICATION.
30700   c
30800   333e TYPE 334e
30900   334e FORMAT(1X,'ENTER THE MASS-TRANSFER COEFFICIENT CODE:1
31000        1, 2, OR 3 WHERE:')
31100        TYPE 3350
31200   335e FORMAT(1X,'1=USER SPECIFIED OVER-ALL MASS-TRANSFER COEF
31300        1FICIENT')
314ee        TYPE 3360
31500   3360 FORMAT(1X,'2=CORRELATION MASS-TRANSFER COEFFICIENT BY
316ee        1 MACKAY & MATSUGU')
31700        TYPE 3370
31800   337e FORMAT(1X,'3=INDIVIDUAL-PHASE MASS-TRANSFER COEFFICIENTS')
31900        ACCEPT 420, KMTC
32000   C
32100   C       NOW ENTER THE WIND SPEED IN KNOTS AND CONVERT TO METER/SEC
32200   C       AND METER/HOUR.
32300   C
32400        TYPE 3380
32500   336e FORMAT(1X,'ENTER THE WIND SPEED IN KNOTS')
32600        ACCEPT 280,WINDS
32700   C
32800   C       NEVER LET THE WIND SPEED DROP BELOW 2 KNOTS.  A ZERO WIND
32900   C       SPEED DESTROYS THE MASS-TRANSFER CALCULATION AND WILL
33000   C       YIELD A ZERO MASS-TRANSFER COEFFICIENT.
33100   c
33200        IF(WINDS.LT.2.) WINDS=2.
33300        WINDMS=0.514*WINDS
33400        WINDMH=1853.*WINDS
33500   C
33600   c       NOW CALCULATE THE INITIAL GRAM MOLES FOR EACH COMPONENT TO
33700   c       GET THE INTEGRATION STARTED.
33800   c
33900   339e BM=0.159*BBL
34000        TMOLES=0.
34100        DO 3400 I=1,NCUTS
34200        AMASS=1582.*SPGR(I)*BBL*VOL(1)
34300        MOLES(I)=AMASS/MW(I)
34400        MOLS(I)=MOLES(I)
34500        TMOLES=TMOLES+MOLES(I)
34600   c
34700   c       RHO IS THE DENSITY IN GM MOLES/CUBIC METER.
34800   c
34900        RHO(I)=100.*MOLES(I)/(BM*VOL(1))
35000   3400 CONTINUE
35100   c
35200   c       CALCULATE THE MEAN MOLECULAR WEIGHT OF THE CRUDE
35300   c
35400        WTMOLE=0.
35500        DO 3410 I=1,NCUTS
35600        WTMOLE=WTMOLE+MW(I)*MOLES(I)/TMOLES
35700   3410 CONTINUE
35800        WRITE (IOU,3420) WTMOLE
35900   342e FORMAT(/,1X,'MEAN MOLECULAR WEIGHT OF THE CRUDE = ',1PE10.3)
36000   c
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36100   c        SPECIFY SLICK SPREADING,
36200   C
36300   343e  SPREAD-O.
36400         TYPE 344e
36500   3440  FORMAT(1X,'DO YOU WANT THE SLICK TO SPREAD?')
36600         ACCEPT 390, ANS
36700         IF(ANS.EQ. 'N') GO TO 3450
36800         SPREAD=1.
36900         GO TO 3480
37000   c
37100   C        CALCULATE AN AREA IN SAME WAY IT WILL BE CALCULATE
37200   C        AS THE SLICK WEATHERS.  Z=THICKNESS IN METERS.
37300   C
37400   345e  IF (NZSWI.EQ.1) Go To 3470
37500         TYPE 3460
37600   346e  FORMAT(1X, 'SINCE THE SLICK DOES NOT SPREAD, ENTER
37700         1 A STARTING THICKNESS IN CM')
37800         ACCEPT 280, Z
37900   347e  Z=Z/100.
38000         GO TO 3490
38100   c
38200   c        THE SLICK ALWAYS STARTS AT 2-CM THICKNESS.
38300   c
38400   348e  IF (NZSWI.NE.0) GO TO 3490
38500         2=0. 02
38600   3490  VOLUM=0.
38700         DO 3500I=1,NCUTS
38800         VOLUM=VOLUM+MOLES( I)/RHO(I)
38900   3500  CONTINUE
39000   c
39100   C        CALCULATE THE INITIAL AREA AND DIAMETER.
39200   C
39300         AREA=VOLUM/Z
39400         DIA=SQRT(AREA/0 .785)
39500   c
39600   C        THE MASS-TRANSFER COEFFICIENT CAN BE CALCULATE ACCORDING TO:
39700   C
39800   c              1.  A USER-SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT.
39900   C
40000   C              2.  THE MASS-TRANSFER COEFFICIENT CORRELATION ACCORDING
40100   c                  TO MACKAY AND MATSUGU, 1973, CAN. J. CHE, V51,
40200   C                  P434-439.
40300   C
40400   c              3.  INDIVIDUAL OIL- AND AIR-PHASE MASS-TRANSFER COEFFI-
40500   c                  CIENTS BASED ON SOME REAL ENVIRONMENTAL DATA SUCH
40600   c                  AS THAT OF LISS AND SLATER.  SCALE THE AIR-PHASE
40700   C                  VALUE WITH RESPECT TO WIND SPEED ACCORDING TO
40800   C                  GARRATT, 1977, MONTHLY WEATHER REVIEW, V105,
40900   C                  P915-920.
41000   C
41100   c       TEMP [S R*T AND USED TO CHANGE THE UNITS ON THE MASS-
41200   C       TRANSFER COEFFICIENT.
41300   C
414ee   3510  TEMP=(8.2E-05)*TK
41500         Go To (3520,3560,3710), KMTc
416ee   c
417ee   c        USER SPECIFIED OVER-ALL MASS-TRANSFER COEFFICIENT.
41800   c
41900   3520  TYPE 3530
42000   3530  FORMAT(IX,'ENTER THE OVER-ALL MASS-TRANSFER COEFFICIENT
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42100          1. CM/HR. TRY 10')
42200          ACCEPT 280,UMTC
42300          WRITE (IOU,3540) UMTC
42400    3540  FORMAT(1H1,'OVER-ALL MASS-TRANSFER COEFFICIENT WAS USER
42500          I-SPECIFIED AT ',1PE10.3,' CM/HR BY INPUT CODE 1')
42600    c
42700    c        CONVERT CM/HR TO GM-MOLES/(HR)(ATM)(M**2) SINCE VAPOR
42800    C        PRESSURE IS THE DRIVING FORCE FOR MASS TRANSFER.
42900    C
43000          UMTC=UMTC/TEMP/100.
43100          DO 355e I=1,NC1
43200          MTC(I)=UMTC
43300    3550  CONTINUE
43400          GO TO 3790
43500    c
43600    c        USE THE MACKAY AND MATSUGU MASS-TRANSFER COEFFICIENT.
43700    c
43800    356e  TERM1=0.015*WINDMH**0.78
43900          IF(SPREAD.EQ.0.) GO TO 3570
44000          TERM2=DIA**(-0. 11)
44100          GO TO 3580
44200    c
44300    c        IF THE SLICK DOES NOT SPREAD BASE THE DIAMETER DEPENDENCE
44400    c        ON 1000 METERS AND DIVIDE THE RESULT BY e.7
44500    c
44600    357e  TERM2=0.65
44700    c
44800    C        KH INCLUDES THE SCHMIDT NUMBER FOR CUMENE.
44900    C
45000    3580  KH=TERM1*TERM2
45100          WRITE(IOU,3590)
45200    359e  FORMAT(1H1,'WEATHERING DATA FOR OIL ON THE OPEN OCEAN')
45300          IF(NIP.NE.1.AND.NBI.NE.1) GO TO 3650
45400          WRITE(IOU,3600)
45500    3600  FORMAT(IX,'AFTER: ')
45600          IF(NIP.NE.1) GO TO 3620
45700          WRITE(IOU,3610) NHIP
45800    3610  FORMAT(9X,' ICE POOL WEATHERING FOR ',1PE9.3,' HOURS')
45900    3620  CONTINUE
46000          IF(NBI.NE.1) GO TO 3640
46100          WRITE(IOU,3630) NHBI
46200    363e  FORMAT(9X,'BROKEN ICE FIELD WEATHERING FOR ',1PE9.3,' HOURS')
46300    364e  CONTINUE
46400    365e  WRITE (IOU,3660) KMTC
46500    3660  FORMAT( /,1X,'OVER-ALL MASS-TRANSFER COEFFICIENTS BY INPUT
46600          1 CODE' ,12)
46700          WRITE(IOU,3670) KH
46800    3670  FORMAT( /,1X, "OVER-ALL MASS-TRANSFER COEFFICIENT FOR CUMENE = '
46900          1,1PE10.3,' M/HR',/)
47000          WRITE(IOU,3680)
47100    3680  FORMAT(3X,'CUT',12X,'M/HR',7X,'GM-MOLES/(HR)(ATM)(M**2) ')
47200          DO 3700 I=1,NC1
47300    C
47400    c        THE MASS-TRANSFER COEFFICIENT IS CORRECTED FOR THE
47500    c        DIFFUSIVITY OF COMPONENT I IN AIR.  THE SQRT IS USED
47600    C        (I.E. LISS AND SLATER),BUT THE 1/3 POWER COULD ALSO
47700    C        BE USED (I.E. THE SCHMIDT NUMBER).
47800    c
47900          MTCA(I)=KH*0.93*SQRT((MW(I)+29 .)/MW(I))
48000    c
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48100   C        MTC(I) IS THE OVER-ALL MASS-TRANSFER COEFFICIENT DIVIDED
48200   C        BY R*T.   R=82.06E-06 (ATM)(M**3)/(G-MOLE)(DEG K)
48300   c
48400          MTC(I)=MTCA(I)/TEMP
48500          WRITE(IOU,3690) I,MTCA(I),MTC(I)
48600   3690 FORMAT( 2X, I3,2(1BX,1PE1O.3))
48700   3700 CONTINUE
48800          GO TO 3790
48900   c
49000   C        uSER SPECIFIED INDIVIDUAL-PHASE MASS-TRANSFER
49100   C        COEFFICIENTS.
49200   c
49300   3710 TYPE 372e
49400   3720 FORMAT(IX,'ENTER THE OIL-PHASE MASS-TRANSFER COEFFICIENT
49500        I IN CM/HR, TRY 10')
49600          ACCEPT 280, KOIL
49700          TYPE 3730
49800   373e FORMAT(1X,'ENTER THE AIR - PHASE MASS-TRANSFER COEFFICIENT
49900        I IN CM/HR, TRY 1000')
50000          ACCEPT 280, KAIR
50100          TYPE 3740
50200   374e FORMAT(1X,'ENTER THE M OLECULAR WEIGHT OF THE COMPOUND
50300        1 FOR K-AIR ABOVE, TRY 200')
50400          ACCEPT 280, DATAMW
50500   c
50600   C        SCALE K-AIR ACCORDING TO WIND SPEED (GARRATT, 1977),
50700   C        SO THAT AS THE WIND SPEED GOES UP THE MASS TRANSFER
50800   c        GOES UP, I.E., THE CONDUCTANCE INCREASES.
50900   c
51000          KAIR=KAIR*(1.+0.089*WINDMS)
51100          RKAIR=1./KAIR
51200   C
51300   C        CALCULATE R*T IN ATM*CM**3/GM-MOLE
51400   c
51500          RT=82.06*TK
51600          HTERM=WTMOLE/(DCRUDE*RT)
517ee          WRITE (IOU,3660) KMTC
51800   c
519ee   c        WRITE THE USERS INPUT, WIND SPEED, AND HENRYS LAW
52000   C        TERM TO THE OUTPUT.
52100   C
52200          WRITE IOU,3750) KAIR,KOIL,DATAMW
52300   375e  FORMAT /,1X,'K-AIR = ',1PE10.3,', AND K-OIL =',1PE10.3
52400        1,' CM/HR, BASED ON A MOLECULAR WEIGHT OF ',1PE1O.3)
52500          WRITE( IOU,3760) WINDMS
52600   3760 FORMAT(1X,'WIND SPEED = ',1PE10.3,' M/S')
52700          WRITE (IOU,3770) HTERM
52800   377e FORMAT(1X,'THE HENRYS LAW CONVERSION TERM FOR OIL = '
52900        1,1PE10.3,' I/ATM')
53000          WRITE (IOU,3680)
53100   C
53200   C        CALCULATE THE OVER-ALL MASS-TRANSFER COEFFICIENT BASED
53300   c        ON GAS-PHASE CONCENTRATIONS FOR EACH CUT.
53400   c
53500          00 3780 I=1,NC1
53600          HLAW(I)=HTERM*VP(I)
53700          MTCA(I)=RKAIR+HLAW(I)/KOIL
53800   c
53900   c        NOW TAKE THE INVERSE TO OBTAIN CM/HR AND THEN MULTIPLY
54000   c        BY eel TO GET M/HR.
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54100   C
54200         MTCA(I)=0.01/MTCA(I)
54300   c
54400   c       CORRECT FOR MOLECULAR WEIGHT ACCORDING TO LISS & SLATER,
54500   c       1974, NATURE, V247,P181-184.
54600   c
54700         MTCA(I)=MTCA(I)*SQRT(DATAMW/MW( I))
54800         MTC(I)=MTCA(I)/TEMP
54900   c
55000   c       ANO WRITE THE OVER-ALL MASS-TRANSFER COEFFICIENT
55100   c       IN M/HR AND MOLE/HR*ATM*M*M.
55200   c
55300         WRITE  (IOU,3690)I,MTCA(I),MTC(I)
55400   3780  CONTINUE
55500   3790  SPGRB=141.5/(APIB+131 .5)
55600         MASS=0.1582*BBL*SPGRB
55700         WRITE 10U,38EM) BBL,MASS
55800   3800  FORMAT(/,1X,*FOR THIS SPILL OF ',1PE10.3,' BARRELS, THE
55900        1 MASS IS ',1PE10.3,' METRIC TONNES')
56000         VOLUMB=VOLUM/0 .159
56100         WRITE(IOU,381O) VOLUM,VOLUMB
56200   3810  FORMAT( /,1X,'VOLUME FROM SUMMING THE CUTS = ',1PE8.1,' M**3
56300        1, OR ',1PE10.3,' BARRELS')
56400         GO TO (3840,3820,3840), KMTC
56500   3820  WRITE( IOU,3830)WINDS,WINDMH
56600   3830  FORMAT( /,IX, 'WIND SPEED = ',1PE10.3,' KNOTS, OR ',1PE10.3
56700        1,' M/HR ' )
56800   3840  WRITE( IOU,3850)DIA,AREA
56900   3850  FORMAT(/,1X,'INITIAL SLICK DIAMETER = ',1PE10.3,' M, OR AREA
57000        1 = ',1PE10.3,' M**2')
57100         IF(SPREAD.GT.0.) GO TO 3870
57200         WRITE (IOU,3860)
57300   3860  FORMAT(/,1X,'THIS SLICK DOES NOT SPREAD FOR THIS CALCULATION')
57400   c
57500   c       CALCULATE THE KINEMATIC VISCOSITY OF THE CRUDE AT 122
57600   c       DEG F AND THE ENTERED ENVIRONMENTAL TEMPERATURE.
57700   c       USE THE VISCOSITY MIXING RULE OF (MOLE FRACTION)*(LOG),
57800   c       SEE PAGE 460 OF REID, PRAUSNITZ & SHERWOOD IN
57900   c       THE BOOK 'THE PROPERTIES OF GASES AND LIQUIDS'
58000   c
58100   3870  VISMIX=0.
58200         DO 388e I=1,NCUTS
58300         VISMIX=VISMIX+MOLES(I)*VLOGK(I)/TMOLES
58400   3880  CONTINUE
58500         VISMIX=EXP(VISMIX)
58600         WRITE( IOU,3890)VISMIX
58700   3890  FORMAT( /,1X,'KINEMATIC VISCOSITY OF THE BULKCRUDE FROM
58800        1 THE CUTS = ',1PE8. 1,' CENTISTOKES AT 122 DEG F')
58900         VISMIX=0.
59000   c
59100   c       SCALE THE VISCOSITY WITH TEMPERATURE ACCORDING TO
59200   c       ANDRADE.
59300   c
59400         EXPT=EXP(1923. ● (1./XSAVE-0.00I 721))
59500         DO 3900 I=1,NCUTS
59600         VIS(I)=VISK(I)*EXPT
59700         VLOG(I)=ALOG(VIS( I))
59800         VISMIX=VISMIX+MOLES(I)*VLOG(I)/TMOLES
59900   3900  CONTINUE
60000         VISMIX=EXP(VISMIX)
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60100          WRITE IOU,3910) VISMIX,XPRINT, EXPT
60200    3910 FORMAT /,1X,'KINEMATIC VISCOSITY OF THE BULK CRUDE FROM THE
60300         1 CUTS =',1PE8.1,' AT T =',0PF5.1,' DEG F, scALE
60400         2 FACTOR = ',1PE8.1)
60500    c
60600    C        IMPORTANT NOTE:  THE VISCOSITY PREDICTION OF THE WHOLE
60700    C        CRUDE FROM CUT INFORMATION IS NOT GOOD AT ALL.  SO THE
60800    C        VISCOSITY INFORMATION CALCULATED ABOVE IS NOT USED IN
60900    C        THIS VERSION OF THE CODE, BUT IT COULD BE IF A GOOD
61000    c        MIXING RULE IS EVER DETERMINED.
61100    c        THEREFORE, FOR THE TIME BEING, THE VISCOSITY OF THE WHOLE
61200    c        WEATHERED CRUDE IS CALCULATED ACCORDING TO MACKAY.
613e0    c
614ee    c        NOW LOAD THE VISCOSITY INFORMATION IN THE FORM
61500    c        OF THREE CONSTANTS:
61600    c             1.  THE VISCOSITY IN CP AT 2S DEG C
61700    C             2.  THE ANDRADE-VISCOSITY-SCALING CONSTANT
61800    C                 WITH RESPECT TO TEMPERATURE, SEE GOLD &
61900    C                 OGLE, 1969, CHEM. ENG., JULY 14, P121-123
62000    C             3.  THE VISCOSITY AS AN EXPONENTIAL FUNCTION OF
62100    C                 THE FRACTION OF OIL WEATHERED
62200    C
62300          IF(LSWTCH.EQ.99) GO TO 3930
62400          TYPE 3920
62500    392e FORMAT(1X,'SINCE A LIBRARY CRUDE WAS NOT USED
62600         1,',/,1X,'ENTER THE FOLLOWING THREE VISCOSITY CONSTANTS')
62700          GO TO 3950
62800    3930 TYPE 3940
62900    3940 FORMAT(1X,'DO YOU WANT TO ENTER NEW VISCOSITY CONSTANTS?')
63000          ACCEPT 390, ANS
63100          IF(ANS.EQ.'N') GO TO 3990
63200    3950 TYPE 3960
63300    3960  FORMAT(1X,'1. ENTER THE BULK CRUDE VISCOSITY
63400         1 AT 25 DEG C, CENTIPOISE, TRY 35.*)
63500          ACCEPT 280,VISZ
63600          TYPE 3970
63700    397e FORMAT(1X,'2. ENTER THE VISCOSITY TEMPERATURE SCALING
63800         1CONSTANT (ANDRADE), TRY 9000.')
63900          ACCEPT 280, MK3
64000          TYPE 3980
64100    398e  FORMAT(1X,'3. ENTER THE VISCOSITY-FRACTION-OIL
64200         1-WEATHERED CONSTANT, TRY 10.5')
64300          ACCEPT 280, MK4
64400          GO TO 4000
64500    C
64600    C        USE THE LIBRARY VISCOSITY DATA
64700    c
64800    399e  VISZ=VISZL(IC)
64900          MK3=MK3L(IC)
65000          MK4=MK4L(IC)
65100    C
65200    C        INSERT VISCOSITY CALCULATION ACCORDING TO MASS
65300    C        FRACTION EVAPORATED.  THIS IS THE VISCOSITY
65400    C        MODIFICATION RELATIVE TO CUTVP1
65500    c
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100    4000 VSLEAD=VISZ*EXP(MK3*(1./TK-0 .003357))
200         WRITE (OU,4O1O) VISZ,MK3,MK4,VSLEAD
300    4010 FORMAT /,1X,'VISCOSITYACCORDING TO MASS EVAPORATED:
400         1 VIS25C =',1PE9.2, *, ANDRADE =',1PE9.2
500         2,', FRACT WEATHERED =',1PE9.2',VSLEAD=',1PE9.2
600         3,' CP')
700         C2P=1./C2
see         W RI TE (IOU,4300)C1.C2P.C4
900         NEQ=NCUTS
1000   C
1100   C        SET UP THE DISPERSION PROCESS CONSTANTS.
1200   C        CALCULATE THE FRACTION OF THE SEA SURFACE SUBJECT TO
1300   C        DISPERSIONS/HOUR .
1400   C
1see        TYPE 4e2e
1600   4020 FORMAT(1X,'DO YOU WANT THE WEATHERING TO OCCUR WITH
1700        1 DISPERSION?')
1800        ACCEPT 390, ANS
1900        FRACTS=0.
2000        IF(ANS.EQ.'N') Go To 4080
2100        IF(LSWTCH.NE.99) GO TO 4040
2200        TYPE 4e3e
23ee   4030 FORMAT(1X,'DO YOU WANT TO ENTER NEW DISPERSION
24ee        1 CONSTANTS?')
2500        ACCEPT 390, ANS
2600        IF(ANS.EQ. *N') GO TO 4070
27ee   4e4e TYPE 4050
2800   4050 FORMAT(1X,'ENTER THE WIND SPEED CONSTANT, TRY 0.1')
2900        ACCEPT 280, KA
3000        TYPE 4060
3100   4060 FORMAT(IX,'ENTER THE CRITICAL DROPLET SIZE CONSTANT
32ee        1, TRY 50')
33ee        ACCEPT 280, KB
34ee   4e7e FRACTS=KA*(1.+WINDMS)**2
3500   4080 WRITE IO(J,4090) FRACTs
3600   4e9e FORMAT(/,1X,'THE FRACTIONAL SLICK AREA SUBJECT TO
37ee        1 DISPERSION IS ',1PE8. 1," PER HOUR')
3800        IF(ANS.EQ. 'N') GO TO 4110
3900        WRITE (IOU,4100) KA,KB,STEN
4000   4100 FORMAT(1X,'THE Dispersion Parameters USED:  KA = '
4100        1,1PE9.2,', KB = ',1PE9.2,', SURFACE TENSION =',1PE9.2
4200        2,' DYNES/CM')
43ee   c
44ee   c        PRINT EVERY xp TIME INCREMENT (HOURS).
45ee   c        XI IS THE STARTING TIME = 0.
46ee   c        X2 IS THE NUMBER OF HOURS FOR WEATHERING TO OCCUR.
47ee   c
4800   4110 XP=1.
4900        X1=0.
5000        MOLS(NCUTS+1)-AREA
5100   c
5200   c        PRINT AN OUTPUT FILE FOR 80 COLUMN OUTPUT, THIS IS
5300   C        THE CUTVP2.TYP FILE.
54ee   C
5500        WRITE(ITY,4120)
5600   4120 FORMAT(1H1,'OPEN OCEAN WEATHERING')
5700        IF(NIP.NE.1.AND.NBI.NE.1) GO TO 4180
5800        WRITE(ITY,4130)
5900   4130 FORMAT(1X,'AFTER:')
6000        IF(NIP.NE.1) GO TO 4150
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6100          WRITE(ITY,4140) NHIP
6200    4140  FORMAT(9X,'ICE POOL WEATHERING FOR ',1PE9.3,' HOURS")
63ee    4150  CONTINUE
64ee          IF(NBI.NE.1) GO TO 4170
6500          WRITE(ITY,4160) NHBI
66ee    4160  FORMAT(9X,'BROKENICE FIELD WEATHERING FOR ',1PE9.3,' HOURS*)
67ee    4170  CONTINUE
68ee    418e  WRITE (ITY,4190) (ANAME(J),J=1 ,5)
69ee    4190  FORMAT /,1X,'OIL:',5A5)
7eee          WRITE( ITY,4200)XPRINT,WINDS
7100    42ee  FORMAT 1X,'TEMPERATURE=',F5.1,"DEG F, WIND SPEED= '
7200         1,F5.1,' KNOTS')
73ee          WRITE( ITY,4210)BBL
74ee    4210  FORMAT 1X,'SPILLSIZE=',1PE10.3,' BARRELS')
7500          WRITE (ITY,4220) KMTC
7600    422e  FORMAT 1X.'MASS-TRANSFER COEFFICIENT CODE=',I3)
77ee          WRITE(ITY,4230)
78ee    423e  FORMAT(/,1X,'FOR THE OUTPUT THAT FOLLOWS, MOLES
79ee         1=GRAM MOLES')
8eee          WRITE(ITY,4240)
8100    424e  FORMAT(1X,'GMS=GRAMS, VP=VAPOR PRESSURE IN ATMOSPHERES*)
8200          WRITE(ITY.4250)
8300    425e  FORMAT 1X,'BP=BOILING POINT IN DEG F, API-GRAVITY')
84ee          WRITE(ITY,4260)
85ee    426e  FORMAT 1X,'MW=MOLECULAR WEIGHT')
86ee          WRITE(ITY,4270)
8700    427e  FORMAT /,2X,'CUT',3X,'MOLES',6X,'GMS',8X,'VP',8X,'BP'
8800         1,7X, 'API',5X,'MW')
89ee          DO 4290 I=1,NCUTS
9eee          GMS=MOLES(I)*MW(I)
9100          IMW=MW(I)
92ee          WRITE ITY,4280) I,MOLES(I),GMS,VP(I ),TB(I ),API(I), IMW
9300    428e  FORMAT(3X,I2,5(1X,1PE9.2),1X,I3)
94ee    429e  CONTINUE
95ee          WRITE (ITY,4300) C1,C2P,C4
96ee    43ee  FORMAT /,1X,'MOUSSE CONSTANTS:MOONEY=',1PE9.2
9700         1,', MAX H20=',0PF5.2,',WIND**2=',1PE9.2)
98ee          WRITE( ITY,4310)KA,KB,STEN
9900    4310  FORMAT 1X,'DISPERSION CONSTANTS: KA=',1PE9.2
ieeee        1,', KB=',1PE9.2,', S-TENSION=',1PE9.2)
10100         WRITE( ITY,4320)VISZ,MK3,MK4
ie2ee   432e  FORMAT 1X,'VIS CONSTANTS: VIS25C=',1PE9.2
1 e3ee       1,', ANDRADE=',1PE9.2,', FRACT =',1PE9.2)
10400         WRITE (ITY,4330)
1 e5ee  433e  FORMAT /,1X,'FOR THE OUTPUT THAT FOLLOWS, TIME=HOURS')
1 e6ee        WRITE(ITY,4340)
1 e7ee  434e  FORMAT 1X, 'BBL=BARRELS,SPGR=SPECIFIC GRAVITY, AREA=M*M')
i0800         WRITE(ITY,4350)
1 e9ee  435e  FORMAT 1X,'THICKNESS=CM, W-PERCENT WATER IN OIL (
ii000        1MOUSSE)')
11100         WRITE(ITY,4360)
11200   436e  FORMAT 1X,'DISP=DISPERSION RATE IN GMS/M*M/HR')
i1300         WRITE(ITY,4370)
11400   437e  FORMAT IX,'ERATE=EVAPORTION RATE IN GMS/M*M/HR')
11500         WRITE(ITY,4380)
1 160e  4380  FORMAT 1X,'M/A=MASS PER M*M OF OIL IN THE SLICK')
1i700         WRITE(ITY,4390)
1i800   439e  FORMAT 1X,'I=FIRST CUT WITH GREATER THAN 1%(MASS)
11900        1 REMAINING')
1 2eee        WRITE (ITY,4400)
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12100   4400 FORMAT(IX,'J=FIRST CUT WITH GREATER THAN 50%(MASS)
1 2200       1 REMAINING')
12300         IF(FRACTS.NE.0.) GO TO 4420
12400         WRITE (ITY,4410)
12500   4410 FORMAT(1X,'DISPERSION WAS TURNED OFF')
1 2600  4420 IF(SPREAD.NE.0.) GO TO 444e
12700         WRITE(ITY,4430)
128ee   4430 FORMAT 1X, 'SPREADING WAS TURNED OFF')
12900   4440 TCODE=KMTC
13000         TYPE 4450
13100   4450 FORMAT(/,IX,'PLEASE WAIT')
132ee         CALL BRKG4(MOLS,X1,X2,XP,NEQ,NDEL)
133ee   4460 CONTINUE
1 34ee        WRITE(IOU,4470)
13500   447e FORMAT(//,1X,'********* FINAL OVERALL MASS BAL ANCE FOR PARENT
136ee        1 OIL ***********')
13700         CHECK=TMASS+TME+TMD+DELMAS
138ee         DO 4480 I=1,NG
1 3900        FMF(I)=0.
14000   4480 CONTINUE
14100         DO 4490 I=1,NEQ
1 42ee        FMF(I+NG)=YM1(I)/MASSAV(I+NG)
143ee   4490 CONTINUE
1 44ee        WRITE(IOU,4500)
14500   4500 FORMAT( /,1X,'FINAL MASS FRACTIONS OF CUTS:')
14600         WRITE IOU,4510) (FMF(I), I=1,NEQ+NG)
14700   4510 FORMAT( 11(1X,1PE1O.3))
148ee         FR=TMASS/TMASAV
149ee         WRITE(IOU,4520)FR
15000   4520 FORMAT(1X,'FRACTION (BASED ON MASS) REMAINING= ',1PE1O.3)
15100         WRITE(IOU,4530) TMASS,TMD,TME,DELMAS,CHECK
15200   4530 FORMAT(1X,'MASS REMAINING= ' ,1PE9.3,1X, "MASS DISPERSED=',1PE9.3,
153ee        11X,'MASS EVAPORATED= ',1PE9.3,1X,'MASS DELETED= '
15400        2, 1PE9.3,1X,'TOTAL= ',1PE9.3)
1 5500        WRITE(IOU,4540) TMASAV
156ee   454e FORMAT(1X, 'ORIGINAL MASS=',1PE9.3)
15700   4550 ENO
```

