The Role of Asbestos in Plastics

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Introduction

DURING the past twenty years the use of asbestos fiber in molding compounds has increased considerably, and hence the plastics field has served as an outlet for large quantities of asbestos fibers from Canada. It is estimated that approximately 14,000 tons of asbestos fibers varying from Group 4 to floats are used by the plastics industry.

The utility of fillers in molding compositions has long been known. Their original purpose was to help make molding practical and to reduce the product cost. In the early days, these fillers consisted of sawdust, cotton waste, powdered asbestos, silica, diatomaceous earth, sand, clay, powdered glass, cork, marble dust, slate flour, or other materials. Each filler had certain good characteristics as well as certain objectionable ones.

In this presentation it is proposed to discuss only asbestos as a filler in molding plastics.

Types of Plastics

In general, molding plastics can be divided into the following classes: (1) cold-molded, (2) thermoplastics, and (3) thermosetting.

Cold-Molded Plastics

Asbestos fillers have the following advantages in the cold-molding field:

(1) Lower molding cost

(2) Make cold-molding possible by controlling the flow of material under pressure while it is in the cold mold

(3) Improve mechanical properties

(4) Increase hardness

(5) Decrease molded shrinkage

(6) Increase heat and fire resistance

(7) Allow ejection of the cold moldings from the mold, and improve handling and movement of the uncured moldings without danger of deformation or warpage

Unfilled moldings would be impractical in the cold-molding field of bitumens and phenolics. Because the filler must produce sufficient handling strength, asbestos, with its fibrous character, is desirable. Binders normally used are asphalts, pitches, gilsonite, polymerizable oils, resins, and similar compounds.

Cold-molded products of the bituminous type are sometimes loaded with as much as 85 per cent of asbestos. Such a product possesses good heat resistance and fairly good electrical insulating properties, and is low in cost. Its strength is not equal to that of hot-molded products; however, it is sufficient for the type of moldings made with cold-molding powders.

Cold-Molded Phenolics

Viscous solutions of a suitable phenolic resin are used as binders in cold-molded phenolics. The advantages of this higher-priced type of cold-molding compound are: better surface finish, lighter colours, more dimensional uniformity, and better mechanical and electrical properties.

Manufacturing Method

Cold-molded compounds are in general made by loading the fillers into a heated internal mixer, after which the binders and other ingredients are added in liquid form or in solution. This mass becomes somewhat tacky and, after discharge, it is allowed to 'season'. Later on it is screened to separate lumps, whiskers, and other extraneous material to provide a fairly uniform granular compound for molding.

The grades of asbestos used in the cold-molding field are normally described as floats and shorts. The quality and physical characteristics of the asbestos are important and should be controlled. The most important and troublesome variables within this field are:

(1) Texture and quality of fiber should be as constant as possible so that the molder can set up his working formula and not be forced to make repeated changes.

(2) Bulking property of fiber should be kept constant. For example, if the fiber is increased in bulking properties, more binder is required and this increases product cost. On the other hand, if the fiber is too heavy or less bulky, the molding material becomes tacky because it does not absorb the proper quantity of binder. This condition also causes screening and molding difficulties, sticking to the molds, increased baking time, and softer moldings. Often, the mechanical strength of the product is lowered.

(3) Excess moisture in the asbestos also can cause trouble, such as sticking and blistering. Normally, asbestos as received by the molder contains from one to two per cent of moisture. Under some storage conditions in customers' plants, the fiber may pick up additional moisture; this is why some plant operators pre-dry their fiber as a protection against any moisture increase due to storage conditions.

(4) Non-uniform fibers should be at an absolute minimum. They may be described as those that have 'whiskers' or long fibrils in excess of the average fiber length for that particular grade. These 'whiskers' twist and tangle and interfere with the efficiency of the screening process. They also cause sticking to the molds, produce surface blisters, and in most cases affect the finish and the appearance of molded products.

