

Asbestos Floats

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INTRODUCTION

ASBESTOS FLOATS may be defined briefly as blends of airborne particles of fibrous asbestos and dust produced during the milling stages and collected by Cottrell precipitators, dust sheds, or baghouses.

The various grades of asbestos floats on the market contain fibrous asbestos particles ranging in length from microscopic to approximately $\frac{1}{4}$ -inch. The fines or dusts present in the floats are from 40 microns to 2 microns or less in cross-section.

Airborne asbestos particles are of diverse length because they are collected at numerous places in the mill. There are: (1) dusts removed from dry rock storage bins, (2) dusts removed from rock and fibre screens, (3) particles from the tops of collectors, and (4) fines removed by suction from the processing equipment.

Sometimes the airborne particles are kept segregated, so that there is a partial separation by gravity. This is accomplished by a series of dust chambers enclosed in a long, rectangular building. The longest and heaviest particles fall nearest to the air flow entrance, the small-

est at a point farthest away and nearest the exit. Sometimes the air from the dust chamber building is passed through a series of baghouses or electric precipitators to collect the extremely fine particles which normally escape to the atmosphere.

In other instances, the airborne particles by-pass the dust chambers and are passed through rows of bag collectors.

Regardless of the method of collecting the particles, the milling department must select proper fibre sizes for blending, producing uniform floats to meet the requirements of the trade.

Sometimes one grade of float can be used successfully in many commercial products; in other cases, great care must be taken to produce a float for use in a specific product.

The present total production of all grades of Canadian floats approximates 40,000 tons per year and it is possible that this quantity may be greatly increased by the proposed expansion programmes now going into effect in Canada.

Since floats are valued at \$40 per ton at the Canadian mines, a tonnage of 40,000 has a potential sales value of \$1,600,000. This division of the asbestos industry is a good business, and it is well worth the concentrated effort of research and development engineers to find

new uses, and so expand the market, for all available floats.

PHYSICAL PROPERTIES OF FLOATS

According to the Quebec Screen classification, there are two general classes of floats, known as 7RF and 7TF.

Samples of various commercial floats were obtained on the market and a series of tests were devised to determine the differences in their physical properties. Some of these tests were similar to those made by many manufacturers who use floats in their products. The results of some of these tests are given in Table I. They do not, however, include the official Quebec Screen test. Manufacturers using floats usually set up their own specifications, based upon requirements for their particular products.

LOOSE DENSITY

The loose density of floats can be measured by slowly sifting the powder into a can or container of definite dimensions so that the weight per cubic foot can be calculated.

Although in some products the loose density of the floats is not particularly important, in others it is critical, so each float must be considered as an individual case.

In the present investigation eleven 7RF floats were tested and their loose densities were found to range

TABLE I

IDENTIFICATION	LOOSE DENSITY lb./cu.ft.	MATERIAL +100 M %	FINES -200 M %	GRIT +48M %	WHISKERS +48 M %	GRIT -48 M +80 M %	WHISKERS -48 M +80 M %	OIL ADSORPTION c.c./g. fiber
(1) 7RF....	19	3	96	0.04	1.90	0.02	0.64	0.66
(2) 7RF....	20	4	93	0.14	2.50	0.14	0.66	0.74
(3) 7RF....	21	4	93	0.24	2.26	0.12	1.18	0.75
(4) 7RF....	22	4	93	0.16	1.30	0.20	0.94	0.68
(5) 7RF....	22	3	95	0.12	0.80	0.10	0.46	0.65
(6) 7RF....	24	5	90	Tr.	1.16	0.04	0.96	0.68
(7) 7RF....	24	5	89	0.06	1.28	0.10	1.12	0.71
(8) 7RF....	20	6	91	0.12	4.12	0.56	1.10	0.66
(9) 7RF....	25	7	84	0.24	0.70	0.46	1.30	0.65
(10) 7RF....	23	7	88	0.46	2.38	0.54	0.92	0.65
(11) 7RF....	14	1	96	0.04	0.50	0.02	0.84	1.05
(12) 7TF....	23	2	96	Tr.	0.30	Tr.	0.50	0.75
(13) 7TF....	23	2	95	0.06	0.60	0.06	0.70	0.65
(14) 7TF....	26	3	91	0.00	0.10	Tr.	0.16	0.68