```
 100          REAL*4 MW,MOLS,KA,KB,MOLES,MTC,MWU,K,K0,MK,MW1,K11,MK4
 200         1,MK3L,MK4L,MTCA,KH,KOIL,KAIR,MASS,MK3,MOLSAV,MLSAV,MASSAV
 300         2,NHIP,NHBI
 350            CHARACTER*5 ANAMEL,ANAME
 375            CHARACTER*1O FNAME
 400          COMMON /LIST1/TBL(6,30),APIL(6.30),VOLL(6,30),ANAMEL(6,5)
 500         1,DESC(30,5),VOL(30),APIBL(6),ANAME(5)
 600         2,C1L(6),C2L(6),C4L(6),STENL(6),VISZL(6),MK3L(6)
 700         3,MK4L(6),TB(30)
 800         4,API(30),SPGR(30),MW(30),MOLES(30),RHO(30),MTC(30),MTCA(30)
 900         5,HLAW(30),VLOGK(30),VLOG(30),VP(30),VISK(30),VIS(30),YM(30)
1000         6,GONE(30),T10(30),MLSAV(30),MASSAV(30)
1100         7,UOP(30),CI(30),OSPGR(30),OAPI(30),OUOP(30)
1200         8,TC(30),VC(30),PC(30),HVAP1(30),A(30),B(30)
1300         9,HVAPZ(30),CNUM(30),DELH(30),DELHTB(30),EM(30)
1400         1,MWU(30),VPI(30),VFRAC(100),WYI(30),TBNN(100),K0(30),MK(30)
1500         2,TMPVP(30),TMPDS(30),YM1(30),MOLS(30)
1600         3,K(30),YSAVE(30),YMSAVE(30),YF(30)
1700         4, FRACTS,DISPER,Z,TERM2,SPREAD ,KB,WINDS,C1,C2,C3,C4,K11,MK4
18e@         5,APISWI,APIB,KH,KOIL,KAIR,MASS,MK3,MW1,TC1,VC1,PC1,CNUM1,VIS1
1900         6,VSLEAD,STEN,DCRUDE,BM, TMOLES,WTMOLE,MOLSAV, TME,TMD,FE,HOUMOU
2000         7,TMASAV,C3SAVE,NHIP    ,NHBI,TMASS,DELMAS,SPRFAC,TE
2100          COMMON /LIST2/NCTS(6),ITEML(6),ISAMPL(6),NC(30)
22ee         1,NS(30),NEQ1,NEQ2,NEQ3,IOU,IPU,ITY,NC1,NCUTS,KMTC,MOUSWI
2360         2,LINE,NIP,NBI,NQUIT, ITEM, ISAMP
```