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After the molding powders are properly sized by screening, they are ready to be placed in the mold. At this point, the bulk factor is extremely important because preforming and final molding are one and the same operation. Moreover, positive molds are used, and most molded parts are each fitted with from one to several metal inserts. The molds are loaded by means of a small hand rake or mechanical rake. Good pourability and proper bulk of the molding compounds are indispensable at this step for good and efficient cold-molding. If the molding compound charge is insufficient, then the molded part is off-size; and if the charge is excessive, the product is heavy and in some extreme cases may even damage the mold.

The cold-molding operator has his own responsibilities. He must develop a well-balanced compound in which the ratio of binder to filler is adjusted in relation to the bulk value of the filler. If he does this, sticking and off-size products, as well as other troubles, will be minimized or eliminated.

In most cases, the compounds are dusted with a powdered lubricant before they are loaded into the mold, to prevent any sticking tendency. If the formulation is made correctly, the cold-molded compound will flow properly and produce good material. The main factors the operator must constantly watch are: (1) bulk of the asbestos filler; (2) ratio of binder to filler; (3) proper size of particles of the molding compound; and (4) molding pressure as well as baking temperatures and cycles.

In general, it may be stated that cold-molded products are not suitable for power factor applications of any importance; but they are used extensively as heater plug parts and as housings for the shielding of electrical units. High loading of asbestos as a filler imparts the heat and flame resistance required.

Thermoplastics

In the thermoplastics field the fillers generally used are zinc oxide, titanium oxide, blanc fixe (barium sulphate), talc, diatomaceous earth, and asbestos.

The *common names* of the most familiar thermoplastics are: cellulose nitrate, cellulose acetate, cellulose acetate butyrate, ethyl cellulose, vinyls, polystyrenes, vinylidene chlorides, and esters of acrylic acid.

The disadvantages of fillers in thermoplastics may be summarized as follows:

(1) Mineral fillers increase the specific gravity and molding weight of both thermoplastics and thermosetting molding compounds.

(2) Fillers preclude production of transparent or translucent plastics (molded, cast, or fabricated). Translucency can be obtained only to a limited extent when the refractive index of the plastic and the filler are approximately the same; in these cases, however, the moldings lack quality.

(3) Fillers decrease water and moisture resistance.

(4) Fillers also reduce electrical and mechanical properties. The exceptions are resistance to arcing and compressive strength.

(5) Fillers in most cases damage the delicate molding and fabricating equipment.

(6) Fillers frequently introduce new and sometimes complicated problems in the difficult art of colouring, mottling, and configuration of thermoplastics.

(7) Fillers in thermoplastics impose the need for special types of processing, molds, and methods of molding.

(8) Fillers increase the quantity of waste and re-work.

(9) Fillers make injection and extrusion molding methods troublesome and wasteful. Consequently, work along these lines is chiefly experimental at present.

Asbestos improves the heat resistance and compressive strength of the thermoplastic moldings. It also reduces the cost and the tendency to cold-flow, with resultant deformation and warpage. Although hardness is improved, the increase is only moderate. Resistance to flammability and arcing is also improved by asbestos; however, this is true of all mineral fillers.

Incorporation of fillers in thermoplastics is usually handled by one of three different methods, briefly described as follows:

(1) Preliminary mixing of the plastic binder in powdered or flake form with the plasticizers, fillers, and other ingredients in ball mills or in internal mixers.

(2) Blending of the ingredients, including binders, plasticizers, and fillers, with or without solvents, in heated kneaders. Hot-rolling is followed by calendering, stamping, or by molding.

(3) Incorporation of the fillers and plasticizers on the hot rolls after the plastic binder has been consolidated into a plastic sheet. This procedure is used for blanking and/or fabricating and/or molding.

To obtain a good product requires considerable good judgment on the part of the operator. This is influenced by: (1) method of incorporation; (2) time of mixing; (3) temperature of mix; (4) percentage of filler; (5) type of filler; (6) mixing technique; and (7) type and condition of the plastic binder.

