COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1970 / 18

Estimated Consumption of Drilling Mud Materials in Australia and Papua and New Guinea in 1968 and Comparative Study of the same for 1963 - 1968

by

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MINERAL RESOURCES BRANCH

PETROLEUM TECHNOLOGY SECTION

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SUMMARY

This record is the second on estimates of consumption of drilling mud materials used in drilling exploration wells in Australia and Papua - New Guinea. The first compilation was prepared by P.G. Duff and was issued in 1968 as B.M.R. Record No. 1968/64.

Included in this record are estimates of consumption of drilling mud materials for 1968, the average of estimated consumption for the period 1963-1968, the results of the study of parameters relevant to drilling and their correlation with amounts of estimated consumption of mud materials during 1963-1968, the frequency of usage of mud materials for 1968, the consumption of drilling mud materials by the Bureau of Mineral Resources and a new list of trade names for various mud chemicals, their packaging quantities and their most common application in drilling muds.

INTRODUCTION

Essential data for consumption of drilling mud materials, during 1968, were obtained largely from well completion reports submitted in respect of drilling operations carried out under the Petroleum Search Subsidy Act 1959-1968 and other statutory reports. Consumption of materials was then estimated according to definition No.8 (see table definitions). These estimates are presented in TABLE II. It is to be noted that estimates were obtained on the basis of drilling of exploration wells only. Therefore, the results shown in this report may be somewhat overestimated as the footage used included drilling of developmental wells which would use less mud on equal footage basis. However, it will be shown later that this is not necessarily so.

TABLE III contains data of major importance in drilling. These data were used in obtaining some parameters which would correlate with consumption of drilling mud materials.

Data on mud materials used in drilling by the Bureau of Mineral Resources are shown separately in TABLE I; they are not included in TABLES II and III.

The report does not consider the use of materials used in drilling for seismic surveys by private industry.

Definitions of terms and procedures for obtaining data presented are given under a number in the table of definitions.

Tables I to IV were made to extend the data contained in the previous record. For instance, consumption by B.M.R. is given in TABLE I; consumption (actual and frequency) by exploration companies is given in TABLE II; wells and footage drilled and examined, consumption and deviation from averages are given in TABLE III. TABLE IV contains information on packaging quantity and comments on the most common usage of various components of drilling mud.

Drilling activities were classified according to whether they were conducted on land or in marine operations. This action required a definition of marine drilling which is given in the table of definitions.

It is shown that the considerable increase in consumption drilling mud materials during 1968 is due to the increase of footage drilled in marine operations.

DISCUSSION

In order to evaluate trends in annual consumption of drilling mud materials, available data were subdivided into groups and subgroups shown in TABLE II.

It will be seen that there was an abnormally high consumption of barytes and, to some extent, of bentonites in relation to the total footage made in marine drilling operations in the Gulf of Papua during 1968. This apparently resulted from the need to control the drilling through considerable sections of Miocene mudstone, the necessity for dumping badly contaminated muds and circulation losses in a number of offshore wells.

The consumption of barytes was also relatively high in the land drilling operations, as shown in TABLE II, column b; this might have been due to the heaving shales encountered in certain wells in the Perth Basin.

TABLE II, columns a, b, e, and f, show that, the consumption of barytes, attapulgite, lubricants, surfactants, calcium chloride, salt and lost circulation materials was much higher in 1968 than in 1967 although the number of wells and total footage drilled in each of these two years were about the same (TABLE III). However, the consumption of the majority of drilling mud materials did not change much in this two-year period.