```
      SUBROUTINE DOCHAR
      INCLUDE 'VARI.FOR'
c
c       THIS SUBROUTINE CHARACTERIZES THE CUTS.  IF THE LAST CUT IS
c       RESIDUUM DO NOT CHARACTERIZE IT  BUT USE A VAPOR
c       PRESSURE OF 0. AND A MOLECULAR WEIGHT OF 600.
c
10    MW(NCUTS)=600.
      VP(NCUTS)=0.
c
c       NV=1 MEANS NO RESIDUUM CUT PRESENT.
c       NV-2 MEANS A RESIDUUM IS PRESENT.
c
      NV=1
      NC1=NCUTS
      DO 90I=1,NCUTS
      SPGR(I)=141.5/(API(I)+131.5)
      SPGR(I) =0.983*SPGR(I)
c
c       IF  APISWI=1 (PREVIOUS WEATHERING HAS OCCURED), CALCULATE
c       A NEW BULK API GRAVITY
C
      DCRUDE=0.
      DO 20 J=1,NCUTS
      DCRUDE=((VOL(J)*SPGR(J))/100)+DCRUDE
20    CONTINUE
      APIB=(141.5/DCRUDE)-131.5
      TBN=TB(I)
c
c       CALCULATE U.O.P. K-FACTOR AND CORRELATION INDEX
c
      UOP(I)=((TB(I)+459.)**.33333)/sPGR(I)
      CI(I)=(473.7*SPGR(I))-456.8+(49339/(((TB(I)-32.)/1.8)+273.))
      APIN=API(I)
c
c       THE RESIDUUM CUT IS IDENTIFIED BY A NORMAL BOILING
C       POINT OF 850.  LOOP AROUND THE NV=2 SWITCH IF A
C       RESIDUUM IS PRESENT.  NC1 IS THE NUMBER OF PSEUDO COMPONENTS
C       WITH FINITE VAPOR PRESSURES.
C
      IF(TBN.LT.850.) GO TO 30
      Nv=2
      NC1=NCUTS-1
30    CALL  CHAR(APIN,TBN,AN,BN,NSN,NV)
c
c       THE CHARACTERIZATION SUBROUTINE RETURNS THE LOG10 OF THE
c       KINEMATIC VISCOSITY (CENTISTOKES) AT 122 DEG F.
c
      VISK(I)=10.**VIS1
      VLOGK(I)=ALOG(VISK(I))
      GO TO (40,90), NV
c
c       STORE THE CUT INFORMATION FOR A NON-RESIDUUM CUT.
c
40    NS(I)=NSN
      A(I)=AN
      B(I)=BN
      MW(I)=MW1
      TC(I)=TC1
      TC(I)=TC(I)+459.
```