Because of the conditions under which hot-rolling is practical in the thermoplastics industry, and because the binders are plasticized, the operation is a safe and efficient one for the operator. Binders remain fusible indefinitely, and this permits perfect blending by pulling the filled compound in fairly thin sheets over and over as required. Filler loadings are usually on the low side.

In most cases, a well-formulated compound can be processed and molded without sticking to hot steel; however, in some special cases lubricants are used to minimize possible difficulty.

Most of the thermoplastics used for regular molding can be produced in a large variety of molding flows, because the plastic base and the plasticizer content, or their ratios, can be changed within wide limits.

In thermoplastics, the molder must give close attention to: (1) nature, grade and flow of the base; (2) nature of the plasticizer, whether it is a solid or liquid; (3) percentage of plasticizer; (4) nature and percentage of fiber; (5) preheating; (6) molding temperature; and (7) molding pressure.

Special techniques have been developed by the trade for the drilling and machining of each particular type of thermoplastic, filled or unfilled.

Asbestos, especially light-coloured fibers, can be used in moderate percentages in the manufacture of thermoplastic molding or calendering materials based on ethyl cellulose, vinylchloride acetate, and vinylchloride (polyethylene has been tried experimentally). The asbestos filler improves the hardness, heat resistance, burning rate, compressive strength, and arcing resistance of the product but it affects adversely such characteristics as specific gravity, translucency, appearance, depth of colour, other colour possibilities, flexibility, shock and flexural strength, water resistance, and electrical properties.

In the thermoplastics field, the use of fillers is very limited. Vinyl chloride acetate and vinylchloride-base floor tiles, however, constitute a very important and growing field. Work is also being done on floor coverings.

Asbestos is used in some types of shellac-base compounds also, but not to the extent it was in the past.

One manufacturer in the United States has been producing injection moldings in very large quantities with a compound made with mineral fillers, asphalts of high purity, pitches, plasticizers, and hardening or strengthening agents such as asbestos or other fibers of short or medium length. We understand that the cost of these moldings ranges from $20 to $200 per ton.

Thermosetting Plastics

The thermosetting field of plastics is large, and use of fillers has many advantages. Filled moldings are cheaper, and the fillers control the flow of the molding compound. In addition, they improve the mechanical strength and dimensional uniformity, they make the moldings more dependable and durable, and they decrease the shrinkage and warping tendencies of moldings after their ejection from the hot mold. Fillers shorten the curing time and increase hardness; they improve heat, fire, and arcing resistance.

Some of the disadvantages in the use of commercial fillers in these plastics are: increase in specific gravity and molded weight; decrease in water and moisture resistance; lowering of electrical properties; increase in wear and tear on equipment and molds. Moreover, asbestos introduces grit, rock, and magnetite. These impurities increase deterioration of equipment; they make drilling and machining operations difficult.

In the production of thermosetting plastics it is generally accepted that, if the compound has a tendency to stick to the hot-mixing rolls, it will also stick to the molds and cause rejections, expensive delays, and cleaning jobs. Moreover, the mirror polish of the cavities may be damaged, and internal lubrication of the molding compounds is indispensable.

If the compound flows poorly, production is decreased. Also, moldings are mechanically weak, untrue, and defective dimensionally, and electrical and other properties are erratic.

On the other hand, if the compound flows immoderately and too rapidly, it causes excessive case hardening, excessive and wasteful flash, lack of dimensional accuracy, decreased mechanical and electrical strength, and upsetting of pins, removable parts, inserts, and the like. It also interferes with the efficiency of the ejecting devices.

