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REPORT ON TESTING OF "NYMCEL" CARBOXYMETHYLCELLULOSE AS AN ADDITIVE IN DRILLING MUDS

by

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INTRODUCTORY NOTE

The use of carboxymethylcellulose (C.M.C.) in modern drilling mud technology is now a well-established practice.

Initially C.M.C. was used in the control of filtrate (water loss) from drilling muds in preference to starch which had a tendency to ferment if the pH of the mud to which it was added was too low.

Because of its solubility in water, C.M.C. is often used to build viscosity in low solids content muds. Previously bentonite was used exclusively to obtain viscosity increase. However, bentonite addition also increased the solids content.

C.M.C. has also proved to be efficient in creating and maintaining a stable emulsion in oil emulsion muds.

To a lesser degree, C.M.C. has been used as a retarder in cement slurries for oilfield cementing operations. When used in cement, C.M.C. also has the ability to lower the loss of water from the slurry when the slurry is under a differential pressure; this minimizes the risk of a "flash set".

Most companies producing C.M.C. for use in drilling muds provide the purchaser with a choice of three grades - high, medium and low viscosity.

The approximate quantity of C.M.C. used in Australian drilling has been calculated after an examination of well reports submitted by companies under the Petroleum Search Subsidy Acts. From these, an average C.M.C. consumption per well was obtained and this was multiplied by the total number of wells drilled in that year to arrive at the approximate yearly consumption as follows:

1963	-	108	short	tons	(of 2,000 lbs)
1964	-	71	"	"	"
1965	-	118	"	"	"
1966	-	80	"	"	"

Various trade names given to C.M.C. for use in drilling muds are as follows:

NYMCEL	-	Holland
DRISCOSE	-	U.S.A.
CELLOFAS	-	Great Britain
TYLOSE	-	Germany
MAJOL	-	Sweden

TESTING OF "NYMCEL" CARBOXYMETHYLCELLULOSE AS AN ADDITIVE IN DRILLING MUDS

In September, 1966 Mr. E. G. Hawkins, of W. J. Bush and Co. (Australia) Pty. Ltd., visited the Petroleum Technology Laboratory to discuss the possible use of "Nymcel" C.M.C. in drilling muds.

It was suggested to Mr. Hawkins that he forward samples of various grades of "Nymcel" to the Petroleum Technology Laboratory for evaluation and comparison with a widely used American C.M.C. especially marketed for use in drilling muds.

The "Nymcel" samples arrived in January, 1967 and were tested using laboratory-prepared muds simulating actual drilling conditions.

Four grades of "Nymcel" were received and classified, according to the "Nymcel" catalogue, as follows :

NYMCEL. T.Y.G. 97 :- For normal use, that is, for reduction of filtrate values without any great variation in viscosity.

NYMCEL. T.L.G. 98 :- For use where filtrate reduction is necessary but increase in viscosity is undesirable.

NYMCEL. T.H.G. 98 :- Used where filtrate reduction is necessary and viscosity increase is also required.

NYMCEL. T.V.G. 40 :- For reduction of filtrate when a large increase in viscosity is also necessary.

The American C.M.C. samples used for comparison have been designated as follows :-

C.M.C. N would compare with T.Y.G. 97, normal use.

C.M.C. L would compare with T.L.G. 98, where low viscosity is required.

C.M.C. V.H. would compare with T.V.G. 40, where a large increase in viscosity is required.

No American C.M.C. samples held in the laboratory compare with sample T.H.G. 98.

All testing was carried out in accordance with American Petroleum Institute (A.P.I.) procedure using test equipment approved by this authority.

Test results are given in three tables 1, 2 and 3 at the end of this report. A brief discussion of the results follows.

TABLE 1.

The stock mud used for all tests shown in this table consisted of a bentonite slurry lightly treated with tannin. This original mud had a relatively low filtrate value and an apparent viscosity (A.V.) which was much too low for normal use.

