CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 66-37

PELLETIZING EXPANDED PERLITE FINES

by

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MINERAL PROCESSING DIVISION

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COPY NO. 14

MARCH 29, 1966

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SUMMARY OF RESULTS

Perlite 'fines' of minus 8 mesh size were pelletized on a bench scale, using various quantities of six different binders. Compressive strength and abrasion resistance of the pellets was adequate with five of the binders. The quantity of binder required varied considerably, depending on the binder. Organic binders burned out of pellets exposed to a temperature of 540°C (1004°F). All pellets heated to 815°C (1500°F) shrank considerably, because at this temperature the perlite began to fuse.

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INTRODUCTION

Expanded perlite 'fines', reportedly formed during the production of coarser expanded perlite, were investigated to determine if they could be pelletized for use as loose insulation. The investigation was undertaken at the request of the producer, Western Insulation Products Ltd., Edmonton, Alberta; the 'fines' are apparently not marketable in the present form.

The material received had a bulk density of 12 lb/cu ft. Its size grading, determined by sieving for five minutes on a mechanical shaker, is shown in Table 1.

TABLE 1

Grading of Perlite 'Fines'

Sieve Size Designation	Accumulative Per Cent Passing
8 mesh	100.0
14	99.9
28	87.2
48	76.0
100	64.9
150	58.0

PELLETIZING BINDERS

As it is non-plastic, perlite can be pelletized only by using a binder. In this investigation, six binders were used, in various proportions. The binders were:

(a) Bentonite (Arrowhead M)
Magnet Cove Barium Corp. Ltd.,
Calgary, Alta.

(b) Poly-vinyl alcohol (Alvanol 70-05)
E.I. Du Pont de Nemours & Co. Inc.,
Niagara Falls, N.Y.

(c) Sodium Silicate (u-Brand: 52°Bé)
National Silicates Ltd.,
New Toronto, Ont.

(d) Carboxy-methyl cellulose (Carboxel: high viscosity)

(e) Carboxy-methyl cellulose (Carboxel: medium viscosity)
Standard Chemical Ltd.,
Toronto, Ont.

(f) Sodium Algenate (Kelsize S)
Kelco Co.,
New York, N.Y.

The appropriate weight of binder was thoroughly mixed with the pelletizing water. For tests A to T, the binder was mixed with 350 g of water; for test U, the binder was mixed with 200 g of water. The sodium silicate, being a liquid,mixed readily with the water, whereas it was necessary to heat the water to dissolve the poly-vinyl alcohol. Several hours were required to get the bentonite, the carboxy-methyl cellulose and the sodium algenate binders into suspension.

PELLETIZING

The pelletizing was done in a small barrel-type concrete mixer, from which the paddles had been removed. A charge of 200 g of perlite was used for each pelletizing test. About three-quarters of the charge was placed in the mixer, and the binder-water mixture was sprayed, from a flexible plastic bottle fitted with a perforated top, onto the perlite as it cascaded in the revolving mixer. The binder suspension was added until pellets began to form, then by alternate additions of the remaining dry perlite and of binder, the pellets were increased in size. In tests A to T, not all of the binder suspension was required to pelletize the 200 g of perlite, whereas in test U, all the suspension was added, but not all of the 200 g of perlite was used. In each test, the pellets, which ranged in size from 1/4 to 1/2 in., were removed from the mixer when they had become sufficiently consolidated during rotation to withstand subsequent handling. The remaining pellets were weighed and placed in a dryer at 110°C (230°F) for several hours. The dried pellets were then re-weighed

to determine the amount of water added during pelletizing. From this figure, the actual percentage of dry binder in the pellets was calculated. The bulk density of several of the dried products were determined to be between 15 and 16 1/2 lb/cu ft.

The dry compressive strength of the pellets produced from each test was measured. Ten dried pellets of various sizes were broken in an Allis-Chalmers Pelletester, an electrically-powered compression testing machine which indicated graphically the diameter of a pellet and the load in pounds at which it broke. The relative resistance to abrasion was demonstrated by rubbing pellets between the fingers. This is an arbitrary test and is not related to any other method of evaluation.

The design proportions and the physical properties of the dried pellets are shown in Table 2.