Attempts to correlate annual estimated consumption of drilling mud materials plot B, FIG. 1, with parameters such as annual total or examined number of wells and footages (TABLE III, columns a, b, c, d, e, f, h, i, j and k) could not be made readily; the only parameter which tends to correlate with plot B, FIG. 1, is the annual footage for marine wells (plot A, FIG. 1; TABLE III, column g,). This correlative tendency required more direct evidence and, in order to show that it was only marine drilling that produced the sharp increase in consumption of mud materials during 1967-1968, as shown by plot B, FIG. 1, estimates of annual consumption of drilling mud materials were prepared assuming that all footage was drilled on land. Results of these estimates are given in the TABLE III, column m, and are shown in plot C, FIG. 1. Plot C shows a constant rate of increase of about 35 per cent per annum since 1964. The ratio of ordinates for plots B, and C, for 1968 is 3.3 whereas for 1967 it is 1.2. This confirms that marine drilling was responsible for the considerable increase in consumption of drilling mud materials during 1968. More evidence to this effect is revealed by the fact that the ratio of consumption of drilling mud materials in marine drilling to that of land drilling operations is 0.32 for 1967 (when corrected to 1968 footage) and 1.8 for 1968.

CONCLUSIONS

1. Marine drilling during 1968 was responsible for about a threefold increase in consumption of drilling mud materials when compared with that in 1967.

2. Since 1964 total consumption, calculated at a constant footage, of drilling mud materials for drilling on land increased at a uniform rate of about 35%.

3. About 30 per cent of total annual footage is sufficient for adequate representation or estimation of consumption of drilling mud materials.

T A B L E I.

Actual consumption of drilling mud materials by B.M.R. during 1968.

Purpose for which drilling was made.	Total annual footage	Consumption of materials and footage within which they were used, in pounds.					
		Bentonite		Jel Flake		Lime	
		Quantity	Footage	Quantity	Footage	Quantity	Footage
Shot holes	310,127	10,070	30,446	NIL	NIL	NIL	NIL
Stratigraphic and hydrological	14,483	9,760	5,771	60	347	24	1104

T A B L E II.

ESTIMATED CONSUMPTION OF DRILLING MUD MATERIALS FOR 1968 AND THE AVERAGE FOR 1963-1968 PERIOD (see note 5; below).

DISTRIBUTION / CHARACTERISTICS AND COMPONENTS	AUSTRALIA					T.P.N.G.			AUSTRALIA AND T.P.N.G.						
	LAND			MARINE		LAND	MARINE		LAND		MARINE		LAND AND MARINE AVERAGE FOR 1968		Average for the period 1963-1968 inclusive (see Note 3., below)
	Usage in Short Tons (see Note 1., below)	Footage used / Footage examined	Drilled with gas or air. In Short Tons (see Note 2., below)	Usage in Short Tons (see Note 1., below)	Footage used / Footage examined	Usage in Short Tons (see Note 1., below)	Usage in Short Tons (see Note 1., below)	Footage used / Footage examined	Usage in Short Tons (see Note 5 below)	Footage used / Footage examined	Usage in Short Tons (see Note 1., below)	Footage used / Footage examined	Usage in Short Tons (See Notes 5 and 4 below)	Footage used / Footage examined	
Columns (reference to next page)	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
% of wells examined	18.7		100	34.4		100	87.5		19.7		54.5		23.8		33.4
% of footage examined	24.8		100	37.0		100	90.0		26.1		50.0		32.6		40.5
Bentonites	3312	1.00	NIL	3370	1.00	161	500	1.00	3720	1.00	3398	1.00	8140	1.00	4050
Attapulgites	216	0.21	NIL	570	0.33	NIL	-	-	198	0.18	422	0.18	807	0.19	280
Barium Sulphate	3740	0.39	NIL	2810	0.96	1588	11800	1.00	9380	0.41	23400	0.98	43500	.64	10280
Phosphates	1.3	0.09	NIL	4.5	0.37	0.2	0.2	0.22	2.1	0.14	3.7	0.30	7.5	0.21	4.4
Tannins	8.7	0.11	NIL	-	-	NIL	50	1.00	8	0.10	91	0.44	145	0.24	126
Lignites	203	0.47	NIL	207	0.69	4.6	-	-	202	0.48	143	0.38	400	0.44	379
Lignosulphonates	588	0.88	NIL	330	1.00	7	16	0.41	564	0.85	273	0.74	878	0.80	756
Oil base and invert emulsions muds	42	0.04	NIL	-	-	NIL	-	-	38	0.04	-	-	32	0.02	-
Emulsifiers for invert emulsions muds	52	0.04	NIL	-	-	NIL	-	-	47	0.04	-	-	39	0.02	28
Surfactants/Detergents, in gallons	1575	0.30	NIL	4470	0.31	NIL	-	-	1440	0.27	3310	0.17	6250	0.23	2147
Lubricants — Liquids, in gallons	9000	0.20	NIL	5560	0.53	NIL	-	-	8220	0.18	4110	0.30	13000	0.23	2672
Lubricants — Solids	5.4	0.08	NIL	-	-	NIL	40	0.51	4.9	0.07	72	0.52	114	0.13	25
Hydrocarbons, in 1000 of gallons.	580	0.48	NIL	291	0.53	NIL	-	-	530	0.43	216	0.30	763	0.36	-
Foamers, in gallons	-	-	5720	-	-	NIL	-	-	5720	-	-	-	5720	-	2216
Defoamers	3.1	0.14	NIL	1.0	0.19	NIL	-	-	2.8	0.13	0.7	0.11	3.4	0.12	2