It was desired that the filtrate value be brought to an A.P.I. specification of less than 10 ml. and that the A.V. be increased. Accordingly, 0.09 lb. and 0.18 lb. additions of various grades of C.M.C. per 1 cu. ft. of stock mud, were made. The results obtained, shown in Table 1, permit the classification of materials used, in a descending order of efficiency as follows :

Addition 0.09 lb./cu. ft.	Addition 0.18 lb./cu. ft.
FILTRATE CONTROL	
T.V.G. 40; T.H.G. 98; V.H.; N.	T.V.G. 40; N;
T.Y.G. 98; L; T.L.G. 98	T.H.G. 98; V.H.; L.
	T.Y.G. 97.
	T.L.G. 98.
VISCOSITY CONTROL	
V.H.	V.H.
T.V.G. 40	T.V.G. 40
N.	N.
T.H.G. 98	T.H.G. 98
L.	L.
T.Y.G. 97	T.Y.G. 97
T.L.G. 98	T.L.G. 98

It can be seen that the American C.M.C. denoted by the letters V.H. is superior to "Nymcel" T.V.G. 40 in producing the required characteristics of viscosity.

It may be argued that the rise in A.V. using the C.M.C. V.H. is too great. However, less of this C.M.C. could be used to obtain the desired filtrate improvement with a much less increase in A.V.

TABLE 2.

The mud used for these tests consisted of a bentonite slurry heavily contaminated with cement as would be the case when drilling out a cement plug after cementing casing in place.

This contaminated mud was treated with water only to reduce the very high viscosity and gel values.

The resultant mud produced a very high filtrate value and a very low A.V. Normally, at a well site, this type of contaminated mud would probably be discarded but it was used in the laboratory as an extreme test of the efficiency of the C.M.C. materials being investigated.

As in Table 1 the effectiveness of the materials is listed in descending order of efficiency.

FILTRATE CONTROL

Addition 0.02 lb./cu. ft.	Addition 0.04 lb./cu. ft.
V.H.	V.H.
T.V.G. 40	L.
T.H.G. 98; T.Y.G. 97.	N.
N.	T.Y.G. 97.
T.L.G. 98.	T.V.G. 40.
L.	T.H.G. 98.
	T.L.G. 98.

VISCOSITY CONTROL

Viscosity increases in this badly contaminated mud were so slight that a true test of efficiency could not be gained. The slight increase gained, however, does favour the American C.M.C. V.H.

Here again the American C.M.C. products prove to be superior to "Nymcel" in producing lower filtrates.

TABLE 3.

In this series of tests a slightly cement-contaminated slurry was used and thinning was again effected with water. This type of mud would not be discarded during drilling but would be treated to increase the viscosity and lower the filtrate.

The lists following are again given in order of descending efficiency.

FILTRATE CONTROL

Addition 0.25 lb./cu. ft.	Addition 0.40 lb./cu. ft.
V.H.	T.V.G. 40; T.H.G. 98; T.Y.G. 97; V.H.; N; L.
T.V.G. 40; T.H.G. 98; T.L.G. 98; N; L.	T.L.G. 98
T.Y.G. 97.	

VISCOSITY CONTROL

Addition 0.25 lb./cu. ft.	Addition 0.40 lb./cu. ft.
V.H.	V.H.
T.V.G. 40	T.V.G. 40
N.	N.
T.H.G. 98.	T.H.G. 98.
T.Y.G. 97; L.	T.Y.G. 97.
T.L.G. 98.	L.
	T.L.G. 98.

Again the American C.M.C. V.H. proved to be superior to "Nymcel" in lowering of filtrate and increasing of viscosity.

It should be noted (Tables 1, 2 and 3) that "Nymcel" T.L.G. 98, used where low viscosity is required, did in fact maintain the lowest viscosity throughout all the tests. This is very important in drilling muds where it is necessary to reduce filtrate values without increasing an already high viscosity.

Price could play a very important part in the commercial comparison of "Nymcel" and the American C.M.C. as no harm would be done by adding an excess of a cheaper C.M.C. as this material is soluble and would not increase the solids content of the mud.

Our price list, dated February 1966, shows that the normal grade of American C.M.C. costs 56 cents (Aust.) per pound F.A.S. Houston U.S.A., compared with "Nymcel" T.Y.G. 97 price of 22 cents (Aust.) per pound, delivered at Sydney.

The price list also gives the "L" grade of American C.M.C. price as 39 cents (Aust.) per pound compared with "Nymcel" T.L.G. 98 price of 22 cents (Aust.) per pound.