from 14 to 25 pounds per cu. ft. The heaviest is No. 9 and the lightest No. 11. Nos. 1 to 5, inclusive, and No. 8, all with loose densities between 19 and 23 pounds per cubic foot, may be considered as falling within the same range, as also may Nos. 6, 7, 9, and 10, which are slightly heavier (23 to 25). Float No. 11 is in a class by itself and is light in weight as well as bulky (loose density 14). If density were the only physical property that had to be considered, this record would enable the manufacturer to select the proper one for his purpose.

The three *TF* floats included in the Table differ from the *RF* floats in degree of particle fineness. Nos. 12 and 13 have identical loose density (23) while No. 14 is heavier (26).

CLASSIFICATION BY WET WASHING

Fibre and Grit +100 Mesh

A classification of the particles can be obtained by a wet-washing method which determines the amounts of fibre and grit plus-100-mesh and of fines minus-200-mesh. This information is particularly useful if the floats are to be used in molding, extrusion, or spraying.

The *RF* float No. 11 contains only 1 per cent of material larger than 100 mesh. In the other *RF* floats, the content ranges from 3 to 7 per cent, indicating the presence of material that is sometimes referred to as 'whiskers'. In the plastics industry, particles plus 100 mesh may be helpful in producing impact strength in the product.

The three *TF* floats contain almost identical amounts of plus-100-mesh material. In two of them the percentage is lower than in the first ten *RF* floats.

Fines -200 Mesh

The fines minus-200-mesh in the *RF* floats range from 84 to 96 per cent, and in the *TF* floats from 91 to 96 per cent.

The material between plus 100 mesh (fibre and grit) and minus 200 mesh (fines) would be collected on the 200 mesh screen. Its amount can be obtained by adding the plus 100 mesh and minus 200 mesh values shown in the Table and subtracting the sum from 100.

This test, although useful, does not distinguish between, or give the relative amounts of, 'whiskers' (asbestos fibres) and particles of grit that might be present in the floats.

Grit +48 Mesh

In many cases, the grit particles in the floats are of very diverse size. Usually, they are small pieces of serpentine rock and magnetite, or small bundles of asbestos fibre. Complete classification, therefore, requires a further breakdown to determine the quantities of these objectionable particles present in the floats.

This test is made by water elutriation and by careful separation of the grit from 'whiskers' of fibre bundles.

The amount of grit plus-48-mesh in the eleven *RF* floats ranges from a 'trace' to 0.46 per cent. The percentage is lowest in samples Nos. 1, 6, and 11 and highest in No. 10. Although these quantities of grit seem small, they could cause considerable trouble in a manufacturing process by plugging extrusion apparatus or scoring the walls of expensive molds.

The three *TF* floats are almost free from grit plus-48-mesh.

'Whiskers' +48 Mesh

'Whiskers' are short asbestos fibres that may be valuable or objectionable, depending upon the use for which the product is required.

The quantity of whiskers in the eleven *RF* floats ranges from 0.50 per cent (in No. 11) to 4.12 per cent (in No. 8). In the *TF* floats, the range is from 0.10 per cent (No. 14) to 0.60 per cent (No. 13).

Grit -48 Mesh +80 Mesh

In some special products, the presence of grit smaller than 48 mesh, and even smaller than plus 80 mesh, is considered objectionable. Therefore, a further separation is made to determine the quantities of this grit that may be present in these floats.

As shown in Table I, the range for the eleven *RF* floats tested is from 0.02 per cent (Nos. 1 and 11) to 0.56 per cent (No. 8).

Two of the *TF* floats are free from this size of grit and the third (No. 13) contains only 0.06 per cent.

'Whiskers' -48 Mesh +80 Mesh

The presence of whiskers in the sizes of minus 48 mesh and plus 80 mesh is also objectionable because they affect the surface of certain products.

The eleven *RF* floats tested contain whiskers of this size ranging from 0.46 per cent (No. 5 to 1.30

per cent (No. 9). Corresponding figures for the *TF* floats are a low of 0.16 per cent (No. 14) and a high of 0.70 per cent (No. 13).