T A B L E II Continued.

Columns (See previous page)	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Flosal	-	-	NIL	-	-	NIL	68	1.00	-	-	123	0.44	188	0.18	-
Starch	337	0.48	NIL	-	-	NIL	-	-	307	0.43	-	-	252	0.26	80
Carboxymethylcellulose	190	0.79	NIL	57	0.85	NIL	43	1.00	174	0.71	119	0.92	358	0.79	167
Lost circulation material	193	0.41	NIL	333	0.56	21	240	1.00	265	0.43	680	0.75	1250	0.56	548
Caustic soda	270	0.92	4.6	252	1.00	5.7	6.6	0.90	267	0.89	198	0.96	522	0.92	364
Soda ash	73	0.22	NIL	2.9	0.47	1.1	14	0.53	71	0.26	47	0.50	129	0.36	64
Bicarbonates (Na^+or K^+)	21	0.37	NIL	2.7	0.30	NIL	7.5	0.34	19.2	0.34	34	0.32	67	0.33	30
Lime	6	0.19	4.0	42	0.42	NIL	-	-	9.5	0.17	31	0.24	53	0.20	19
Gypsum	-	-	NIL	-	-	NIL	-	-	-	-	-	-	-	-	33
Calcium chloride	100	0.23	NIL	2.3	0.23	NIL	-	-	91	0.20	1.7	0.13	78	0.17	31
Silicate	-	-	NIL	-	-	NIL	-	-	-	-	-	-	-	-	20
Bichromates	2	0.09	5.3	-	-	NIL	-	-	7.1	0.08	-	-	1.5	0.47	20
Chromates	-	-	NIL	-	-	NIL	0.6	0.18	-	-	1.1	0.08	1.7	0.03	-
Salt	1210	0.25	NIL	-	-	NIL	-	-	1105	0.22	-	-	900	0.13	258
SF 100	11	0.08	NIL	-	-	NIL	-	-	10	0.07	-	-	8	0.04	-
Preservative	-	-	NIL	-	-	NIL	-	-	-	-	-	-	-	-	2

Notes:

1) Unless stated otherwise.

2) Two wells were drilled with air. Material used in mudding up of these wells prior to logging is included in the column a.,

3) Using annual averages. Note 1., applies

4) Based on total footage drilled within any subgroup (i.e. Land or Marine etc.) ; B.M.R. drilling excluded.

5) Total footage of air drilling was 18770. This footage is not included in footage used/footage examined ratios. Consumption of materials in air drilling is incorporated in columns i., and m., in their original form, that is, without applying corrections given by the formula stated under the definition No.8. Note 1., applies.

D E F I N I T I O N S (for the purpose of this work).