Estimates of approximate amounts of C.M.C. used in Australian drilling include 108 short tons in 1963; 71 short tons in 1964 and 118 short tons in 1965.

TABLE 1.

A.P.I. TESTS	ORIG. MUD.	Addition, 0.09 lb./cu.ft. C.M.C.							Addition, 0.18 lb./cu. ft. C.M.C.						
		T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.	T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.
APPARENT VISCOSITY (cp.)	3.5	15	11	7	5.5	26	12	7.5	27	17	10.5	7	48	9	11
PLASTIC VISCOSITY (cp.)	2	8	7	5	4	15	9	5	14	11	7	5	32	13	8
YIELD (lb./100 sq. ft.)	3	14	8	4	3	22	6	5	26	12	7	4	32	12	6
INITIAL GEL (lb/100 sq. ft.)	0	5	2	1	0	6	2	1	12	3	2	1	15	2	2
TEN MINUTE GEL (lb./ 100 sq. ft.)	6	48	23	12	9	46	18	10	69	35	18	12	81	27	16
FILTRATE (ml)	14	8	8	9	10	8	8	9	7	8	8.5	9.5	8	7	8
IMPROVEMENT IN FILTRATE CONTROL (ml)	-	6	6	5	4	6	6	5	7	6	5.5	4.5	6	7	6
IMPROVEMENT IN VISCOSITY A.V. (cp.)	-	11.5	7.5	3.5	2	22.5	8.5	4	23.5	13.5	7	3.5	44.5	15.5	7.5

TABLE 2.

A.P.I. TESTS	ORIG. MUD.	Addition 0.02 lb./cu. ft.							Addition 0.04 lb./cu. ft.						
		T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.	T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.
A.V. (cp)	2	2.3	2.3	1.8	2	2.5	2.5	2.3	2.3	2.5	2	2	2.5	2.3	1.8
P.V. (cp.)	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	1.5	1.5	1.5	1.5	1.5	1
YIELD (lb./100 sq. ft.)	2	1.5	1.5	0.5	1	2	2	1.5	0.5	2	1	1	2	1.5	1.5
INIT. GEL (lb./100 sq. ft.)	1	1	1	0	0	2	2	1	1	1	0	1	1	1	0
10 MIN GEL. (lb./100 sq. ft.)	4	3	3	2	2	4	5	3	3	4	3	3	4	4	3
FILTRATE (ml)	229	173	198	198	217	95	215	227	170	191	158	197	91	153	139
IMPROVEMENT IN FILTRATE CONTROL(ml)	-	56	31	31	12	134	14	2	59	38	71	32	138	76	90
IMPROVEMENT IN VISCOSITY A.V. (cp.)	-	0.3	0.3	nil	nil	0.5	0.5	0.3	0.3	0.5	nil	nil	0.5	0.3	nil

TABLE 3

A.P.I.	ORIG. MUD.	Addition 0.25 lb./cu. ft.							Addition 0.40 lb./cu. ft.						
		T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.	T.V.G. 40	T.H.G. 98	T.Y.G. 97	T.L.G. 98	V.H.	N.	L.
A.V. (cp.)	4.3	20	11	7.5	5	35	13	7	32	17.5	11.5	6	63	20	9.5
P.V. (cp.)	4	15	9	6.5	5	25	11	6	21	15	10	5	40	17	8
YIELD (lb./100 sq. ft.)	0.5	10	4	2	0	20	4	2	22	5	3	2	46	6	3
INIT. GEL. (lb./100 sq. ft.)	0	2	0	0	0	2	1	1	2	1	0	0	4	1	1
10 MIN. GEL. (lb./100 sq. ft.)	1	7	3	1	3	31	3	2	21	5	1	1	49	4	2
FILTRATE (ml)	23	11	11	12	11	10	11	11	9	9	9	11	9	9	9
IMPROVEMENT IN FILTRATE CONTROL (ml)	-	12	12	11	12	13	12	12	14	14	14	12	14	14	14
IMPROVEMENT IN VISCOSITY (cp.)	-	16	7	3	1	31	9	3	28	13	7	2	59	16	5