In the manufacture of plastics, the presence of whiskers results in non-uniform pourability of the molding powders. This necessitates a re-screening operation so that uniformly coated powders will properly fill the molds. In many cases, the whiskers and crudy fibre bundles are not thoroughly covered by the organic plastic material and this increases the water absorption properties of the plastic material, which may result in the formation of blisters.

OIL-ADSORPTIVE CAPACITY

The capacity of a float to adsorb oil is important because it gives an indication of ability to hold an organic liquid when manufacturing a plastic or caulking compound.

This test, made by manufacturers, consists of titrating a given weight of float with oil until its adsorptive capacity is reached. In practice, the adsorptive capacity is considered to have been reached when oil can be released from a ball of the thoroughly mixed float and oil by applying a small amount of pressure against it. The results of this test are expressed in terms of cubic centimeters of oil per gram of float.

For the eleven *RF* floats tested, the oil adsorptive capacity ranges from 0.65 to 1.05 cubic centimeters per gram. The value for No. 11 (1.05 c.c./gm.) is much higher than that for any of the others, which all fall between 0.65 and 0.68 c.c./gm. except Nos. 2, 3, and 7 (0.71 to 0.75 c.c./gm.).

Two of the *TF* floats, Nos. 13 and 14, have closely similar adsorptive capacity, 0.65 and 0.68 c.c./gm., respectively. No. 12 gave a higher value (0.75 c.c./gm.).

MISCELLANEOUS PHYSICAL TESTS

Numerous other tests, of importance to the manufacturer of certain asbestos products, are made on floats. Data for these are given in Table II and are summarized in the following paragraphs.

Surface Area

Study of the surface area of each float was made to obtain data on its covering power as a filler. In this test, the surface area is measured by the air permeability method by means of the Bowen apparatus, fol-

TABLE II

IDENTIFICATION	SURFACE AREA cm ² /gm.	DENSITY lb./cu. ft.		COMPRESSIBILITY* % THICKNESS AT 200 COMPRESS.		SPRINGBACK, % THICKNESS AT MAX. COMPRESS.		SUPP. COND. OF PRESSED SPECIMEN	IONIZABLE SLATS, MICROHOS/cm/10 volts	DRY BULK, VOL. OF 100 g. cc.	WATER-SOLUBLE		MAGNETIC RATINGS
		2,000 p.s.i.	3,000 p.s.i.	2,000 p.s.i.	3,000 p.s.i.	2,000 p.s.i.	3,000 p.s.i.				Solids %	CHLORINE as Cl %	
(1) TRF	14,800	89.9	94.7	29	32	2.5	2.8	Sm'l whiskers & bundles	219	350	0.16	0.017	4.7
(2) TRF	11,300	93.6	97.0	28	32	3.1	3.7	"	218	335	0.17	0.024	6.3
(3) TRF	13,000	98.5	99.2	28	32	3.2	3.3	"	222	340	0.18	0.029	6.1
(4) TRF	11,800	95.5	99.1	29	32	3.3	3.4	Grit & few whis. & bund. Sm'l amt. of grit & whis. Good smooth	206	305	0.16	0.025	6.0
(5) TRF	13,000	95.0	98.2	28	31	2.6	3.4	"	212	300	0.17	0.022	5.7
(6) TRF	14,000	100.0	105.4	28	32	3.8	4.0	"	379	320	0.36	0.15	4.1
(7) TRF	13,900	100.8	105.2	28	32	3.4	4.0	"	393	295	0.38	0.16	5.1
(8) TRF	12,500	102.7	107.7	28	32	3.6	4.2	Grit mostly	421	360	0.26	0.15	5.1
(9) TRF	7,500	99.6	105.8	27	31	3.4	3.9	"	190	255	0.12	0.0049	5.9
(10) TRF	8,600	101.2	105.8	28	31	3.0	3.4	"	243	285	0.14	0.0038	9.6
(11) TRF	20,800	93.6	99.2	35	39	5.8	6.7	Good Surface	260	475	0.16	0.0015	3.4
(12) TTF	15,400	95.0	100.0	27	31	3.3	3.7	Good surface	221	295	0.15	0.022	5.0
(13) TTF	11,300	94.8	99.4	27	30	3.5	3.3	Large grit	176	290	0.14	0.0034	4.0
(14) TTF	15,600	96.0	99.5	27	29	3.3	3.3	Good surface	396	275	0.36	0.16	3.9

*Measurements start at 200 p.s.i. as zero point.

lowing the Lea and Nurse technique (1).

