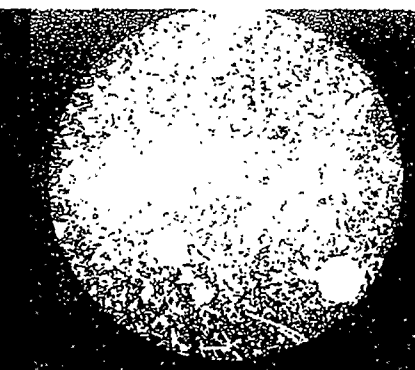

Photomicrographs of (Fig. 1) Filter-Cel, one of the Celite filter aids at 300 times actual particle size, and (Fig. 2) of Celite Snow Floss at exactly the same magnification

1 2

FILLERS—ASBESTOS AND DIATOMACEOUS SILICA

by A. B. CUMMINS*

TWO OF THE MORE IMPORTANT MINERAL OR inorganic fillers employed in the plastics industry are asbestos and diatomaceous silica. Mineral fillers are required where high heat resistance, exceptional electrical properties or minimum moisture absorption characteristics are required in molded products. In addition, there are other characteristics of each of these fillers that make their use important in the plastics field.

Chemical composition

The term asbestos has now come to include most of the more or less fibrous minerals. However, as employed in the plastics industry, asbestos usually refers to the mineral *chrysotile*. This is a hydrated magnesium silicate, corresponding in composition fairly closely to the formula $H_4Mg_3Si_2O_9$ or $3MgO \cdot 2SiO_2 \cdot 2H_2O$. Asbestos is employed in the form of fabric, paper and definitely fibrous forms for laminated compositions, etc., but its general use as a filler is as asbestos *fines* or floats, consisting of very fine fibers with associated dust and non-fibrous asbestic material.

Diatomaceous silica is a natural occurring opaline silica, containing three to eight percent of combined water and some two to six percent of other substances in chemical combination (alumina, iron oxide, alkaline earths and alkali metals). The material is of plant origin, consisting of the silicified residues of diatoms, which are microscopic aquatic plants of common occurrence. Diatomaceous silica is unique among mineral fillers because of its microscopic structure, great bulk, high absorptive capacity and low specific gravity.**

Chemical analyses for samples of *chrysotile* asbestos from Quebec and Arizona and of a leading grade of commercial diatomaceous silica are given in Table I:

TABLE I

	Chrysotile Canadian	*Chrysotile* Arizona	Diatomaceous Silica *Celite*
Moisture (Loss at 100° C.)	1.88	0.69	0.30
Combined H_2O (Loss on ignition)	13.60	13.86	0.22
SiO_2	39.91	42.69	92.42
Al_2O_3	1.35	0.39	3.86
Fe_2O_3	2.05	0.63	1.35
MgO	41.57	41.73	0.60
CaO	Trace	0.20	0.28
Na_2O	....	....	1.01
TOTAL	100.36	100.19	100.04

General characteristics

Asbestos. The only natural fibrous material of mineral composition available. Its use is required when a fine fibrous filler must be used for temperature conditions above that which can be tolerated by the usual organic fillers, such as woodflour, cellulose, etc., which char at temperatures below that at which any apparent change occurs with asbestos.

The specific gravity of pure *chrysotile* may be as low as 2.23, but for commercial grades the range will be ordinarily from 2.45 to 2.80. Color varies from nearly white to gray. Heat resistance is good to above 1400 deg. F. Dry density of commercial grades varies from 12 to 40 lbs. per cu. ft. Fineness specifications vary widely. Fiber length in all materials used as a powdered filler is below 1/8 inch.

Diatomaceous Silica. Its true specific gravity is within the range of 2.0 to 2.3. Apparent density (dry) is 8.0 to 25.0 lbs. per cu. ft. Fineness specifications range between zero percent on 200 mesh to ten to fifteen percent on 150 mesh depending on the use. While diatomaceous silica has an extraordinarily high absorptive capacity for

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** Diatomaceous Silica in Plastics, Modern Plastics, October 1939.

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liquids, etc., it is readily mixed with plastic compositions and can be handled satisfactorily in molding operations.

Developments during 1939

Asbestos. Greater effort has been made on the part of manufacturers to effect standardization of grades and to provide new and improved grades than in any previous year. At least one of the leading asbestos producers has carried out extensive technical investigations on the grades of fiber most suitable for different purposes and has set up a continuous technical service group to meet the requirements of the plastics trade, both in supplying the proper grades of short-fiber filler and in developing the best technique and methods in the use and application of asbestos in molding powders.

Some outstanding advances during 1939 have been:

1. Production of necessary grades now standardized at economic price levels.
2. Commercial availability of cleaner and better short-fiber grades.
3. Establishment of expert technical service.

Diatomaceous Silica. The use of diatomaceous silica in synthetic plastics is relatively new, but has been definitely increasing. During 1939, the increase in use came to nearly 100 percent over the average for the previous four year period. This has come about through wider acquaintance with the unique properties of diatomaceous silica and recognition of some of the outstanding qualities of molded objects filled with this inorganic material. Two outstanding developments have taken place in 1939:

1. The practical solution of problems in the fabrication of molding powders containing high loadings.
2. Introduction of certain new grades of material which are characterized by more ready mixability.

Types of products in which employed

Asbestos	*Diatomaceous Silica*
Heater plugs	Battery boxes
High heat-resistant parts, irons, ovens, etc.	Phonograph records
Electrical panels	Heater plugs
Flooring compositions	Sulphur plastics
Luminated products	Electrical parts
Electrical insulations	Closures
Wax compositions	Surgical parts
Roofings	Asphaltic cements and enamels
Friction materials	Rubber products
"Haveg" type compositions	Box toe compositions
Coating compositions	For many parts requiring excellent and durable surface finish
	Phone receivers
	Precision molding

Forms available

Asbestos	*Diatomaceous Silica*
Long fiber	Natural powders and calcined powders of different degrees of fineness and chemical purity
Short fiber	
"Floats"	
Fabric	
Yarn	
Paper	Different density materials available from very light powders to those of 25 lb. per cu. ft. loose weight
Low iron-content grades	

Outstanding characteristics as fillers

Asbestos	*Diatomaceous Silica*
High heat resistance	High heat resistance
Chemical inertness	Chemical inertness
Low moisture absorption	Minimum moisture absorption
Low shrinkage	Lowest specific gravity of any mineral filler
Low coefficient expansion	Exceptional surface finish
Fair electrical properties	Excellent electrical properties
Permits high loadings	Good to exceptional surface hardness
High impact strength (with better quality grades)	Good molding flow
	Grit-free grades available

Trade names

Asbestos	*Diatomaceous Silica*
1. *Chrysotile*	1. *Infusorial*
a. Canada	2. *Kieselguhr*
b. Arizona	3. *Diatonite*
2. *Amphibole*	

A close-up of one of the huge cliffs of diatomaceous earth at Lompoc, Cal., showing the great depth and uniformity of the deposit. (Photo, courtesy Johns-Manville)

Figs. 3-4 show microphotographs of typical