```
      VC(I)=VC 1
      PC(I)=PC 1
      CNUM(I)=CNUM1
C
C       FIND THE TEMPERATURE AT WHICH THE VAPOR PRESSURE IS 10 MMHG
C       BY USING NEWTON-RAPHSON WITH TB AS THE FIRST GUESS.
C
      NC(I)=0
      YTEN=ALOG10(0.01315/PC(I))
      X=(TB(I)+459.)/TC(I)
50    EX=EXP(-20.*(X-B(I))**2)
      Y=-A(I)*(1.-X)/X-EX
      YOBJ=Y-YTEN
      VP(I)=PC(1)816.**Y
      TEST=ABS(VP(I)-0.01315)
      IF(TEST.LT.0.001315) GO TO 80
      NC(I)=NC(I)+1
      IF(NC(I).GT.20) GO TO 60
      DY=A(I)/(X*X)+40.*(X-B(I))*EX
      BI=YOBJ-DY*X
      X=-BI/DY
      GO TO 50
C
C       UNSUCCESSFUL EXIT FROM NEWTON-RAPHSON
C
60    TYPE 70, I,X,Y
70    FORMAT( 1X,'TIO FAILURE FOR' ,14,' AT T = ',1PE10.3,' WHERE
     1 LOG10( P) = ',1PE10.3)
      GO TO 460
C
C       SUCCESSFUL EXIT FROM NEWTON-RAPHSON
C
80    T10(I)=X*TC(I)
C
C       CALCULATE THE HEAT OF VAPORIZATION AT 10 MMHG WITH THE
C       CLAPEYRON EQUATION AND USE WATSONS METHOD FOR THE
C       VAPOR PRESSURE BELOW 10 MMHG.  SEE GAMSON AND WATSON,
C       1944, NATIONAL PETROLEUM NEWS, R-258 TO R-264.
C
      TR2=T10(I)/TC(I)
      EX=92.12*(TR2-B(I))*EXP(-20.*(TR2-B(I))**2)
      HVAP=1.987*T10(I)*T10(I)*(2.303*A(I)/(TR2*TR2)+EX)/TC(I)
      HVAP1(I)=HVAP/MW(I)
      HVAP2(I)=HVAP/(1.-TR2)**0.38
90    CONTINUE
C
C       END OF TRUE-BOILING-POINT CUTS CHARACTERIZATION
C
      WRITE (IOU,100) (ANAME(I),I=1,5)
100   FORMAT( 1H1,'SUMMARY OF TBP CUTS CHARACTERIZATION FOR: '
     1,5A5)
      IF(NIP.NE.1.AND.NBI.NE.1) GO TO 150
      WRITE(IOU,110)
110   FORMAT(1X,'AFTER:')
      IF(NIP.NE.1) GO TO 130
      WRITE(IOU,120) NHIP
120   FORMAT(8X,'ICE POOL WEATHERING FOR ',1PE9.3,' HOURS')
130   CONTINUE
      IF(NBI.NE.1) GO TO 150
      WRITE(IOU,140) NHBI
```

```
140   FORMAT(8X,'BROKEN ICE FIELD WEATHERING FOR ',1PE9.3,'HOURS')
150   CONTINUE
      WRITE(IOU,160)
160   FORMAT /,1X,'CODE VE RSION IS CUTICA OF MAY 84')
      WRITE( IOU,170)ITEM,ISAMP
17%   FORMAT 1X,'ITEM ',15,', SAMPLE ',I5)
180   CONTINUE
      WRITE(IOU,190)
190   FORMAT(/,8X,'TB',7X,'API',6X,'SPGR',7X,'VOL',8X,'MW',8X
     1, 'TC',8X,'PC',8X,'VC',8X,'A',9X,'B',8X,'T10',7X,'VIS'
     2,4X, 'NC NS')
      0 0 210 I=1,NCUTS
      WRITE (IOU,200)I,TB(I),API(I),SPGR(I),VOL( I),MW(I),TC(I)
     1,PC(I),VC(I),A(I),B(I),T10(I),VISK(I),NC(I),NS(I)
200   FORMAT(1X,I2,12(1X,1PE9.2), 2(1X,12))
210   CONTINUE
      WRITE(IOU,220)
22e   FORMAT(//,7X,'UOP K',4X,'CORRELATION INDEX')
      DO 240 I=1,NCUTS
      WRITE(IOU,230)I,UOP(I),CI(I),(DESC(I,J) J-1,5)
230   FORMAT(1X,I2,1X,1PE9.2,7X,1PE9.2,7X,5A5)
24e   CONTINUE
      WRITE (10U,25I3) APIB
25e   FORMAT(//,1X,'BULK API GRAVITY = ',F5.1)
      WRITE (IOU,260)
260   FORMAT(//,1X,'TB = NORMAL BOILING TEMPERATURE, DEG F')
      WRITE (IOU,270)
27e   FORMAT(1X,'API = API GRAVITY')
      WRITE (IOU,280)
280   FORMAT(1X,'VOL = VOLUME PER CENT OF TOTAL CRUDE')
      WRITE (IOU,290)
29e   FORMAT(1X,'MW = MOLECULAR WEIGHT')
      WRITE(IOU,300)
300   FORMAT 1X,'TC = CRITICAL TEMPERATURE, DEGRANKINE')
      WRITE(IOU,310)
310   FORMAT 1X,'PC = CRITICAL PRESSURE, ATMOSPHERES')
      WRITE(IOU.320)
320   FORMAT 1X,'VC= CRITICAL VOLUME. CC/MOLE')
      WRITE(IOU,330)
330   FORMAT(1X,*A AND B ARE PARAMETERS IN THE VAPOR PRESSURE
     1 EQUATION')
      WRITE(IOU,340)
340   FORMAT 1X,'T10 IS THE TEMPERATURE IN DEG R WHERE THE VAPOR
     1 PRESSURE IS 10 MM HG')
      WRITE (IOU,350)
350   FORMAT(1X,'VIS IS THE KINEMATIC VISCOSITY IN CENTISTOKES
     1 AT 122 DEG F')
      WRITE(IOU,360)
36e   FORMAT(1X,'UOP K IS THE U.O.P. K CHARACTERIZATION FACTOR']
      WRITE(IOU,370)
370   FORMAT 1X,'CORRELATION INDEX IS DEFINED IN (COLEMAN, 197S)')
      WRITE (IOU,380)
380   FORMAT 1X,'NC= ERROR CODE, SHOULD BE LESS THAN 20')
      WRITE(IOU,390)
39e   FORMAT 1X,'NS= ERROR CODE, SHOULD BE EQUAL TO 1')
      WRITE IOU,400) NcuTs
400   FORMAT 1X,'IGNORE THE ERROR CODES FOR COMPONENT NUMBER ',12
     1,' IF IT IS A RESIDUUM')
410   WRITE(IPU,420) ITEM, ISAMP
42e   FORMAT 215)
```

```
      WRITE ( IPU,430) (ANAME(I), I=1,5)
430   FORMAT( 5A5)
C
C       THE CUTVP2.PLT PLOT FILE IS WRITTEN AS:
C             1.  ITEM AND SAMPLE NUMBER ON 215
C             2.  THE CRUDE NAME ON 5A5
C             3.  NCUTS ON 15
C             4.  BOILING  POINT IN DEG F OF EACH CUT ON
C                 10(1X,1PE10.3).
C             5.  TEMPERATURE IN DEG F OF EVAPORATION, XPRINT
C                 WIND SPEED IN KNOTS, WINDS
C                 KA AND KB IN THE DISPERSION EQUATION,
C                 SURFACE TENSION IN DYNES/CM, STEN
C                 VOLUME OF THE SPILL IN  BARRELS, BBL
C                 CI, C2, AND C4 IN THE MOUSSE EQUATION,
C                 KMTC, MAss TRANSFER COEFFICIENT CODE (FLoATED).
C                 ALL ON 1O(1X,1PE1O.3),
C             6.  NUMBER OF CUTS+1 ON 15
C             7.  TIME, MASS OF CUTS, AREA ON 1O(IX,IPE1O.3)
C             8.  TOTAL MASS FRACTION REMAINING IN THE OIL
C                 SLICK FOR EACH TIME STEP PRINTED ON
C                 10(1X,1PE10.3)
C
C       ITEMS 6 AND 7 ABOVE ARE WRITTEN FOR EACH TIME STEP
C       WITH THE FIRST TIME STEP BEING ZERO. WHEN THE
C       VERY LAST TIME STEP IS WRITTEN THEN ITEM 8 IS WRITTEN.
C
C       THE NUMBER OF LINES WRITTEN ON THE CUTVP2.PLT PLOT FILE
C       REFERS TO THE NUMBER OF 'TIMES* WRITTEN THROUGH
C       ITEMS 6 AND 7 ABOVE.
C
      WRITE( IPU,440) NCUTS
440   FORMAT( 15)
      WRITE( IPU,450) (TB(I), I=1,NCUTS)
450   FORMAT( 1O(1X,1PE19.3) )
460   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE CHAR(API1,TB1,A1,B1,NS1,NV)
      INCLUDE 'VARI.FOR'
      DIMENSION T(2,6),C(2,6),P(4),V(2,6)
      DATA ((C(I,J),J=1,6),I=1,2)/6.241E+01,-4.595E-02,-2.836E-01
     1,3.256E-03,4.578E-04,5.279E-04
     2,4.268E+02,-1 .007,-7.449, 1.38E-02,1.047E-03,2.621E-02/
      DATA ((T(I,J),J=1,6),I=1,2)/4.055E+02 ,1 .337,-2. 662,-2.169E-03
     1,-4.943E-04,1.454E-02
     2,412.2,1.276,-2.865,-2.888E-03,-3.707E-04,2.888E-02/
      DATA P/1.237E-02,0.2516,4.039E-02,-4.024E-02/
      DATA ((V(I,J),J=1,6),I=1,2)/ -0.4488,-9.344E-04,0.01583
     1,-5.219E-05,5.268E-06,1.536E-04
     2,-0.6019,1.793E-03,-3.159E-03,-5.1E-06,9.067E-07,3.522E-05/
c
c        THIS SUBROUTINE CHARACTERIZES A CUT OF CRUDE OIL WITH RESPECT
C        TO VAPOR PRESSURE.  THE INPUT REQUIRED IS API GRAVITY ANO THE
C        BOILING POINT AT 1 ATMOSPHERE.  THE OUTPUT IS A SWITCH NS
C        WHERE NS1=1 MEANS THE VAPOR PRESSURE EQUATION CAN BE USED DOWN T
c        10MMHG AND NS=2 MEANS THE CLAPEYRON EQUATION SHOULD BE USED.
c
c        THE VAPOR PRESSURE EQUATION IS:
c
c        LOG10(PR) = -A*(1.-TR)/TR - EXP(-20*(TR-B)**2)
c
c        WHERE PR = REDUCED PRESSURE, TR = REDUCED TEMPERATURE AND
c        A AND B ARE RETURNED BY THIS SUBROUTINE.
c
c        API = GRAVITY, TB = BOILING POINT AT 1 ATMOSPHERE IN  DEG F.
c        CALCULATE CRITICAL TEMPERATURE AND MOLECULAR WEIGHT.
c
      API2=API1*API1
      TB2=TB1*TB1
      CROSS=API1*TB1
      I=1
      IF(API1.GT.35.) I=2
      VIS1=V(I,1)+V(I,2)*TB1+V(I,3)*API1+V(I,4)*CROSS+V(I,5)*TB2
     1+V(I,6)*API2
      GO TO (10,30), NV
10    I=1
      IF(TB1.GT.500.) I=2
      MW1=C(I,1)+C(I,2)*TB1+C(I,3)*API1+C(I,4)*CROSS+C(I,5)*TB2
     1+C(I,6)*API2
      TC1=T(I,1)+T(I,2)*TB1+T(I,3)*API1+T(I,4)*CROSS+T(I,5)*TB2
     1+T(I,6)*API2
      TCK=(TC1+459.)/1 .8
C
C        CALCULATE THE VISCOSITY OF THE CUT.
C
      I=1
      IF(API1.GT.35.) I=2
      VIS1=V(I,1)+V(I,2)*TB1+V(I,3)*API1+V(I,4)*CROSS+V(I,5)*TB2
     1+V(I,6)*API2
c
c        CALCULATE THE CARBON NUMBER
c
      CNUM1=(MW1-2.)/14.
      X=ALOG10(CNUM1)
C
C        CALCULATE B FOR THE VAPOR PRESSURE EQUATION
C
```

