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EVALUATION OF BENTONITE FROM NEAR PRINCETON, BRITISH COLUMBIA

by

J. S. ROSS

MINERAL PROCESSING DIVISION

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EVALUATION OF BENTONITE FROM NEAR PRINCETON, BRITISH COLUMBIA

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SUMMARY OF RESULTS

Eleven bentonite samples from near Princeton, British Columbia were submitted for evaluation. Ten were combined into four composite samples, pulverized, and tested for their swelling and colloidal properties.

Sample No. 1 Cut possesses better colloidal properties than the others. This sample and sample 2-2, were tested for viscosity and gel properties, with and without the use of sodium carbonate as an additive. The quality of sample No. 1 Cut approached that of a commercial swelling bentonite more closely than the others, but even with additives it did not have the gel strength and viscosity of the commercial bentonite.

In Canada, practically all the bentonite consumed is of the swelling type and finds use in iron-ore pelletizing, well drilling and foundry molding. Sample No. 1 Cut does not have the quality usually required in well drilling, and the tests made, while not conclusive, suggest that it does not have the quality usually required in pelletizing concentrates and in steel-foundry molding. At a later date, this sample may be tested for its efficiency as a pelletizing agent, along with several other Canadian bentonites.

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* Senior Scientific Officer, Mineral Processing Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

On January 30, 1964, Mr. W.P. Harland of Vancouver submitted eleven bentonite samples for evaluation as to possible use. These samples came from a deposit immediately east of the Similkameen River and about 4 miles south of Princeton, British Columbia.

DESCRIPTION OF SAMPLES

The samples arrived in polyethelene bags and were labelled as follows:

Bore hole No. 2 - samples 2, 3, 4, 5, 6, 7 and 8
Bore hole No. 3 - samples 3, 4 and 5
No. 1 Cut

After macroscopic examination, ten of these eleven samples were grouped into four composite samples as shown in Table 1.

TABLE 1

Description of Composite Samples

Composite No.	Original Samples	Thickness of Horizon (ft)
2-1	Bore hole No. 2, sample 3	1.5
2-2	Bore hole No. 2, samples 4, 5, 6, 7 and 8	7.0
3-1	Bore hole No. 3, samples 3, 4 and 5	4.0
No. 1 Cut	No. 1 Cut	15.0

Sample 2, bore hole No. 2, was greenish buff, contained an estimated 10 to 15 per cent sand and soil, and was not processed or tested. Composite 2-1 was greenish buff, plastic, and appeared to contain less than 5 per cent sand and soil. Composite 2-2 contained less sand and soil than the latter and was greenish buff and extremely plastic. Composite 3-1 was similar to 2-1 but was not as plastic, whereas No. 1 Cut was buff and granular. When dried to a granular state the samples became brown, with the exception of No. 1 Cut.

MILLING AND TESTING PROCEDURE

All composite samples were dried and crushed in a jaw crusher. Representative portions were riffled and pulverized with a hammer mill. The loss in moisture of the original samples was determined, and the particle-size distribution of the pulverized No. 1 Cut was measured using an Alpine Air-Jet Sieve.

The pulverized products were tested for swelling index and colloidal content. The swelling index is the number of millilitres of gel that are formed in one hour by the addition of 2 grams of dried bentonite to 100 millilitres of water. The colloidal content is the percentage of bentonite remaining in suspension after a mixture of water and 2 per cent bentonite has been allowed to settle for 24 hours.

Because relatively low swelling and colloidal results were obtained, only samples No. 1 Cut and 2-2 were tested further. With the use of a Fann V-G meter, the apparent plastic viscosities and gel strengths were determined at various intervals during a 24-hour period for 6 per cent aqueous mixtures of these two samples. These tests were repeated at the end of a 10-minute mixing interval with various proportions of sodium carbonate added to the mixture. After determining the amount of sodium carbonate that would produce optimum results within reasonable limits, the viscosities and gel strengths were ascertained for sample No. 1 Cut at various intervals over a 24-hour period. The yield after a 24-hour ageing period was obtained for sample No. 1 Cut.

The results were compared with those for an imported commercial bentonite.

RESULTS

Moisture Content

The moisture contents are given in Table 2. Those of the moist samples were considerable.