No.	T E R M	Definition
1	Short Ton.	2000 lbs.
2	Footage or wells examined.	Number of wells and corresponding footages for which data on consumption of drilling mud materials were available for examination.
3	Footage used.	Sum of all footage studied in wells in the various catagories (Land, Marine,) and which was drilled with mud that, at times, contained the component in question. The total footage so drilled in each well was used irrespective of intervals over which the component was in use.
4	Total footage or number of wells.	Sum of Land and Marine (exploration, development and service wells).
5	Marine drilling.	- is termed "marine" if it is carried out on submerged lands from an artificial platform, mobile and/or fixed; it does not include drilling from man-made islands connected by a causeway or a bridge to the mainland or an island. The classification of "marine" as defined above, also applies to inland waters provided the abovementioned drilling techniques are used.
6	Land drilling.	- is termed so if it is carried out on the mainland of Australia and T.P.N.G. or on islands around Australia and T.P.N.G.
7	Percentage of difference of deviation from average (Table II, columns b., f., i., and k.,) = $\frac{(A - av.)\ 100}{av.}$ = Frequency of usage. where: A - is the actual value (wells, footage) for a particular year in a given column. av.- is the average value for the same actual column as A.	
8	Estimated consumption of any drilling mud material = $\left(\begin{array}{c}\text{amount of an additive consumed during} \\ \text{drilling of footage that was examined}\end{array}\right) \times \left(\frac{\text{Total footage}}{\text{Footage examined}}\right)$	
9	Consumption of drilling mud materials.	Estimation of consumption for combined subgroups (such as Land-Australia plus Land-T.P.N.G., etc.) was prepared by obtaining individual sums of each of following: a. Amounts of consumed material or a group of materials. b. Values of footages that were examined. c. Values of annual footages. These values are then inserted into the formulae as under No.8 above.
10	Estimated consumption for 1968.	- is based on the actual consumption obtained from footage which was examined and was drilled within the period 1.1.68 - 31.12.68 inclusive, irrespective whether relevant wells were completed or not.
11	Average for the period 1963-1968	- Estimated amount of consumption of a material or a group of materials for each year were added up and the resulting sum was divided by 6.

TABLE III.

Correlation of consumption of drilling mud additives (see fig.1.,).

Year and other characteristics.	Annual							Percentage of annual total that was examined for the purpose of consumption of drilling mud additives.				Estimated annual consumption (Land and Marine) of drilling mud additives, in Short Tons. (see Note 3, below)	Annual consumption estimated assuming that all footage was drilled on land and using consumption from examined footage which was drilled on land. (see Note 3, below)
	Wells				Footage			Wells.		Footage.			
	Total number.		Number of wells examined for the purpose of consumption of drilling mud additives. (see Note 2, below)	Percentage of Marine wells in the number of wells examined, (see Note 4; below)	Total.		For Marine wells only. (see Note 1, below).						
	ACTUAL (see Note 1, below)	Percentage of difference of deviation from average. (see column a,)			ACTUAL (see Note 1, below)	Percentage of difference of deviation from average. (see column e,)		ACTUAL (see Note 2, below)	Percentage of difference of deviation from average. (see column h,)	ACTUAL (see Note 2, below)	Percentage of difference of deviation from average. (see column j,)		
Column	a	b	c	d	e	f	g	h	i	j	k	l	m
1963	127	-35.9	83	NIL	663,942	-31.2	NIL	65.4	+91.2	74.8	+83.8	5146	5,146
1964	210	+ 6.1	91	NIL	1,065,361	+ 9.8	767	43.3	+28.5	44.0	+ 8.0	3177	3,177
1965	209	+ 5.6	43	3.4	1,153,189	+18.9	33,774	20.6	-38.8	23.5	-42.2	6986	6,160
1966	134	-32.3	48	3.4	755,822	-22.6	24,831	35.8	+ 6.1	44.2	+ 8.6	11833	11,300
1967	278	+40.4	33	27.3	1,077,860	+11.1	118,172	11.9	-64.7	23.9	-41.3	20640	16,100
1968	232*	+17.2	59	29.3	1,103,902*	+13.8	312,618*	25.4	-24.6	33.7	-17.2	77886	23,700
Average	198		59.5		970,012			33.7		40.7			