```
      BPRIME=P(1)+X*(P(2)+X*(P(3)+X*P(4) ))
      B1=BPRIME-0.02
c
c       CALCULATE THE CRITICAL VOLUME, CC/GMOLE
c
      VW=1.88+2.44*CNUM1
      VC1=VW/0.044
c
c       CALCULATE THE CRITICAL PRESSURE IN ATMOSPHERES
c
      PCP=20.8*TCK/(VC1 -8.)
      PC1=PCP+10.
      TR=(TB1+459.)/(TC1+459.)
      PR=1./PC1
      NS1=1
      IF(TR.LE.B1) GO TO 2e
      A1=(ALOG10(PR)+EXP(-20.*(TR-B1)**2))*TR/(TR-1 .)
      GO TO 3e
20,   NS1=2
30    RETURN
      END
```

```
      SUBROUTINE MACK
      REAL*4 KAY,KAY0,MID,MOLEFT,MDH,MVO,L0,LH
      INCLUDE 'VARI.FOR'
      DIMENSION KAY(30),KAY0(30)
C
C       THIS SUBROUTINE CALCULATES THE INPUT PARAMETERS FOR THE
C       MACKAY EVAPORATION MODEL
C
c       THE MACKAY EVAPORATION EQUATION IS:
C
c             DF = DTHETA * H
c
c       WHERE DF IS THE CHANGE IN THE VOLUME FRACTION EVAPORATED
c       IN ONE TIME INCREMENT, H IS THE HENRY'S LAW COEFFICIENT, AND
c       DTHETA IS THE INCREASE IN THE "EVAPORATIVE EXPOSURE", WHICH
c       IS DEFINED AS:
c
c           DTHETA = K*A*DT/V
c
c       WHERE A IS THE SLICK AREA, DT IS THE TIME INCREMENT, V IS
c       THE SLICK VOLUME AT THE BEGINNING OF THE TIME INCREMENT,
c       AND K IS THE MASS TRANSFER COEFFICIENT.
C
C       FIRST DETERMINE WHICH CUTS EVAPORATE.  FOR NOW USE CUTS WHICH
c       HAVE VAPOR PRESSURES GREATER THEN 1X10E-07 AT
C       ENVIRONMENTAL TEMPERATURE.
c
      MAC=40
      CUTOFF=1.0E-07
      I CNT=0
10    ICNT=ICNT+1
      IF (VP(ICNT).GT.CUTOFF) Go To 10
      ICNT=ICNT-1
c
c       CALCULATE HEAT OF VAPORIZATION USING RESULTS OF
c       FALLON AND WATSON
C
      DO 20 I=1,ICNT
      API2=API(I)*API (I)
      TB2=TB(I)*TB(I)
      CROSS=API(I)*TB(I)
      DELH(I)=232.2-(0.2441*TB(I))-(0.6937*API(I))
     1-(3. 583E-04*CROSS)+(1.024E-04*TB2)+(1.037E-04*API2)
      DELH(I)=DELH(I)*MW(I)
      DELHTB(I)=DELH(I)/(TB(I)+459.)
20    CONTINUE
C
C       CALCULATE MEAN (DELTAH/TB) FOR "TROUTON'S RULE"
C
      SDH=0
      0 0 30 I=1,ICNT
      SDH=SDH+DELHTB(I)
30    CONTINUE
      MDH=SDH/ICNT
C
C       CALCULATE MOLAR VOLUME OF OIL
C
      MVO=WTMOLE/DCRUDE
C
C       NOW PERFORM A SIMPLE (ZERO PLATE) BATCH
```

```
C       DISTILLATION IN ORDER TO FIND THE BUBBLE POINT VERSUS
C       VOLUME FRACTION DISTILLED CURVE.  THE INTEGRATION IS
c       CARRIED OUT USING A FIRST ORDER RUNGA-KUTTA NUMERICAL
c       Integration SCHEME (SEE GREENSPAN, 1971).
C
C       TVOL IS THE TOTAL VOLUME OF THE BATCH (INITIALLY) IN METERS
C       CUBED .  VOLU IS THE REMAINING VOLUME OF THE BATCH.
C       EM(I) IS THE NUMBER OF GRAM-MOLES REMAINING
C       IN EACH CUT.  MOLEFT IS THE TOTAL NUMBER OF MOLES LEFT.
C       L0 IS THE TOTAL INITIAL NUMBER OF MOLES IN THE BATCH.
c
      WRITE(MAC,40)
40    FORMAT(1H1 ,2X, '**************** MACKAY PARAMETER CALCULATIONS
     1  ******************')
      WRITE(MAC,50)
50    FORMAT(/,2X,'THE MACKAY EVAPORATION MODEL IS DESCRIBED IN')
      WRITE(MAC,60)
60    FORMAT(2X,' (MACKAY ,1982)')
      WRITE(MAC,70)
70    FORMAT(2X,'THE FOLLOWING ARE THE RESULTS OF A CALCULATION OF THE')
      WRITE(MAC,80)(ANAME(I),I=1 ,5)
80    FORMAT(2X,' INPUT PARAMETERS FOR THE MACKAY MODEL FOR ',5A5)
      TT=TE-459.
      WRITE(MAC,90) TT
90    FORMAT(2X,'AT',1PE9.3,' DEGREES F')
      WRITE(MAC,100)
100   FORMAT(//,2X,*SIMULATED ONE-PLATE BATCH DISTILLATION:')
      TVOL=BM
      VOLU=BM
      DO 110 I=1,NCUTS
      EM(I)=MOLES(I)
110   CONTINUE
      J=1
      L0=TMOLES
c
C       LH AND RH ARE THE ENDPOINTS FOR THE INTERVAL HALVING TRIAL AND
C       ERROR THAT IS USED TO CALCULATE THE BUBBLE POINT OF THE
C       REMAINING LIQUID.
C
      LH=TB(1)+459.
      RH=TB(NC1)+459.
120   CONTINUE
      MOLEFT=0.
      DO 130 I=1,NCUTS
      MOLEFT=MOLEFT+EM( 1)
130   CONTINUE
c
c       BEGIN TRIAL AND ERROR TO GET BUBBLE POINT
c
      DO 160 L=1,20
      YTOT=0.
      MID=(RH+LH)/2.
C
C       THE SUBROUTINE VPIF RETURNS THE VAPOR PRESSURE OF THE
C       NON-RESIDUUM CUTS IN ATMOSPHERES AT THE TEMPERATURE
C       MID.  MID IS THE CENTER OF THE INTERVAL OF INTERVAL HALVING.
c
      CALL VPIF(MID,NC1)
C
C       WYI(I) IS THE THE MOLE FRACTION OF EACH CUT
```

```
c         IN THE VAPOR PHASE.  YTOT IS THE TOTAL MOLE FRACTION OF CUTS.
c
      DO 140 I=1,NC1
      WYI(I)=(VP(I)*EM(I)/MOLEFT)
      YTOT=YTOT+WYI (I)
140   CONTINUE
      IF(YTOT.GT.1.) GO TO 150
      LH=MID
      GO TO 160
150   CONTINUE
      RH=MID
160   CONTINUE
c
c         VFRAC IS THE VOLUME FRACTION DISTILLED.  TBNN(J) IS THE
c         BUBBLE POINT OF THE CURRENT FRACTION.
c
      VFRAC(J)=1.-(VOLU/TVOL)
      TBNN(J)=MID-459.
      WRITE(MAC,170)
170   FORMAT(///,8X,'F',7X,'TEMP(F)',5X,'Y SUM')
      WRITE(MAC,180) VFRAC(J),TBNN(J),YTOT
180   F O R M A T  2X,3(1X,1PE10.3))
      WRITE(MAC,190)
190   FORMAT(//4X,'I',3X,'MOLES I',5X,'VP(I)',5X,'Y(I)',/)
      DO 210 I=1,NC1
      WRITE(MAC,200) I, EM(I),VP(I),WYI(I)
200   FORMAT(2X,I2,3(1X,1PE10.3))
210   C O N T I N U E
c
c         IF ALL OF THE LAST CUT WITH VAPOR PRESSURE [AT ENVIRONMENTAL
C         TEMPERATURE) GREATER THAN 1X10E-7 IS GONE THEN STOP INTEGRATION.
C
      IF (EM(ICNT).EQ.0.)GO To 310
      TMK=0.
c
c         K0 AND MK ARE INTERMEDIATE VALUES FOR THE RUNGA KUTTA.
c
      DO 230 I=1,NC1
      KAY0(I)=-(0.05*L0)*(VP(I)*EM(I)/MOLEFT)
      MK(I)=EM(I)+KAY0(I)
c
c         ZERO MK IF IT  GOES NEGATIVE.
C
      IF  (MK(I).GT.0.) GO TO 220
      MK(I)=0.
220   CONTINUE
      TMK=TMK+MK(I)
230   CONTINUE
      IF(TMK.EQ.0.) GO TO 310
      IF (NC1.EQ.NCUTS)GO To  240
      TMK=TMK+EM(NCUTS)
240   CONTINUE
C
C         RESET ENDPOINTS FOR SECOND HALF OF INTEGRATION.
c
      RH=MID+100.
      LH=MID-100.
      DO 270 L=1,20
      YTOT=0.
      MID=(RH+LH)/2.
```