Chrysotile asbestos as a filler has a number of advantages, some of which are common with other fillers. Advantages of chrysotile are: (1) it is mineral in nature; (2) it is available in large quantities; (3) it is low or moderate in cost; (4) it is fibrous in structure; (5) it is possible to adjust percentages used in relation to fiber length; (6) it is easy to process and mold in compounded form; (7) it retains the binders; (8) it is inert to reactions involving rolling, molding, and curing of the compounds; (9) it permits the manufacturer to use high percentages of filler, *e.g.*, 65 to 70 per cent; (10) it allows the molder to vary the percentage and fiber length to achieve desired mechanical strengths; (11) it imparts toughness; (12) is provides better surface finish than soft wood flours, barytes, or mica; (13) it retards the burning rate; (14) it supplies heat and fire resistance; (15) it increases hardness; (16) it reduces the natural shrinkage of the resins and plastic binders; (17) it allows blending with mineral and organic fillers; and (18) it increases the moisture resistance of moldings partly filled with cellulose fillers.

Compared with other mineral fillers, chrysotile has the following advantages: (1) it is fibrous and available in lengths desired; (2) it has excellent binder retention; (3) it is easy to process and mold; (4) it may be loaded at higher levels than other mineral fillers; and (5) it produces the hardest and toughest moldings at loadings impossible with other fillers.

Asbestos - filled thermosetting moldings excel all others in heat resistance, up to temperatures of 450°F., because asbestos loadings can be made at higher percentages than is possible with other mineral fillers. The impact strength can be varied within wide limits by varying the quantity and length of asbestos.

Chrysotile asbestos has some disadvantages however. Chief of these are:

(1) *Combined Water*

Combined water is present as a part of the chrysotile structure. If temperatures of molded products reach 450°F. or higher and some of the combined water in the asbestos is liberated, the molding will blister and crack. This difficulty is particularly significant when heater plugs and other electrical and heating appliances are involved.

(2) *Fiber Length*

Fiber lengths of asbestos used in plastics vary, depending upon the grade. The molder must understand the type of fiber and something about its properties, especially the specific gravity, bulk, molded weight, mechanical and electrical properties, water and moisture resistance. In addition, he must understand mixing techniques, colouring, surface finish, molded shrinkage, and percentage of fiber available in the asbestos grade used.

(3) *Dust or Fines*

The so-called 'dust' or 'fines' in asbestos may be granular, fibrous, or talcy. Variations in the ratio of dust to fiber, and its degree of fineness, will affect all those properties mentioned under the heading of fiber length. For example, surface quality of the molding will improve as the percentage of dust increases; however, all other conditions being equal, the surface quality of the molding will be lowered as the fibrous structure of the dust, or as the particle size of the dust, increases. In other words, a fine granular dust will impart the best surface finish.

(4) *Talcy Dust*

Talcy dust adheres to the surfaces of the fibers, producing what is called the 'talcose' effect. It retards, and in extreme cases prevents, adhesion of the resin binder to the asbestos filler and adhesion of the blending charge to the hotter of the mixing rolls. This often results in increased rolling time, sticking, fouling, irregularities, poor detail, inferior surface finish, and increased rejections or waste.

(5) *Rock*

The so-called 'rock fraction' in asbestos, which is mostly ground serpentine, is usually present in differing percentages. This fraction has a tendency to segregate when the ingredients forming the molding compound are given the preliminary dry- and cold-mixing. Accumulation of rock on the bottom of the mixer or ball mill unbalances the disposition of the ingredients. Presence of this rock in a molding compound will tend to scratch the delicate mirror polish of the mold, which is costly to repolish.

(6) *Pencils of Fiber*

'Pencils' are defined as fiber bundles not well opened, and thin in cross-section. These pencils cause the charge to stick to the hot rolls and molds as a result of the pencils being crushed between the friction rolls or under the molding pressure. When this happens, the newly exposed fiber surfaces remain partly coated and do not ride with the charge on the rolls or within the mold. When the pencils remain uncrushed they are enclosed by the binder, and, when opened by the grinding operation, they appear as poorly bound units, or as uncoated fibers or specks that show on the exposed surface of the moldings and throughout their mass. These pencils may also be blamed to a certain extent for blistering of material within the mold or in service.