The eleven RF floats tested show a wide range of surface area, from 7,500 cm²/gm. (No. 9) to 20,800 cm²/gm. (No. 11). In other words, float No. 9 has the lowest, and float No. 11 has the greatest, covering power as a filler. In plastics, the surface area of the float governs the amount of filler that can be used successfully prior to pressing in a given mold.

Two of the three TF floats (Nos. 12 and 14) have the same surface area, approximately 15,500 cm²/gm. For No. 13 the value is 11,300 cm²/gm. The high value of 15,500 for Nos. 12 and 14 indicates the presence in these floats of a large percentage of fines.

Density at 2,000 and 3,000 p.s.i.

Ten-gram samples of each float were subjected to pressures of (1) 2,000 p.s.i. and (2) 3,000 p.s.i. and their densities calculated in pounds per cubic foot. These pressures were selected because they correspond to the range of pressures used in the plastic-molding industry, and the data obtained are helpful in selecting the proper asbestos filler for molding powders.

At 2,000 p.s.i. the densities range from 89.9 lb./cu. ft. (No. 1) to 102.7 lb./cu. ft. (No. 8). Several of the samples have substantially identical density, but for the group as a whole the differences in density are such as would influence the selection of the filler to be used for certain products.

At 3,000 p.s.i., the densities range from 94.7 lb./cu. ft. (No. 1) to 107.7 lb./cu. ft. (No. 8). The increase in density for the additional

1,000 p.s.i. pressure ranges from 3.2 to 6.2 lb./cu. ft.

Compressibility of Floats at 2,000 and 3,000 p.s.i.

In this test, a 10-gram sample of the float is compressed at 200 p.s.i. and its thickness measured. It is then compressed at (1) 2,000 p.s.i. and (2) 3,000 p.s.i. and its thickness again measured. The reduction in thickness, expressed as a percentage, gives a measure of the compressibility for each float. Thirteen of the fourteen floats tested show about the same percentage of compressibility (27 to 29). For No. 11, the value (35) is appreciably higher.

This is an important property and must be taken into consideration when pressing a molding powder to a definite size after the molding cavity has been properly filled. Uniform compressibility is important as a bulky fibre will also exhibit poor dimensions after pressing.

Springback After Release of Pressures

The amount of 'springback' of a molding powder is another important property considered by plastics manufacturers. If the springback is too great, it will be difficult to obtain the proper dimensions for a molded product. Too much emphasis cannot be placed upon this property.

All fourteen floats were tested for springback at pressures of both 2,000 and 3,000 p.s.i. As will be noted from the data in Table II, the springback factor is uniformly low for all of them except No. 11 which, also, is the sample with the highest percentage of compressibility.

To use float No. 11, with a springback of 5.8 and 6.7 per cent, allowance must be made for its compressibility or the plastics manufacturer cannot control the dimensions of his product.

Surface Condition of Pressed Blocks

The surface characteristics of pressed blocks of the floats are noted in Table II. The surfaces usually show long 'whiskers', short stubby fibre bundles, and grit, which generally are considered poor properties from the viewpoints of appearance and water adsorption.

A smooth surface is desirable, provided the molded product meets all other specifications of the manufacturer. Five of the floats give good smooth surfaces and probably will be satisfactory for use in molding powders, provided other properties are acceptable.

Ionization Salts

For the manufacture of some special types of molding powders, it is essential that the asbestos fibre have low electrical conductivity. In this case, some plastics companies make a test on water-soluble material leached from floats. Apparently, all floats contain a certain quantity of water-soluble material. Its conductivity is determined, and the result of the test is expressed in terms of micromhos per centimeter per 10 volts. For the eleven RF floats tested, this factor ranges from 190 (No. 9) to 421 (No. 8). For the TF floats, Nos. 12, 13, and 14, the values are, respectively, 221, 176, and 396.