```
      CALL VPIF(MID,NC1)
      DO 250I=1,NC1
      YTOT=YTOT+(VP(I)*MK(I)/TMK)
25e   CONTINUE
      IF (YTOT.GT.1.) GO TO 2 6 0
      LH=MID
      GO TO 270
260   CONTINUE
      RH=MID
270   CONTINUE
      VOLU=0.
      DO 290 I=1,NC1
      KAY(I)=-(0.05*L0)*(VP(I) ● MK(I)/TMK)
      EM(I)=EM(1)+0.5*(KA%(I)+KAY(I))
c
c       ZERO EM IF IT GOES NEGATIVE
c
      IF (EM(I).GT.0.) GO TO 280
      EM(I)=0.
280   CONTINUE
C
C       CALCULATE THE REMAINING VOLUME.  RHO IS THE DENSITY IN
C       GRAM MOLES PER METER CUBED.
C
      VOLU=VOLU+EM(I
290   CONTINUE        )/RHo(I)
      IF(NC1.EQ.NCUTS) GO TO 300
      VOLU=VOLU+MOLES(NCUTS)/RHO(NCUTS)
300   CONTINUE
C
c       RESET THE ENDPOINTS AND RETURN FOR ANOTHER "TIME" STEP
C
      LH=TBNN(J)+459.
      RH=LH+100.
      J=J+1
      GO TO 120
310   CONTINUE
c
c       NOW LEAST SQUARES THE TBNN VS. VFRAC OATA.
c
      SX=0
      SY=0
      SX2=0
      SXY=0
      SY2=0
      DO 320 I=1.J
      SX=SX+VFRAC(I)
      SY=SY+TBNN(I)
      SX2=SX2+VFRAC(I)*VFRAC(I)
      SY2=SY2+TBNN(I)● TBNN(I)
      SXY=SXY+TBNN(I● VFRAC(I)
320   CONTINUE
      XM=SX/J
      YMM=SY/J
      BNUM=SXY-(SX*SY/J)
      BDEN=SX2-(SX*SX/J)
      BEE=BNUM/BDEN
      AA=YMM-BEE*XM
C
C       CALCULATE CORRELATION COEFFICIENT
```

```
C
      FAC1=(SX2-SX*SX/J)
      FAC2=(SY2-SY*SY/J)
      RDEN=(FAC1*FAC2)**0.5
      R=BNUM/RDEN
C
C        PRINT OUT MACKAY PARAMETERS
C
      WRITE (MAC,330)
330   FoRMAT (/,6X,'DELTAH',
     14X, 'DELTAH/TB')
      Do 350 I=1,ICNT
      WRITE( MAC,340)I,DELH(I),DELHTB(I)
340   FORMAT(1X,I2,5(1X,1PE10.3))
350   CONTINUE
      WRITE(MAC,360)
360   FORMAT(//,2X,'WHERE:')
      WRITE(MAC,370)
370   FORMAT (2X, 'DELTAH IS THE ENTHALPY OF VAPORIZATION IN  BTU/LBMOLE')
      WRITE(MAC,380)
380   FORMAT( 2X,'DELTAH/TB IS THE TROUTONS RULE CONSTANT IN BTU/LBMOLE
     1*DEG R')
390   CONTINUE
      WRITE (MAC,400)
400   FORMAT(//,2X,'LEAST SQUARES OF B.P. VS. FRACTION EVAPORATED:')
      WRITE (MAC,410)BEE
410   FORMAT(/,5X,'SLOPE: ',1PE10.3,'DEG R/FRACTION EVAPORATED')
      WRITE (MAC,420) AA
42e   FORMAT(5X,'INITIAL B.P.: ',1PE10.3,'DEG F')
      WRITE (MAC,430) R
43e   FORMAT(5X.'CORRELATION COEFFICIENT: '.1PE10.3)
      WRITE                (MAC,440) DCRUDE  ' "      "
440   FORMAT (/,2X,'BULK OIL DENSITY: ',1PE10.3,' GRAMs/cc*)
      WRITE MAC,450) MVO
45e   FORMAT(2X, *BULK MOLAR VOLUME OF OIL:  ',1PE10.3,' CC/MOLE')
      WRITE MAC,460) MDH
46e   FORMAT( 2X, 'MEAN TROUTONS RULE CONSTANT: ',1PE10.3,'BTU/LBMOLE
     1*DEG R')
      WRITE(MAC,470)
47e   FORMAT( //,2X,'AFTER SIMPLIFICATION AND COMBINING TERMS, THE '
     1)
      WRITE(MAC,480)
48e   FORMAT( 2x. 'MACKAY EVAPORATION MODEL BECOMES:')
      AAA=MVO*0.01219/(((XPRINT-32.)/1.8)+273.)
      AAA=ALOG(AAA)
      BBB=MDH/1.987
      CCC=BBB/(XPRINT+459 .)
      BBB=BBB+AAA
      DDD=AA+459.
      WRITE(MAC,490)BBB,CCC,DDD,BEE
49e   FORMAT /,10X,'DELTA-F = DELTA-THETA .EXP( ',1PE10.3
     1 , ' - ',1PE10.3,' ( ',1PE10.3,' + ',1PE10.3,'(F)))')
      EEE=CCC*DDD
      FFF=BBB-EEE
      GGG=CCC*BEE
      WRITE(MAC,500)
500   FORMAT(/,15X,'OR')
      WRITE(MAC,510)FFF,GGG
510   FORMAT(/,10X,'DELTA-F = DELTA-THETA * EXP(',1PE10.3,'-',1PE10.3
     I,"(F))')
52e   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE BRKG4(Y,X1,X2,XP,NEQ,NDEL)
      INCLUDE 'VARI.FOR'
      REAL*4 K1,K2,K3,K4
      DIMENSION Y(30),YARG(30),K2(30),K1(30),K3(30),K4(30)
C
C       RUNGA-KUTTA 4-TH OROER NUMERICAL INTEGRATION FOR SIMULTANEOUS
C       DIFFERENTIAL EQUATIONS, SEE C.R. WYLIE, PAGEs lea-117 OR
C       D. GREENSPAN, PAGES 113-115.
C
C       THIS SUBROUTINE 00ES THE PRINTING, THE INITIAL AND FINAL VALUES
C       ARE ALWAYS PRINTED.  PRINT THE RESULTS EVERY XP INCREMENT
C       IN X.
C
C       THE USER MUST WRITE SUBROUTINE FXYZ WHICH CALCULATES THE
C       K1, K2, K3, AND K4 VECTORS AS A FUNCTION OF X AND THE
C       CURRENT Y VECTOR.  INTEGRATION FOLLOWS THE REFERENCES ANO
C       WAS TESTED ON PROBLEM 5, PAGE 116 IN WYLIE.
C
C       THE FIRST NCUTS POSITIONS IN THE Y VECTOR ARE THE MOLES
C       OF THE COMPONENTS, POSITION NCUTS+1 IS THE AREA OF THE
C       SLICK.  POSITION NCUTS+2 IS THE MASS LOST FROM THE SLICK
C       BY DISPERSION ALONE.  POSITION NCUTS+3 IS THE MASS LOST
C       FROM THE SLICK BY EVAPORATION ALONE,
C
C       LINE KEEPS TRACK OF HOW MANY LINES ARE WRITTEN TO THE
C       PLOT FILE.  NEQ1 IS THE NUMBER OF COMPONENTS+1.  NS IS
C       A ROUTING SWITCH TO CHANGE THE PRINT INTERVAL.  IN IS
C       AN INPUT ROUTING SWITCH TO DELETE RAPIDLY CHANGING
C       COMPONENTS.  GONE(LINE) IS THE MASS FRACTION REMAINING
C       AT TIME STEP LINE.  INT IS A SWITCH TO INDICATE WHEN THE
C       INTEGRATION HAS STARTED: INT=1, NOT STARTED; INT=2,
C       STARTED.  ITYP IS A HEADER PRINT SWITCH FOR THE
C       80-COLUMN FILE.
C
      INT=1
      ITYP=1
      LINE=0
      NEQ1=NEQ+1
      NEQ2=NEQ+2
      NEQ3=NEQ+3
      NSS=1
      IN=1
      IKEEP=1
      GONE(1)=1.
      DISPER=0.
C
C       TOTAL IS THE INITIAL NUMBER OF MOLES.
C       TSAVE IS THE INITIAL MASS.
C
      TOTAL=0.
      TSAVE=0.
      DO 10 I=1,NEQ
C
C       CALCULATE AND SAVE THE INITIAL CONDITIONS.
C
      YSAVE(I)=Y(I)
      YMSAVE(I)=Y(I)*MW(I)
      MWU(I)=MW(I)
      TSAVE=TSAVE+YMSAVE( I)
      TOTAL=TOTAL+Y( I)
```

```
10    CONTINUE
C
C       SAVE THE INITIAL AREA.
C
      YMSAVE(NEQ1)=Y(NEQ1)
c
C       INITIALIZE THE MASS LOST BY DISPERSION ALONE AND
c       EVAPORATION  ALONE.
c
      Y(NEQ2) -0.
      Y(NEQ3)=0.
C
C       NDEL IS THE NUMBER OF COMPONENTS DELETED BECAUSE THEY
c       EVAPORATE TOO FAST.  NFAST IS THE CURRENT ARRAY LOCATION
c       OF THE FASTEST MOVING COMPONENT.
C
      NDEL=0
      NFAST=0
      X=X1
c
c       INITIALIZE THE PRINT SWITCH TO FORCE A PRINT AND
c       SUBSEQUENT CALCULATIONS THE FIRST TIME THROUGH.
c
      XW=- 1.
      WRITE"(IOU,20)
20    FORMAT(/,1X,'COUNT THE CUTS IN THE FOLLOWING OUTPUT FROM LEFT
     1 TO RIGHT',/)
      WRITE(IOU,30)
30    FORMAT( 1X,'THE INITIAL GRAM MOLES IN THE SLICK ARE:')
      WRITE( IOU,40)(Y(I),I=1,NEQ)
4%    FORMAT(11(1X,1PE10.3))
      WRITE( IOU,50)
50    FORMAT(/,1X,'THE INITIAL MASSES (GRAMS) IN THE SLICK ARE
     1:')
      WRITE IOU,40) (YMSAVE( I), I=1,NEQ)
      WRITE (IOU,60) TSAVE
60    FORMAT( 1X,'THE TOTAL MASS FROM THESE CUTS IS '
     1,1PE10.3,' GRAMS')
      WRITE(IOU,70)
70    FORMAT( /)
c
c       CALCULATE DY/DX AND SET THE STEP SIZE TO APPROXIMATE
c       A 5% CHANGE IN THE MOST RAPIDLY CHANGING Y.  WHEN THIS
C       Y DECREASES BY A FACTOR OF 20,RESET THE STEp SIZE
C       ACCORDING TO THE NEXT Y.
c       SOME Y'S WILL CHANGE SO FAST THAT THEY WILL BE GONE
C       IN A FEW MINUTES.  THESE ARE DELETED BEFORE INTEGRATION
C       STARTS AND NOTED ON THE PRINTED RESULTS,
C
C       INITIALIZE OR INCREMENT NFAST.
c
80    NFAST=NFAST+1
90    CALL FXYZ(X,Y,K1,NEQ)
C
C       THE TIME UNIT IS HOUR.
c       SET THE STEP SIZE TO H=0.05*Y/(DY/DX).
c
      H=0.05*Y(NFAST)/K1(NFAST)
      YOLD=Y(NFAST)
      H=ABS(H)
```