TABLE 2

Weight and Moisture Content

Sample	Weight as Received (lb)	Moisture (%)
2-1	5.8	34.4
2-2	16.4	36.5
3-1	12.2	27.8
No. 1 Cut	27.3	6.9

Particle Size

After milling, the particle-size distribution of sample No. 1 Cut, as determined with an Alpine Air-Jet Sieve, is as follows: 24.6 per cent plus 200 mesh, 41 per cent minus 200 plus 325 mesh, and 34.4 per cent minus 325 mesh. The particle-size distribution of this milled sample is similar to that of commercial bentonites.

Swelling Index and Colloidal Content

TABLE 3

Swelling Index and Colloidal Content

Sample	A Swelling Index (ml)	B Colloidal Content (%)	A + B with A and B adjusted to %
2-1	11	46	80
2-2	12	52	90
3-1	12	52	90
No. 1 Cut	12	61	99
Commercial	34	95	200

Viscosity and Gel Strengths

After ageing in an aqueous mixture for 24 hours, sample No. 1 Cut had a yield of 47 barrels per ton and initial and 10-minute gel strengths of 2 pounds per 100 square feet as compared with the commercial sample, which had a yield of 89 barrels per ton.

The results of the various viscosity and gel tests are given in Tables 4 and 5.

TABLE 4

Viscosity and Gel Strength

Test		Sample 2-2	Sample No. 1 Cut	Sample No. 1 Cut with 4% Na_2CO_3 in bentonite	Sample Commercial
Age of Mix (min)	Initial Stirring Time (min)	Apparent Viscosity (cp)			
3	3	2 1/2	3	3 1/2	15
5	5	2 1/2		4	15
10	10	3		4 1/2	16
30	10	2 1/2	3 1/2	4 1/2	16 1/2
60	10	3	3 1/2	5 1/2	17
24 hr	10	3 1/2	4	6	18 1/2
		Initial Gel Strength (lb/100 sq ft)			
3	3	1	1	1	15
5	5	1		1	17
10	10	1		1	18
30	10	1	1	1	18
60	10	1	1	1	15
24 hr	10	1	1	1	16
		10-Minute Gel Strength (lb/100 sq ft)			
3	3		1		
5	5				
10	10	1		7	35
30	10	1	1	9	35
60	10	1	1	9	35
24 hr	10	1	1	4	29

TABLE 5

Viscosity and Gel Strength with Additive

	% Na_2CO_3 added to Bentonite: 2	2 1/2	3	4
Sample No. 1 Cut				
Apparent viscosity (cp)	3 1/2	4	4	4 1/2
Initial gel strength (lb/100 sq ft)	1	1	1	2
10-Minute gel strength (lb/100 sq ft)	1	3	6	9
Sample 2-2				
Apparent viscosity (cp)		3	3 1/2	3 1/2
Initial gel strength (lb/100 sq ft)		1	2	3
10-Minute gel strength (lb/100 sq ft)		5	6	5

SUMMARY AND DISCUSSION

The yield, apparent viscosity, gel strength and colloidal content plus swelling index of sample No. 1 Cut are either greater or about equal to those of the other submitted samples. However, the qualities for sample No. 1 Cut are much less than those for a commercial imported bentonite. Additions of sodium carbonate, in amounts up to 4 per cent of the bentonite content, did not improve these properties to any appreciable extent under normal conditions.

In Canada, the main uses for bentonite are in pelletizing, well drilling and foundry molding, in decreasing order of importance. About 95 per cent of the bentonite consumed is used for these purposes and by far the largest amount of this is of the swelling type.

The samples of bentonite that were submitted for testing do not fall into the writer's classification for swelling bentonite.

Bentonite in sample No. 1 Cut produces a yield far less than the yield of 90 to 100 barrels a ton which is normally required for well drilling. To determine precisely the efficiency of this bentonite in foundries and in iron-ore pelletizing, actual foundry and pelletizing tests are required. However, the test work completed on viscosity and gel strength suggests that these bentonites are not competitive in quality for use in steel foundries and in pelletizing iron-ore concentrates. Foundry tests are required to determine this clay's suitability for use in iron foundries.

The Mines Branch is currently testing a number of bentonites for their effectiveness in pelletizing iron-ore concentrates. Because sample No. 1 Cut is from one of the larger bentonite deposits in British Columbia, it may be tested for pelletizing with this group of bentonites at a later date.

It may be possible to improve slightly the quality of this bentonite by removing impurities by air classification. However, the gel and viscosity tests indicate that the quality requires considerable improvement for most of the principal uses.

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