(7) *Lumps of Fiber*

If the fiber is lumpy before the molding powder is made it will cause about the same trouble as pencils. Lumps must be removed to ensure good disposition. The fiber product as produced from the mine should be void of lumps; if not, it should be screened or lightly fluffed before use.

(8) *Whiskers*

Small percentages of long fibers in an extremely short fiber product are called 'whiskers'. Although these whiskers may be only a fraction of an inch longer than the main makeup of the fiber grade, they cause sticking and affect surface quality and appearance.

(9) *Grit*

Grit is usually smaller in particle size than the rock discussed earlier; it is harmful, however, and can damage the molds.

(10) *Magnetite*

Magnetite, an iron oxide having magnetic properties, is usually present in most grades of chrysotile asbestos. Its removal is difficult. The effect of magnetite on electrical properties has been the subject of much discussion, particularly when it is coated by a resin. Its black colour is objectionable in moldings of light colour or shade. Electrical properties of the molding may or may not be affected by the presence of magnetite.

(11) *Alkalinity*

Chrysotile asbestos has a high alkalinity because of the nature of the molecular grouping of its elements, which, in the presence of water, combine to form a small percentage of $Mg(OH)_2$. The *pH* is usually around 9.3 to 9.7. In many molding powders this alkalinity is not objectionable; in others, such as urea formaldehyde, alkalinity is troublesome. However, asbestos is not used to fill resins of this type.

(12) *Capacity for Moisture Absorption*

Asbestos, unfortunately, has a high capacity for absorbing moisture. This effect can be counteracted, however, by oven-drying before the molding powders are made.

(13) *Surface Finish Imparted by Asbestos*

Floats of good grade impart good finish as well as the desired toughness and mechanical strength. As the result of considerable experimentation, floats of excellent quality are now available.

(14) *Phenolic Molding Compounds*

Phenolic resins include the condensation products resulting from the controlled reaction of phenol with formaldehyde or with furfuraldehyde. The ratio of the reactants can be varied. The variations as well as the type of condensing agents, modifiers and/or additives used determine the characteristics of the resultant resin. One- and two-step resins and variations are made; they are used within the field discussed, the type selected being based on the properties desired in the end product. Phenolic molding compounds are made by blending short-fibered asbestos and/or floats and subjecting the mixed ingredients (including fiber) to some type of mechanical or heat treatment while the mass is in motion. Chief among these treatments are: (1) preliminary dry-mixing in ball mills or in internal mixers followed by hot-blending in friction rolls, and finally grinding of the mass to powders of the desired fineness; (2) preliminary dry-mixing in ball mills or in internal mixers followed by hot-friction blending in Banbury mixers, and grinding to powders of the desired fineness. By this method of treatment, fiber length is sometimes reduced, and consequently the toughness and mechanical strengths of the moldings are decreased. However, good blends are made and the curing cycles are reduced.

The purpose of the hot-rolling or hot-blending in Banburys is two-fold, (1) to ensure thorough blending of the resin, fillers, dyes, and lubricants, and (2) to facilitate the advance of the resin in order to decrease molding time. Moreover, reduction in the amount of condensation produced in the mold favours production of perfect, blisterless moldings and tends to reduce molding flash. Thermoset flash is practically useless. On the other hand, the thermoplastics type can be reworked and mixed with virgin compound, with or without the addition of plasticizers to compensate for volatilization in molding.

Preforming.—Phenolic molding compounds are usually preformed in suitable equipment. Preforms produced with the original powders are made in various forms and sizes or pellets, or in shapes approximating the final molding. This method accelerates production, assures uniformity of the molding charge, and reduces waste and flash to a minimum.

Preheating.—Molding preforms are usually preheated in special ovens to bring them to the proper degree of plasticity. Preheating reduces molding time.