```
      H2=H/2.
      GO TO (100,170), IN
C
C       IF THERE IS A RAPIDLY MOVING COMPONENT AT THE BEGINNING
c       ITS  STEP SIZE WILL BE VERY SMALL, DO NOT LET THE
c       STEP SIZE BE LESS THAN 0.05 HOUR.
c
100   IF(H.GT.0.05) GO TO 130
c
c       Y(NFAST) CHANGES TOO FAST TO CALCULATE, DELETE IT AND MOVE
C       EVERYBODY ONE SPACE TO THE LEFT.
C
C       WHEN YOU MOVE THE AREA BE SURE TO SUBTRACT THE CONTRIBUTION
C       OF THE CUT JUST DELETED.
c
      ISTART=1
      NFAST=1
      NDEL=NDEL+1
c
c       DECREASE THE NUMBER OF COMPONENTS BY 1
c
c       DELMAS IS THE TOTAL MASS OF DELETED CUTS
c
      DELMAS=DELMAS+(Y(NDEL)*MW(NOEL) )
      NEQ=NEQ-1
      NEQ1=NEQ+1
      NEQ2=NEQ+2
      NEQ3=NEQ+3
      NEQ4=NEQ+4
      AD=Y(1)/RHO(1)/Z
      00 110 I=1,NEQ
c
c       SHIFT THE ARRAYS.
c
      I1=I+1
      Y(I)=Y(I1)
      VP(I)=VP(I1)
      MTC(I)=MTC(I1)
      YSAVE(I)=YSAVE( 11)
      VLOG(I)=VLOG(I1)
      RHO(I)=RHO(I1)
      MWU(I)=MWU(I1)
      YMSAVE(I)=YMSAVE( 11)
110   CONTINUE
c
c       BE SURE ANO 00 THE LAST THREE POSITIONS WHEN SHIFTING
c
      Y(NEQ1)=Y(NEQ2)-AD
      Y(NEQ2)=Y(NEQ3)
      Y(NEQ3)=Y(NEQ4)
      WRITE (IOU,120)NDEL
120   FORMAT(TX1X,'CUT,'I12,' GOES AWAY IN MINUTES, THEREFORE IT WAS
     1DELETED AND THE CUTS RENUMBERED',/)
      WRITE (ITY,120) NOEL
      GO TO 90
130   IN=2
      GO TO (140,160) ITYP
140   ITYP=2
      WRITE(ITY,150)
150   FoRMAT( /,1X,'TIME',2X,'BBL',3X,'SPGR',2X,'AREA',2X
```

```
     1,*THICKNESS W',2X,'DISP',4X,'ERATE',4X, 'M/A    I    J')
C
C       THE COMPONENTS T HAT MOVE TOO FAST TO CONSIDER (AT TIME
c       ZERO) HAVE BEEN DELETED AND THE ARRAYS SHIFTED.
c
160   NEQ1=NEQ+1
      NEQ2=NEQ+2
      NEQ3=NEQ+3
C
C       NEVER LET THE STEP SIZE BE GREATER THAN 0.5
C
170   IF(H.GT.0.5) H=0.5
      WRITE( IOU,180)H,NFAST
180   FORMAT( /,2x,'STEP SIZE OF ',1PE1O.3,' IS BASED ON CUT ',13,/)
C
C       CHECK THE PRINT SWITCH.
C
1 90  IF(X.LT.XW) GO TO 400
C
C       INCREMENT THE PRINT SWITCH AND CALCULATE INTERMEDIATE
C       RESULTS NOT CARRIED WITH THE INTEGRATION.
C
      XW=X+XP
      YTOT=0.
      TMASS=0.
      Do 200 I=1,NEQ
      YF(I)=Y(I)/YSAVE(I)
      YTOT=YTOT+Y( I)
      YM(I)=Y(I)*MWU(I)
      YM1(I)=YM(I)
      TMASS=TMASS+YM( I)
      YM(I)=YM(I)/YMSAVE(I)
200   CONTINUE
      YM1(NEQ1)=Y(NEQ1)
C
C       CALCULATE THE MEAN MOLECULAR WEIGHT OF THE SLICK.
C
      WMEANS=0.
      DO 210 I=1,NEQ
      WMEANS=WMEANS+MWU( I)*Y(I)/YTOT
210   CONTINUE
      LINE=LINE+1
      WRITE( IOU,220)X,LINE
22e   FORMAT( 2X, 'TIME = ',1PE8. 1,' HOURS, MASS FRACTION OF EACH
     1 CUT REMAINING: ',65X,13)
      WRITE( IOU,230)(YM(I),I=1,NEQ)
23e   FORMAT( 14(1X, 1PE8. 1))
      CHECK=TMASS+Y(NEQ2)+Y(NEQ3)
      WRITE( IOU,240)TMASS,Y(NEQ2),Y(NEQ3),CHECK
24e   FORMAT( 2X, 'MASS REMAINING = ',1PE10.3,', MASS DISPERSED
     1 = ',1PE10.3,', MASS EVAPORATED = ',1PE1O,3,'
     2, SUM = ',1PE10.3)
      WRITE (IPU,250) NEQ1
25e   FORMAT(I5)
      WRITE( IPU,260) X, (YM1(I),I=1,NEQ1)
26e   FORMAT( 10(1X,1PE10.3))
C
C       WHEN THE FRACTION REMAINING OF COMPONENT I GETS LOW,
C       SET ITS VAPOR PRESSURE AND MOLES EQUAL TO ZERO.
C
```

```
      DO 270 I=ISTART,NEQ
      IF(YF(I).GT.1.0E-08) GO TO 270
      IKEEP=I+1
      VP(I)=0.
      Y(I)=0.
270   CONTINUE
      ISTART=IKEEP
      NFAST=IKEEP
      GONE(LINE)=TMASS/TSAVE
      ZP=Z*100.
      WRITE(IOU,280) GONE(LINE),Y(NEQ1),ZP,WMEANS
280   FORMAT( 2X, 'FRACTION (BASED ON MASS) REMAINING IN THE SLICK
     1=',1PE8.1,', AREA=',1PE8.1,' M**Z, THICKNESS='
     2,1PE8.1,' CM, MOLE WT=',0PF5.1)
C
C       WIO IS THE MOUSSE CALCULATION.
C
C       FIRST CHECK TO SEE IF MOUSSE HAS ALREADY BEEN FORMED.
C       IF  IT HAS, CALCULATE XMOU, WHICH IS A FAKE
C       TIME. THIS WILL MATCH THE MOUSSE AND VISCOSITY DATA TO
C       THE PREVIOUS CONDITIONS
C
C       IF NOT, PROCEED IN THE NORMAL MANNER
C
      IF (MOUSWI.NE.1) Go To 290
      C3NEW=C4*WINDS*WINDS
      XMOU=X+(HOUMOU*C3SAVE)/C3NEW
      CALL WIO(XMOU,W,VTERM)
      GO TO 300
290   CALL WIO(X,W,VTERM)
C
C       VISCP1IS THE VISCOSITY OF THE PARENT OIL  WITH NO WATER
C       INCORPORATED.
C       VISCP1 IS IN CENTIPOISE, FEVAP IS THE FRACTION OF OIL
C       EVAPORATED.  NOTE THAT FEVAP IS NOT
C       1 - (FRACTION REMAINING) BECAUSE DISPERSION LOSSES
C       WOULD BE INCLUDED.  THE FRACTION EVAPORATED MUST
C       CORRECT FOR THE LOSS DUE TO DISPERSION.
C
C
C       ● ================ ● ==
C       WE MIGHT WANT TO CHANGE TO A BETTER FEVAP
C       CALCULATION LATER.
C       ****************** **
C
300   FEVAP=(1.-GONE(LINE))/YM(NEQ)+FE
      VISCP1=VSLEAD*EXP(MK4*FEVAP)
C
C       VTERM IS THE VISCOSITY MULTIPLIER FROM THE MOUSSE
C       CALCULATION.
C
      VISCP=VISCP1● VTERM
C
C       CALCULATE THE BULK SPGR.
C
      BSPGR=0.
      DO 310 I=ISTART,NEQ
      BSPGR=BSPGR+SPGR(I)*Y(I)/YTOT
310   CONTINUE
      VISQT=SQRT(VISCP/10.)
```

```
C
C       CALCULATE THE DISPERSION FACTOR,
C
      FB=1./(1.+KB*VISQT*Z*STEN/0.024)
      DISPER=FRACTS*FB
      WRITE( IOU,320)W,VISCP,DISPER
320   FORMAT( 2X, 'WEIGHT FRACTION WATER IN OIL =',1PE8.1,', VIS
     1COSITY = ',1PE8.1,' CENTIPOISE, DISPERSION TERM ='
     2,1PE8.1,' WEIGHT FRACTION/HR')
      CVOLUM=Y(NEQ1 )*Z
      TBBL=CVOLUM/0 .159
      CVOLUM=(1.0E+06)*CVOLUM
      CSPGR=TMASS/CVOLUM
      WAREA=(1.0E+06)● Z*CSPGR
      WDISP=WAREA*DISPER
      IF(INT.EQ.1) ERATE=0.
      ERATE=ERATE/Y(NEQI )
      WRITE IOU,330) WAREA,CSPGR,TBBL,WDISP, ERATE
330   FORMAT 2X,'MASS/AREA=',1PE8.1,'GMS/M*M,SPGR='
     1,1PE8. 1,', TOTAL VOLUME=',1PE8.1,'BBL,DISPERSION='
     2,1PE8.1,' GMS/M*M/HR, EVAP RATE=',1PE8. 1,' GMS/M*M/HR')
C
C       PRINT AN OUTPUT FILE FOR 80 COLUMN OUTPUT.
C
      DO 340 J=1,NEQ
      JCUT=J
      IF(YM(J).GT.0.5) GO TO 350
340   CONTINUE
350   DO 360 I=1,NEQ
      ICUT=I
      IF(YM(I).GT.0.01) GO TO 37e
360   CONTINUE
370   IX=X
      IW=W*100.
      wRITE (ITY,380)IX,TBBL,CSPGR,Y(NEQ1),ZP,IW,WDISP
     1,ERATE,WAREA,ICUT,JCUT
380   FORMAT(1X,I3,1PE8.1,0PF5.2,2(1PE8. 1),1X,13
     1,3( 1PE8. 1),12,13)
      WRITE (IOU,70)
C
C       INCREASE XP TO 10 HOURS AFTER 50 HOURS OF WEATHERING.
C
      GO TO (390,400), NSS
390   IF(X.LT.50.) GO TO 400
      NSS=2
      XP=10.
C
C       TAKE A STEP IN TIME
C
400   XARG=X
      DO 410 I=1,NEQ3
      YARG(I)=Y(I)
410   CONTINUE
C
C       INT IS A SWITCH TO INDICATE THAT THE INTEGRATION WAS
C       INITIATED.
C
      I NT=2
      CALL  FXYZ(XARG,YARG,K1,NEQ)
      XARG=X+H2
```