TABLE 2

Design and Physical Properties of Pellets

Test No.	Binder				Pelletizing Water (%)	Dry Weight of Pellets Produced (g)	Dry Strength (lb)		Abrasion Resistance
	Type	Weight (g)	Design (%)	Actual (%)			Average	Range	
A	Bentonite	2	1	1.0	153	164	0.2	0.1-0.4	poor
B	"	6	3	2.7	151	191	1.0	0.7-1.6	poor
C	"	10	5	4.3	146	191	1.3	0.4-3.4	poor
D	"	14	7	6.5	152	193	2.6	1.6-4.2	fair
E	"	20	10	8.9	143	203	3.3	1.6-6.4	fair
F	P.V.A.	2	1	0.9	156	187	0.5	0.1-1.0	poor
G	"	6	3	2.4	140	183	2.3	1.7-3.5	good
H	"	10	5	4.0	135	197	4.5	1.8-7.1	good
I	"	14	7	5.6	133	197	6.2	4.5-7.6	good
J	Sod. Sil.	6	3	2.7	157	183	0.1	0.1-0.3	poor
K	"	10	5	4.8	160	188	0.2	0.1-0.4	poor
L	"	14	7	6.3	148	193	0.5	0.2-1.4	poor
M	"	20	10	9.0	145	193	0.6	0.4-1.0	poor
N	"	30	15	13.2	137	200	1.6	0.4-2.9	good
O	C.M.C.(H)	1	0.5	0.4	142	190	0.8	0.3-1.9	fair
P	"	2	1	0.8	142	190	1.3	0.4-2.7	fair
Q	"	4	2	1.7	150	196	2.1	1.0-4.8	good
R	C.M.C.(M)	2	1	0.8	146	190	0.6	0.2-0.9	fair
S	"	4	2	1.6	135	191	2.9	1.1-5.4	good
T	Sod. Alg.	2	1	0.8	147	195	3.7	1.8-6.1	good
U	P.V.A.	6	3	3.3	107	145	4.0	1.6-6.3	good

P.V.A. : Poly-vinyl Alcohol
Sod. Sil. : Sodium Silicate
C.M.C.(H) : Carboxy-methyl Cellulose (High Viscosity)
C.M.C.(M) : Carboxy-methyl Cellulose (Medium Viscosity)
Sod. Alg. : Sodium Algenate

EFFECT OF HEAT ON PELLETS

To determine the effect heat would have on the pelletized perlite, ten pellets each of tests G, N, Q and T were heated in a gas-fired stationary kiln at temperatures of 540°, 815° and 1080°C (1004°, 1500 and 1976°F) for 10 min.

At temperatures of 540° and 815°, no visible changes had taken place, but the compressive strengths of the pellets of tests G, Q and T were poor, indicating that the organic binders had burned out. The strengths of the pellets of test N were still good; evidently the binder, being inorganic, was not burned out. All pellets fired at 1080°C shrank to about one-half their original size. Their strength increased greatly because fusion of the perlite had begun.

DISCUSSION OF RESULTS

The green strengths of all the pellets produced were sufficient to withstand subsequent handling. Moreover, all of the binders yielded pellets having dry compressive strengths sufficiently high to be handled, although the quantity of binder required varied widely. An average dry compressive strength of at least 1.3 lb would be required if the pellets were to be used for insulation.

With bentonite as the binder, the required strength was obtained with a content of 4.3 per cent. The disadvantage of bentonite, however, was that the resistance to abrasion was low, even with an addition of nearly 10 per cent binder.

Poly-vinyl alcohol yielded pellets having a dry compressive strength of 2.3 lb with an addition of 2.4 per cent of the binder. A strength of about 1.3 lb could be obtained with an addition of between 1.5 and 2.0 per cent. At that concentration,however, the abrasion resistance would probably be only 'fair', and an addition of between 2.0 and 2.5 would likely be required to produce pellets of adequate resistance.

The compressive strength of the pellets using sodium silicate averaged 1.6 lb with 13.2 per cent of the binder. At that percentage, the abrasion resistance was good. With 9.0 per cent of binder, the compressive strength was only 0.6 lb and the abrasion resistance was poor.

The high-viscosity carbonxy-methyl cellulose gave pellets of adequate compressive strength with 0.8 per cent of binder, but the abrasion resistance was only fair. With an addition of between 1.0 and 1.5 per cent, the resistance to abrasion would probably be good.

The medium-viscosity carboxy-methyl cellulose would probably give pellets of sufficient compressive strength with an addition of about 1.0 to 1.2 per cent of the binder; the abrasion resistance of the pellets would probably be good.

Sodium algenate binder gave pellets with an average compressive strength of 3.7 lb at an addition of 0.8 per cent. A strength of 1.3 lb and good abrasion resistance could probably be obtained with about 0.5 per cent of this binder.

Higher concentrations of binder than those shown in Table 2 were tried with the two carboxy-methyl cellulose and the sodium algenate, but the viscosities of the binder suspensions were too high to be sprayed from the plastic bottle.

The wide ranges of compressive strengths obtained on pellets formed in each run resulted from the uneven distribution of the binder. In general, the larger pellets contained a higher percentage of binder, resulting in greater strength.

The pellets formed in tests A to T contained between 133 and 156 per cent water. These pellets were too wet, and had a tendency to adhere together. Test U showed that a water content of 107 per cent was adequate for formation of pellets.

The organic binders burned out at a temperature of 540°C (1004°F), resulting in the complete loss of pellet strength. The inorganic binder sodium silicate was not affected by heat until the perlite began to fuse. Although the pellets containing bentonite were not fired, they would undoubtedly react in a similar manner to those containing sodium silicate.

CONCLUSIONS

The perlite 'fines' submitted can be pelletized with the addition of a binder. The percentage of binder required to give sufficient compressive strength and abrasion resistance to pellets varies widely. Approximately 100 per cent water would be required for pelletizing. Inorganic binders yield stable perlite pellets, up to a temperature where fusion of the perlite begins, but organic binders burn out at lower temperatures, with a resultant loss of strength.

Pelletized perlite could possibly be used as insulation and, because the compressive strengths developed during pelletizing are relatively high, it might also be used as aggregate in lightweight concrete.

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