Notes:
1. Taken from the paper presented to the Fourth Session of ECAFE by M.C. Konecki, J.N. Henry and K. Blair of B.M.R.: Review of Developments in the Australian Petroleum Industry since the Third ECAFE Petroleum Symposium; - service and development wells are included. Figures with asterisks are recent actual data.
2. Up to 1967 derived from data which were compiled for preparation of the B.M.R. Record No. 1968/64; - data for service and development wells not available.
3. Excluding amounts of liquid additives; - Notes 1., and 2., apply.
4. Only completed wells in each year were considered.

T A B L E IV.

TYPES, TRADE NAMES, PACKAGING QUANTITY AND PURPOSE IN USE OF DRILLING MATERIALS.

DESCRIPTION OF GROUPS. OF MATERIALS.	TRADE NAMES.	QUANTITY PER PACKAGE, in lbs. (unless otherwise stated)	PURPOSE IN USE.
Bentonites	Aqua-Gel, Magcogel, Milgel	100	Maximum viscosity with minimum amount of solids. Filtration control.
	Fulbent, Unibond	100(?)	
	Volclay	102	
	Kwik-Thix, Super-Col, Quik-Gel	50	Quick viscosity in fresh water muds with minimum chemical treatment.
Attapulgites	Zeo-Gel	100 and 50	To obtain viscosity in salt water muds.
	Salt Gel, Salt water Gel	80	
Calcium Carbonate	Lo-Wate, Calcium Carbonate	-	For increasing weight of oil muds up to 10.8 lbs/gal.
Barium Sulphate	Baroid, Magcobar, Milbar	100	For increasing and control of mud weight up to 20 lbs/gal.
	Sabar, Baryte	112	
Heavy weight material	Galena	100	For increasing and control of mud weight above 20 lbs/gal.
Starches	Impermex, My-Lo-Jel, Milstarch	50	Control fluid loss in salt, lime or shale control reagent muds.
	Dextrid	50	Control fluid loss in salt or brackish water muds.
	Stargel	50	-
Carboxymethylcellulose	Cellophos B-50, Tylose B77	-	-
	Cellex, Driscose, Millwhite	50	Various grades. Control fluid loss in all muds.
	Drispac	-	Control fluid loss in salt muds and also viscosifier.
	Cellofas	56	-
	Cellucol	44	
Tannins	Desco	-	Thinners for salt water muds.
	Rayflo	50	
	Myrtan, Lovis, F.E.8	-	-
	Mil Flo	50	-
	Tannex, Quebracho Extracts	50	Thinners for fresh water muds and lime muds.
	Tanco	-	
Preservative	Paraformaldehyde	44(?)	Inhibiting fermentation of starch in muds with low salinity and alkalinity.