```
      DO 42e I=1,NEQ3
      YARG(I)=Y(I)+H*K1(I)/2.
42e   CONTINUE
c
C       SAVE THE EVAPORATION RATE FROM THE FIRST TIME
C       THE DERIVATIVES ARE CALCULATED.
C
      ERATE=K1(NEQ3)
      CALL FXYZ(XARG,YARG,K2,NEQ)
      DO 43e I=1,NEQ3
      YARG(I)=Y(I)+H*K2(I)/2.
430   CONTINUE
      CALL FXYZ(XARG,YARG,K3,NEQ)
      XARG=X+H
      DO 440 I=1,NEQ3
      YARG(I)=Y(I)+H*K3(I)
44e   CONTINUE
      CALL FXYZ(XARG,YARG,K4,NEQ)
      DO 450 I=1.NEQ3
      Y(I)=Y(I)+H*(K1(I)+2.*(K2(I)+K3(I))+K4(I))/6.
450   CONTINUE
c
c       IF 10 pER CENT BY MOLES OR LESS OF THE SLICK IS LEFT, STOP
C       THE CALCULATION BECAUSE STRANGE THINGS HAPPEN CLOSE TO
c       ZERO OIL.
c
      REMAIN=0.
      DO 46e I=1,NEQ
      REMAIN=REMAIN+Y(I)
46e   CONTINUE
      TEST=REMAIN/MOLSAV
      IF(TEST.GT.0.1) GO TO 510
      NQUIT=I
      TYPE 47e
47e   FORMAT(1X,'THE SLICK HAS DECREASED To 10% OF THE ORIGINAL MOLES. *)
      TYPE 480
48e   FORMAT(1X,'THE INTEGRATION WILL BE STOPPED HERE.')
      WRITE(IOU,490)
49e   FORMAT /,1X,'THE SLICK (MOLES) HAS DECREASED TO 10%
     1 OR LESS, THEREFORE THE CALCULATION WAS STOPPED.')
      WRITE(ITY,500)
5ee   FORMAT( /,1X,'SLICK DECREASED To 10% MAss ● *stop**')
      GO TO 550
c
c       RECALCULATE THE OVER-ALL MASS-TRANSFER COEFFICIENTS OUTSIDE
c       THE DERIVATIVE SUBROUTINE.  THE DIAMETER DEPENDENCE IS VERY
c       SLOW.  TERM2 IS THE OLD DIA**(-0.11).  SO DIVIDE THE OLD
c       COEFFICIENT BY TERM2 ANO MULTIPLY IN THE NEW ONE.
c
c       WHEN YOU CHANGE THE WIND SPEED WITH RESPECT TO TIME,
c       CHANGE THE MASS-TRANSFER COEFFICIENT HERE.  DIVIDE
C       OUT THE OLD WIND TERM AND MULTIPLY IN THE NEW ONE.
c       ALSO, IF THE TEMPERATURE CHANGES, RECALCULATE THE
c       VAPOR PRESSURE HERE.  THIS APPLIES ONLY TO MACKAY
c       ANO MATSUGU.
c
510   GO TO (540,520,540), KMTC
52e   DIA=SQRT(Y(NEQ1)/0.785)
      TNEW=DIA**(-0.11)
      ADJUST=TNEW/TERM2
```

```
      DO 530 I=1, NEQ
      MTC(I)=MTC(I)*ADJUST
530   CONTINUE
      TERM2=TNEW
C
C       CHECK TO SEE IF THE INTEGRATION IS COMPLETED.
C
540   IF(X.GE.X2) GO TO 550
      X=XARG
C
C       CHECK TO SEE IS THE FIRST NON-ZERO MOLES HAS FALLEN TO
C       0.01 OF ITS STARTING VALUE.  IF IT HAS, RECALCULATE THE
C       STEP SIZE ON THE NEXT NON-ZERO COMPONENT. NOTE THAT
C       A COMPONENT IS NOT ZEROED UNTIL ITS MOLE NUMBER HAS
C       FALLEN TO LESS THAN 1.0E-08.
C
      TEST=ABS(Y(NFAST )/YOLD)
      IF(TEST.LT.0.01) GO TO 80
      GO TO 190
550   NSTART=NDEL+1
      WRITE (IOU,560) NSTART
560   FORMAT( /,1X,'THE CUT NUMBERING BEGINS WITH',I3,'BASED ON
     1 THE ORIGINAL CUT NUMBERS',/)
      LINE=LINE+1
      WRITE( IOU,570)X,LINE
570   FORMAT( 1X,'THE FINAL MASS FRACTIONS FOR THE SLICK AT "
     1,1PE8.1,' HOURS ARE:',65X,I3)
      HOUMOU=X
      TMASS=0.
      DO 580 I=1,NEQ
      YM(I)=Y(I)*MWU(I)
      TMASS=TMASS+YM(I)
      YM1(I)=YM(I)
      YM(I)=YM(I)/YMSAVE(I)
580   CONTINUE
      YM1(NEQ1)=Y(NEQ1)
      GONE(LINE)=TMASS/TSAVE
      WRITE(IOU,40) (YM(I),I=1,NEQ)
      WRITE(IPU,250 NEQ1
      WRITE(IPU,260 X, (YM1(I),I=1,NEQ1)
      WRITE(IPU,260 (GONE(I),I=1,LINE)
      ZP=Z*100.
      WRITE (IOU,280) GONE(LINE),Y(NEQ1 ),ZP,WMEANS
      CHECK=TMASS+Y(NEQ2)+Y(NEQ3)
      WRITE (IU,240) TMASS,Y(NEQ2),Y(NEQ3),CHECK
      TME=TME+Y(NEQ3)
      TMD=TMD+Y(NEQ2)
      FE=(Y(NEQ3)/TMASAV)+FE
      WRITE(IOU,590)
590   FORMAT(/,1X,'*****************************************
     1************************* ',/)
      RETURN
      END
```

```
      SUBROUTINE VPIF(TEES,N)
      INCLUDE 'VARI.FOR'
C
C       THIS SUBROUTINE CALCULATES THE VAPOR PRESSURE OF THE CUTS AT
C       A SPECIFIED TEMPERATURE, TEES. IT USES A SIMPSONS RULE
C       INTEGRATION WITH 21 POINTS
C
      YI(X)=((1.-X)**0.38)/(X*X)
      DO 30 I=1,N
      TEE=TEES
      IF (TEE.LT.Tie(I)) GO To 10
      TEE=TEE/TC(I)
      EX=EXP(-20*(TEE-B(I))**2)
      Y--A(I)*(1.-TEE)/TEE-EX
      VP(I)=PC(I)*10.**Y
      GO TO 30
10    CONTINUE
      TR1=TEE/TC(I)
      TR2=T10(I)/TC(I)
      DH=(TR2-TR1)/20.
      RESULT=YI(TR1)
      TR=TR1
      DO 20 L=1,10
      TR=TR+DH
      RESULT=RESULT+4.*YI(TR)
      TR=TR+DH
      RESULT=RESULT+2.*YI(TR)
20    CONTINUE
      TR=TR+DH
      RESULT=RESULT+4.● YI(TR)
      TR=TR+DH
      RESULT=DH*(RESULT+YI(TR))/3.
      P1=-4.33-HVAPZ(I)*RESULT/(1.987*TC(I))
      VP(I)=EXP(P1)
30    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FXYZ(XARG,MOLES1,KK,NEQ)
      REAL*4 MOLES1,KK
      INCLUDE 'VARI.FOR'
      DIMENSION KK(30),MOLES1(30)
C
C       THE VECTOR BEING INTEGRATED RESIDES IN MOLESI(I).
C       POSITIONS I=1 THROUGH I=NEQ ARE THE PSEUDO COMPONENTS,
C       POSITION NEQ1=NEQ+1 IS THE AREA.
C       POSITION NEQ2=NEQ+2 IS THE MASS LOST BY DISPERSION ALONE.
C       POSITION NEQ3=NEQ+3 IS THE MASS LOST BY EVAPORATION ALONE,
C
C
      SUM=0.
      DO 10 I=1,NEQ
      SUM=SUM+MOLES1(I)
10    CONTINUE
      0 0 20 I=1,NEQ
C
C       CALCULATE THE MOLE DERIVATIVES.
C
      TMPVP(I) =MTC(I)*MOLES(NEQ1)*VP(I)*MOLES1(I)/SUM
      TMPDS(I) =DISPER*MOLES1(I)
      KK(I)=TMPVP(I)+TMPDS(I)
      KK(I)=-KK(I)
20    CONTINUE
      VOLLU=0.
      DO 30 I=1,NEQ
      VOLLU=VOLLU+MOLES1 (1)/RHO(I)
30    CONTINUE
C
C       CALCULATE THE AREA DERIVATIVE.
C
      Z=VOLLU/MOLES1(NEQ1)
      KK(NEQ1)=(5.4E+05)*(Z**1.33)*MOLES1(NEQ1)**0.33
      KK(NEQ1) =SPREAD*KK(NEQ1 )*SPRFAC
C
C       CALCULATE THE MASS LOST FROM THE SLICK DUE TO
C       EVAPORATION ALONE AND THEN DISPERSION ALONE.
C
      KK(NEQ2)=0.
      KK(NEQ3)=0.
      DO 40 I=1,NEQ
      KK(NEQ3)=KK(NEQ3)+TMPVP(I)*MWU(I)
      KK(NEQ2)=KK(NEQ2)+TMPDS(I)*MWU(I)
40    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE  WIO(TIME,W,VTERM)
      INCLUDE 'VARI.FOR'
      WFUNC(W)=(1.0-C2*W)*EXP(-2.5*W/(1.0-C1*W))
      VIS(W)=EXP(2.5*W/(1.0-C1*W))
      DATA WSAVE,C4SAVE/-1.,-1./
C
C       THIS IS THE WATER-IN-OIL (MOUSSE) ROUTINE.
C       W IS THE FRACTIONAL WATER CONTENT IN THE OIL.
C       WINDS IS THE WIND SPEED IN KNOTS.
C       TIME IS IN HOURS.
C       CI IS A VISCOSITY CONSTANT = 0.65
C       C2 IS AN OIL-COALESCING CONSTANT AND IS OIL
C       DEPENDENT, AND IS THE INVERSE OF THE MAXIMUM WEIGHT
C       FRACTION WATER IN OIL.
C       C3 IS A WATER INCORPORATION RATE (1./HR), USUALLY 0.01*U*U
C
C       THE PREDICTION EQUATION FOR W IS IMPLICIT AND IS
C       SOLVED BY TRIAL AND ERROR.
C
C       REFERENCE:   CHAPTER 4 BY MACKAY IN OIL SPILL PROCESSES
C       AND MODELS.
C
C       DECEMBER, 1981
C
C       IERR IS THE ERROR CODE.
C       IERR=1 IS A NORMAL EXIT, IERR=2 IS A PROBLEM IN THE
C       TRIAL-AND-ERROR ROUTINE, IERR=3 IS A STEADY-STATE
C       MOUSSE EXIT..
C
C       IF THE OIL  DOES NOT FORM MOUSSE, C2 WAS SET TO -1.
C
      IF(C2.GT.0.) GO TO 10
C
C       NO MOUSSE FOR THIS OIL,  SET TERMS AND RETURN.
C
      W=0.
      VTERM=I .
      GO TO 90
10    IERR=1
C
C       CHECK TO SEE IF  THE WIND OR INCORPORATION RATE CONSTANT
C       CHANGED.
C
      IF(WINDS .EQ.WSAVE.AND.C4. EQ.C4SAVE) GO TO 20
      WSAVE=WINDS
      C4SAVE=C4
      U2=WINDS*WINDS
      C3=C4*U2
20    EX=C3*TIME
      IF(EX.GT.20.) GO TO 80
      TEST=EXP(-EX)
C
C       BRACKET THE TIME WITH TWO VALUES OF W.
C
      W=0.
      WMAX=1./C2
      WSTEP=WMAX/10.
30    W=W+WSTEP
      TRY=WFUNC(W)
      IF(TRY.LT.TEST) GO TO 40
```

```
      IF(W. LT. WMAX) GO TO 39
      I ERR=2
      GO TO 90
c
c        NOW DO INTERVAL HALVING TO FIND W.
c
40    NTRY=0
      wR=w
      WL=W-WSTEP
50    W=(WR+WL)/2.
      TRY=WFUNC(W)
      IF(TRY.LT.TEST) GO TO 60
      wL=W
      GO TO 70
60    wR=w
70    NTRY=NTRY+1
      IF(NTRY.LT.1O) GO TO 50
      VTERM=VIS(W)
      GO TO 90
80    I ERR-3
90    CONTINUE
      RETURN
      END
```

Minerals Management Service
Alaska OCS Region
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Anchorage, AK 99508-4302

Do not Bend

Distinctive Species

COMPUTER MEDIA,
NOT IMAGED

57 COMPUTER MEDIA NOT IMAGED