It is not known at present which values are objectionable, but it appears that a conductance of 300 micromhos or higher per centimeter

(1) For references see end of paper.

per 10 volts may cause trouble, with the molded plastic product having a low dielectric strength.

Dry Bulk

The bulking values of floats are sometimes considered important factors in plastics as well as in dry-wall joint fillers.

By some manufacturers, the bulking value is expressed as the volume, in cubic centimeters, of a given weight, say 100 grams, of the float. Some fillers should have high dry-bulk value while others should not; this depends entirely upon the intended application.

The eleven *RF* floats have dry-bulk values ranging from a low of 255 (No. 9) to a high of 475 (No. 11). For the three *TF* floats, Nos. 12, 13, and 14, the values are, respectively, 295, 290, and 275—differences that may lie within experimental error.

Water-Soluble Material

All floats were analyzed for water-soluble materials by allowing a sample of each to stand in distilled water for 63 hours and filtering off the clear water. Aliquots of the filtrates were dried and weighed to determine total solids, and these were then analyzed for chlorides.

The amount of water-soluble material in the eleven *RF* floats ranges from 0.12 per cent (No. 9) to 0.38 per cent (No. 7). In the *TF* floats the range is about the same, with a maximum of 0.36 per cent for No. 14.

No good correlation exists between the ionizable salt values and the quantity of water-soluble material.

The percentage of chlorine in the residues also was determined. For the eleven *RF* floats it ranges from 0.0015 to 0.16 per cent, and for the three *TF* floats from 0.0084 to 0.16 per cent.

Magnetic Rating

Since many floats are used as fillers in products employed by the electrical industry, it may be important to learn something about their magnetic ratings. The test, an adaptation of the Mapes (2) test, measures the amount of magnetic present.

Ratings of the eleven *RF* floats range from 3.4 (No. 11) to 9.6 (No. 10). The other nine *RF* floats have ratings between 4.1 to 5.9 with an average of 5.4. The three *TF* floats range from 3.9 to 5.0, averaging 4.3.

The maximum magnetic rating value for a successful float is not known precisely, but it is believed that the manufacturer would prefer the lowest rating available. It is known that the smallest trace of magnetite can be easily detected in a magnetic field and it may result in the rejection of the plastic material.

USE OF ASBESTOS FLOATS

Asbestos floats have a definite use in such industrial products as automobile body coatings, adhesives, caulking compounds, dry-wall joint filler, lubricating greases, asphalt and cold-water paints, plastics, molding powders, welding rods, insecticides, radiator scaling compound, acoustical plasters, cements, and many others.

Asbestos floats offer to manufacturers the advantages of being a low-cost inorganic filler, which will improve impact strength and provide good workability, good binding qualities, heat resistance, fair acid and alkali resistance, large surface area, and availability in commercial quantities.

A recommendation for the best grade of asbestos floats for a particular product should be made carefully, since each product has its own requirements and specifications.

Automobile Body Undercoating

A float for automobile body coating to be applied by spray gun may require the absence of 'whiskers' and large particles of grit. If the coating is to be applied by brush, however, the presence of whiskers and grit would not be objectionable. Therefore, the selection of a float for this job depends upon the method of application and such other factors as bulk and fluidity when incorporated in a binder.

Adhesives

The use of floats in adhesives depends upon the type and application of the adhesive product. The proper recommendation can be made only after knowing the desired properties of the adhesives and the method of application. The amount of floats in adhesives (3) varies between 9 and 40 per cent of the mix, depending upon the product.

Caulking Compounds

Caulking compounds may be sensitive to changes in grade of floats. For example, a gun grade of caulking compound may require a float

relatively free from whiskers and grit, while, for a caulking compound applied by knife, a float containing whiskers and some grit could be used. In general, the use of floats in caulking compounds (3) may range from 4 to 15 per cent by weight of compound.