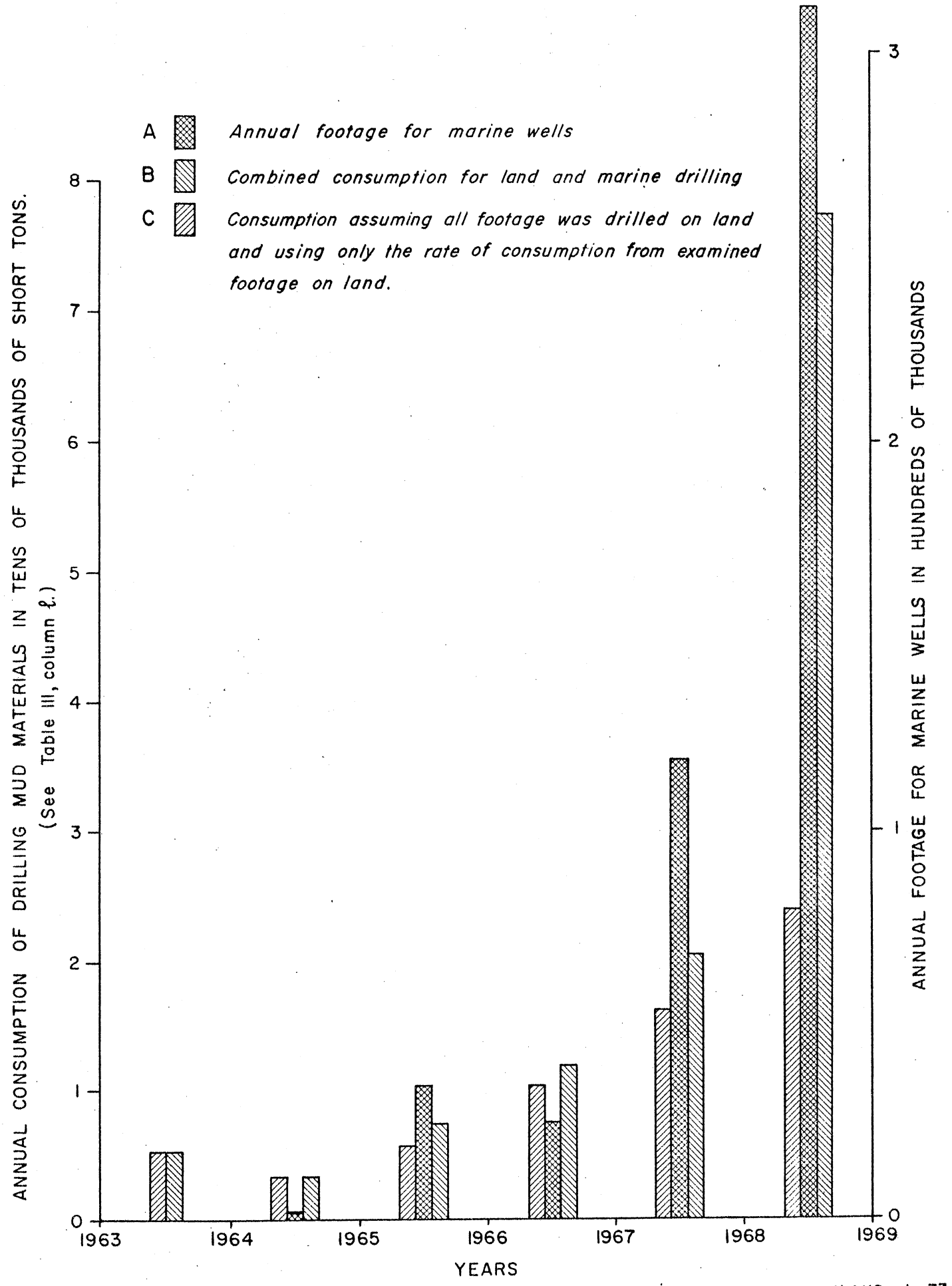
Lignites	Carbonox, TannAthin, Ligco	50	Dispersants, emulsifiers and supplementary additive for lowering fluid loss.
	CC-16, XP-20, Mil-Con	50	For fluid loss control and heat stability in lignosulphonate muds.
	Hydrocarb.	50	For fluid loss control, also emulsifier and thinner for fresh water muds.
Lignosulphonates	Spersene, Q-Broxin, Unical	50	Dispersant and for fluid loss control in gyp, lignosulphonate and SCR muds.
	Kalle-LS-22	55	-
	Kembreak, Lignox	50	Thinner for lime and shale control reagent muds.
	Drillaid	56	-
	Totanin	-	-
	RD-111	50	Dispersant, fluid loss control agent and inhibitor for RD-111 mud.
Phosphates	Barafos, Hagcophos	100	Thinners for low pH fresh water muds and for treating contamination by cement and calcium suphate.
	Oilphos	50	
	SAPP	100 (U.S.A.)	For treating contamination by cement at very low pH.
	Tributyl Phosphate, TSPP	-	-
	Calgon	-	For treating contamination by cement at intermediate pH.
Hydrocarbons	Diesel	-	For Oil Base and Invert Emulsion muds and also as lubricants.
	Crude oil	-	
Surfactants and detergents.	D.D.	-	Emulsifies oil, reduces torque, prevents balling of bit and also for dropping sand from water base muds.
	Condet	5 gal. and 55 gal. (U.S.A.)	
	DMS	55 gal.	Primary surfactant for formulating surfactant muds.
	Salinex	-	Emulsifier for salt water muds.
	Romud-M.D.	5 gal.	-
Foamers	Afrox	55 gal.	For air drilling.
	Tolfoam, Addfoam	5 gal.(?)	In aerated muds.
	Romud-Hi-Ex.	5 gal.	
Defoamers	Aluminium Stearate	25 (U.S.A.)	For muds treated with lignosulphonates and gyp muds.
	Defoamer 23, Defoamer A-40	75 (?)	For salt base muds.
	Defoamer S-10	-	For low ph Muds.
	Romud-Defoamer	5 gal.	-