When long or very long asbestos fibers are used in phenolic molding compounds they are mixed with the finely powdered resins and other ingredients in internal mixers, or by spraying liquid resins, or in solutions. The resultant mixture, although not very uniform, is used for molding. Mechanical mixing does not affect fiber length, but it does create a problem of loading the mold because of the high-bulk factor. Toughness and mechanical strengths are improved, but flow within the mold is retarded. Consequently the molding cycles are longer, more internal lubricant is usually needed, surface quality is poor, and the molded mass is not so uniform as that resulting from short asbestos grades.

The furan resins include the products resulting from the reaction of furfuryl alcohol and furfural;

ASBESTOS-FILLED PLASTIC MOLDING COMPOSITIONS (1)

THERMOSETTING TYPES

	Phenolics		Furans	Melamine Formaldehyde	Cold Molded	
	Molded	Cast	Molded	Molded	Organic	Inorganic
Specific gravity	1.52–2.00	1.70	1.75	1.70–2.00	1.87–2.15	1.60–2.2
Specific volume, cu. in. lb.	18.2–13.8	16.3	15.80	16.3–13.8	14.8–12.9	17.3–12.7
Mold shrinkage, in. per in.	0.0005–0.006	—	—	0.005–0.007	0.010–0.017	0.000–0.010
Tensile strength, p.s.i.	4,000–6,500	3 000–6 000	3,000–4,500	5,500–7,000	1,400–3,000	2,200
Compressive strength, p.s.i.	15,000–35,000	10,500–12,500	10,000–13,000	30,000	6,000–15,000	18,000
Flexural strength	7,000–15,000	5,000–8,000	6,000–9,000	9,000–11,000	3,700–10,000	2,000–7,500
Impact strength, ft. lb./in. of notch-Izod test	0.27–3.5	—	—	0.28–0.40	0.40	0.40
Hardness, Rockwell	M95–M115	R110	R110	M110	M80–M90	M75–M95
Thermal conductivity, 10^{-4} cal/sec/sq. cm per 1°C/cm	8–16	8.4	—	13–17	—	—
Resistance to heat (continuous), °F	350–400	300	265–330	250–400	500	900–1300
Heat distortion temp., °F	290–350	—	—	265	> 400	> 400
Dielectric strength, ⅛ in. thickness, short time, volts per mil	100–350	—	—	350–400	85–115	45
Dielectric strength, ⅛ in. thickness; step by step,—volts per mil	75–325	—	—	320	50–75	50–80
Dielectric constant, 10^6 cycles	5–7	—	—	6.1–6.7	6.0	—
Dissipation (power) factor, 10^6 cycles	0.10–0.50	—	—	0.041–0.050	0.07	—
Arc resistance, seconds	Tracks	—	—	120–140	75–200	100–500
Water absorption, 24 hr., ⅛ in. thick, %	0.10–0.50	—	0.01–0.2	0.08–0.14	5.5–2.0	0.5–15
Burning rate	*Nil*	Almost nil	Slow	*Nil*	*Nil*	*Nil*
Effect of weak acids	None to slight	Same as molded	Same as phenolics	None to slight	Slight	Slight
Effect of strong acids	Decomp. by oxidizing acids; others sl./none			Decomposes	Decomposes	Decomposes
Effect of weak alkalies	Depends on alkalinity; sl. or marked	"	None	Very light att'k	None	None
Effect of strong alkalies			None to slight	Slight attack	Decomposes	None
Effect to organic solvents	None on bleed-proof materials	"	Completely resistant	None on bleed-proof colours	Attacked by some	None
Machining qualities	Poor	"	Fair to good	Fair	Poor to fair	Poor
Molded qualities	Fair to good	"	Good	Good	Fair to good	Fair to good
Cure	In mold	In mold	In mold or oven	In mold	In oven	In oven

(1) Data taken from *Modern Plastics Encyclopedia*, 1955 edition.

furfuryl alcohol with formaldehyde; furfuryl alcohol and ketones, and finally the product resulting from the polymerization of furfuryl alcohol.

Resins made by reacting phenol and furfural also belong to the furan group, but their properties place them with the phenolics.