Wall Joints

The manufacturer of dry-wall joint filler is very careful in his selection of floats. His specifications for asbestos fibre are rigid and he insists upon good bulking value, freedom from grit, good coverage, and no whiskers. Very few natural floats on the market today fulfill these requirements and, therefore, a special float must be made for this job. The amount of floats (3) required for this use may vary between 5 and 20 per cent of the dry mix ready for the market.

Lubricating Greases

Various types of floats have been used in some grades of lubricating greases, but in most greases grit is objectionable. Whiskers may be permitted unless the customer's specification indicates otherwise. The amount of float used in greases varies between 10 and 25 per cent of the product (3).

Paints

Paints, with either asphalt or cold-water base, may require a grit-free and whisker-free float if smooth surface is demanded. Otherwise, some grit and whiskers are allowable. Paints may contain from 5 to 11 per cent of floats.

Plastics and Molding Powders

Floats, with specifications varying from customer to customer, are used extensively for plastics and molding powders.

The general opinion of the plastics manufacturer is that fibrous float structure increases impact strength, allows a wide range for adjusting quantity of floats as filler, furnishes good binder retention and workability, imparts hardness and toughness to the moldings, increases heat and fire resistance, reduces natural shrinkage of resins and binders, reduces warpage and deformation, makes cold-molding possible by controlling the flow under pressure in the molds, allows blending of mineral and organic fillers, imparts good finish, improves the

electrical properties and reduces the cost of moldings.

Molded plastics are carefully checked for specific gravity, flexural strength, tensile strength, compressive strength, impact strength, water absorption, dielectric strength, power factor, shrinkage, heat resistance, visual observations of molding qualities, and ejection from the mold. It is important, therefore, that the plastics manufacturer select asbestos floats with care so that molding powder and molded product have the desired properties. The asbestos floats used as a filler in these materials generally form from 60 to 80 per cent of the mix (3).

Welding Rods

The welding rod manufacturer desires a float which will produce good coating as a filler, and which lacks whiskers and grit that might clog extrusion equipment. Floats also should be free from any sulphide mineral, or at least should contain less than the 0.01 per cent of sulphur that would produce obnoxious gas during welding. The amount of floats used for coating rods varies between 8 and 10 per cent*.

Insecticides

Floats sometimes are used as filler for insecticides to be dusted or sprayed onto flowers, weeds, and other plants. In this case, the float should be a fine dust so that it will impart large coverage. Floats for

*British Patent 535,355; Canadian Patent 365,792.

this purpose must compete with such other powders as talc and diatomaceous earth. The amount of float in a ready-to-use insecticide is approximately 4 to 5 per cent.

Radiator Sealing Compound

Various combinations of materials, including fine asbestos, are used in sealing compounds for automobile radiators. The asbestos forms from 1 to about 6 per cent by weight of the solids content of the mixture†.

Acoustical Plasters

Based upon the weight of the dry compound, some acoustical plasters contain from 6 to 15 per cent of asbestos floats. In this application, the floats function as a filler to provide bulk and fire resistance. Whiskers and grit are not objectionable unless a spray gun is used.

Cements

Cements and adhesives are considered similar by some authorities, and the amount of floats needed for adhesives would apply also to cements. Depending upon the type of cement and the application, the asbestos floats content ranges from 9 to 40 per cent (3). In many cases, whiskers and grit are permitted.

CONCLUSIONS

(1) Fourteen asbestos floats produced in Canada have been examined in tests similar to those made

†U. S. Patents 2,391,737, 2,315,321.

by customers in their own laboratories.

(2) Many of these floats have almost identical characteristics; however, one float, No. 11, differs considerably from all the others and has many unique properties.

(3) The type of float required for a particular product depends upon the use for which the product is manufactured, and each manufacturer has his own specifications and methods for testing the float.

(4) Float characteristics such as grit, whiskers, compressibility, springback, and magnetite rating are usually carefully checked by the plastics manufacturer, since these qualities affect his products.

(5) Bulk, surface area, and density values of floats are considered important factors in such products as wall joint fillers, caulking compounds, some pressed products, and acoustical plasters.

(6) The amount of ionizable salts, water-soluble solids, and chlorides in the floats is a matter of importance and frequently is checked by plastics manufacturers interested in improving the electrical properties of their products.

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