Lubricants	Mud Lube, Bit Lube	5 gal. and 55 gal.	For extreme pressure lubricity.
	Scott-Free, Pipe-Lax	15 gal.	For freeing the pipe.
	Soltex	50	For lowering fluid loss and minimizing heaving shales in water base muds.
	Plumbago	-	Solid lubricant for minimizing drag.
Emulsifiers for Invert Emulsions	Invermul, Protecto-Mul A	50	Primary additives to form stable water-in-oil emulsion
	Geltone, Petrotone	50	For providing weight suspension.
	Briltreat	50	For improving emulsion under high temperatures.
	Duratone	50	For reducing fluid loss.
	Ez-Mul	-	-
Oil Base and Invert Emulsion muds.	Driloil	100	For protecting sensitive formations.
Lost Circulation Material (L.C.M.)	Tuff Plug, Nut Plug	50 (?)	Various grades. For prevention of lost circulation, regaining of returns and plugging of crevices and fractures.
	Nut Hulls, Wall-Nut	50 (?)	
	Cotton seed hulls, Sawdust	-	Filler as well as matting material.
	Fiberform, Asbestos, Cane Pulp, Fibertex, Mud fiber	- 40	Filler as well as matting material.
	Micatex, Magco-Mica, Mica-seal, Mica Fine	50 -	Various grades. For prevention of lost circulation.
	Leather flock, Jel-Flake, Leather-seal	25 50	For matting face of the well bore.
	Diasel M	-	For preparing soft plug in cases of severe loss of circulation.
SF100	SF100	50	Mixed with oil for oil mud casing packs.
Calcium Hydroxide	Lime	50 (U.S.A.)	For conversion to lime muds.
Sodium Hydroxide	Caustic soda	140 (Aust.)	For pH control.
Calcium Sulphate	Gypsum	100 (U.S.A.)	For conversion to gyp muds.
Sodium Chloride	Salt	100 (U.S.A.)	For salt muds and resistivity control.
$Na_2 CO_3$	Soda ash	93⅓	pH control and treating out cement contamination.
Na+ or Ka+ HCO_3^-	Sodium bicarbonate	93⅓	pH control and treating out cement contamination.
Na Chromate/Bichromate	Sodium Chromate/Bichromate	100 (U.S.A.)	Inhibiters of corrosion and gelation at high temperature.
Calcium Chloride	Calcium Chloride	70	Quick set cements, inhibitor, clay or shale control.
Organic silicates	Synergic	-	For pH stability under high temperature.
Ca Mg silicate fibers	Flosal	-	Viscosifier for fresh or salt water muds.

FIG. I.

COMPARATIVE CORRELATION OF CONSUMPTION OF DRILLING MUD MATERIALS

(See Table III, columns g, ℓ and m)



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