(15) *Melamine — Formaldehyde Molding Compounds*

Calcium cyanamide, a fertilizer prepared by heating calcium carbide with nitrogen under pressure, is the starting point in the synthetic preparation of melamine. This water-soluble material reacts with formaldehyde adjusted to a *pH* of 7.2 to 9.0 by means of caustic soda. The primary advantages of melamine formaldehyde resins compared with cheaper urea formaldehyde types are increased stability to heat and hot water, and greater resistance to alkalies and fruit juices. Moreover, the melamine formaldehyde resins permit use of alkaline fillers, such as asbestos. Such fillers cannot be used with the urea resins because they would inhibit setting.

Molding powders are prepared by mixing the liquid resin with the desired percentage of filler. Double-arm open mixers provided with ducts to remove the formaldehyde fumes are used. The damp mass is dumped onto a screener provided with a device to break up the damp resin-filler mixture. From this screener, the compound is conveyed to the oven drier. The galvanized iron shell of the driers must be acidproof. The continuous conveying belt should be chromium plated. The compound, spread in thin layers, is dried under very closely controlled temperature and humidity conditions. During the drying cycle the water content drops from 50 to 1 per cent and chemical condensation of the resin proceeds.

Cutting and grinding are the next steps. Grinding is done in ball mills where pigments, lubricants, and catalysts are added. The catalysts develop acidity when the compounds are heated to molding temperatures. These curing agents reduce the curing time and make the molding operation faster and more economical. The compound taken from the ball mills is ground to a fine powder to provide a more uniform molding powder.

If a molding compound of higher density is desired, the material is heated from 120° to 220°F. in Banbury mixers. The partial fusion thus obtained reduces the volume of the molding compound.

Powders must be kept in cold storage under controlled conditions.

(16) *Colour of Thermosetting Moldings*

For most phenolic molding compounds used for industrial and many other applications, the colour is not important. Colours other than black and brown are available today, however, and the filler has to be selected accordingly.

(17) *Textures*

Asbestos of the chrysotile variety, whether in the form of shorts or floats, should be of soft texture. Semi-harsh and harsh chrysotile fibers have a tendency to pulverize during the processing cycles and are more difficult to coat with resins than are the soft chrysotile fibers. Likewise, the molder will have less trouble in formulation if he knows that the physical properties of his fibers are not altered during his processing.

In the paper, *Heat Treatment of Chrysotile Asbestos Fibers* (1), it was stated that this kind of fiber in the form of floats is very good for use in plastics because of its improved physical properties.

Considerable research is being done in the fields of polyester and epoxy resins with asbestos in various forms. These fields may be very important in the not-too-distant future.

(18) *Physical Properties of Fiber-Containing Moldings*

The accompanying Table, taken from the *Modern Plastics Encyclo-*

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(1) Badollet, M. S., and Streib, W. C., *Heat Treatment of Chrysotile Fibers;* C.I.M., Trans., Vol. LVIII, 1955 pp. 33-37.

pedia for 1955, shows the various properties of the asbestos-filled molded compositions of the thermosetting type.

Conclusions

The role of asbestos in plastics has been reviewed from the viewpoint of its usage in the cold-molding, thermoplastic and thermosetting fields. The advantages and disadvantages of chrysotile asbestos in these fields have been discussed, as well as general methods of compounding the fillers with the resins.

The use of asbestos in plastics is important to both the plastics manufacturer and the asbestos industry, and it will continue so for a long time.

Today, in the competitive market, it is necessary for the asbestos fiber salesman to understand the usage of asbestos in plastics and to be able to help the manufacturer wherever possible. His contacts furnish the leads for future development by the mines of the proper grades of asbestos for the plastics industry. The closest possible co-operation between the mines and the plastics manufacturer is essential to assure the success of the product by keeping variations in quality within the narrowest limits.

Ontario Mining Association

THE Thirty-Seventh Annual Meeting of the Ontario Mining Association, which represents the producing mines of the Province, was held in Elgin House on lake St. Joseph, Muskoka, in mid June.

M. L. URQUHART, Manager for McIntyre Porcupine Mines, Limited, was elected President of the Association for 1956-57, and M. S. FOTHERINGHAM, President of Steep Rock Iron Mines, Limited, was re-elected Vice-President.

Eleven of the fifteen Directors of the Association were re-elected for the ensuing year. To replace the four retiring Directors — J. BEATTIE, B. W. LANG, G. A. MCKAY, and H. L. ROSCOE — the following new Directors were elected for 1956-57:

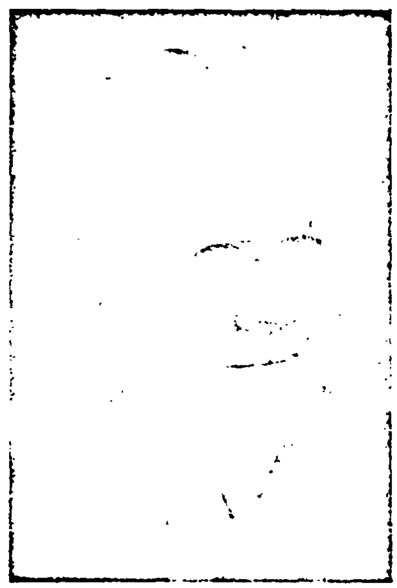
J. M. CUNNINGHAM-DUNLOP, President, Nipissing Mines Company, Limited.

J. A. H. PATERSON, General Manager, Mining Corporation of Canada, Limited

E. A. PERRY, Manager, Hollinger Consolidated Gold Mines, Limited

R. V. PORRITT, Director, Pamour Porcupine Mines, Limited

Guest-speaker at the annual dinner, held on June 18th, was DR. R. L. HEARN, Chairman of the Hydro-Electric Power Commission of Ontario. He reviewed the electric power needs of Ontario, both present and future, and the Province's place in the present world-wide development of nuclear electric power. Concerning the latter, he stated



M. L. Urquhart

that construction will commence this summer on a 20,000 kilowatt experimental nuclear electric power plant adjacent to the Des Joachims station through the joint efforts of the Federal Government, the Canadian General Electric Company, and Ontario Hydro. It is planned to have this plant operating by 1959. The fuel will be natural uranium, possibly enriched with plutonium, and heavy water for the moderator of neutrons. It will be in the form of about 200 rods of uranium sheathed in zirconium to prevent its corrosion by the heavy water and to retain fission products. A second heavy-water system flowing through tubes surrounding the fuel rods will carry the heat given off by the fissioning uranium to steam generators, where ordinary water will be converted to steam to drive a turbine which will, in turn, drive electric generators. From the experience gained in designing and operating this experimental plant, plans for stations of 100,000 kilowatt capacity or higher can be made.

Field Conference, Alta Soc. Petr. Geologists

AS WAS ANNOUNCED in our June BULLETIN (p. 395), the Sixth Annual Field Conference of the Alberta Society of Field Geologists will be held on August 23rd, 24th, and 25th in the Calgary-Banff area, centring in the Canmore-Kananaskis region.

The papers to be presented and discussed at technical sessions on the first day of the Conference were listed in the June BULLETIN. Since that list was published we have learned that the author of the paper on *Belly River Formation Stratigraphy*, not known at that time, is KEITH WILLIAMS. Also, an additional paper, on *The Panther River Structure*, by C. W. HUNT, has been definitely promised, and it is hoped that others will be offered before the opening of the Conference.

The geology to be seen and studied in the field trips will range from the Palaeozoic to the Cenozoic and will include classic thrust faulting.

Members planning to join the Conference should send their applications *immediately* to MR. GRAHAM GAMMELL, Registration Chairman, 406 Canadian Bank of Commerce Building, Calgary. Reservations for accommodations should be made through MR. M. F. TESKEY, Accommodations Chairman, 307 Sixth Avenue West, Calgary.