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TENITE

Eastman Cellulose Acetate Molding Composition

TENNESSEE EASTMAN CORPORATION

KINGSPORT, TENNESSEE

TENITE

A THERMO-PLASTIC MOLDING MATERIAL

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MADE FROM EASTMAN CELLULOSE ACETATE

TENNESSEE EASTMAN CORPORATION
Subsidiary Eastman Kodak Company, KINGSPORT, TENNESSEE

TENITE

Eastman Cellulose Acetate Molding Composition

TENITE is a thermoplastic molding material made from Eastman cellulose acetate. Its characteristics are exceedingly high strength, uniform texture, stability, unusual machinability, smooth finish, high luster, and unlimited color range.

Tenite is produced in all colors, plain and variegated, and in all degrees of translucency from crystal clear to opaque. It is supplied to the molder in slab and granulated forms, and in any desired degree of flow. Tenite is molded merely by the application of heat and pressure, without undergoing any chemical change. Its physical properties can be varied over a wide range, to suit the requirements of use.

Since the Tenite manufacturing process requires no period of aging, quick delivery is possible in both sample lots and production quantities.

USES OF TENITE

Products made from Tenite have strength unsurpassed by that of any other molded product. Tenite excels in toughness and resilience. For this reason, it is adapted to thin-walled products where other types of molding materials are inadequate because of their brittleness.

In uses which demand insurance against cracking, chipping, or shrinking, Tenite is the ideal molding material. It has excellent machining qualities, and may be punched, stamped, drilled, or sawed with ease. Similar operations, such as the crimping of metal beadings, as well as riveting, can be accomplished on a Tenite molded piece without the slightest risk of breakage.

Tenite gives to the molded product a beautiful lustrous finish. This finish can be secured from polished steel molds. Nickel or chromium plating is not necessary, but is desirable to give the mold a hard surface and permanent polish.

Tenite is particularly adapted to the molding of articles which come in contact with the skin. Because Tenite is a low conductor of heat and takes an exceptionally smooth finish, it is pleasant to the touch. It is also without odor or taste.

Tenite is uninjured by contact with oils, either vegetable or mineral. Alcohols are partial solvents and will soften or spot the surface of a molded piece.

Products molded from Tenite are unaffected by ordinary temperatures. Subjection to temperatures of 160° F. or higher, depending somewhat on the degree of flow, will cause softening. Slight shrinkage in thin-walled pieces takes place under continued heat of more than 140° F.

Tenite supports combustion with difficulty, burning like hard rubber, fiber, wood or similar substances. It is listed under

the Underwriters' Laboratories Re-examination Service and rated as follows: "Hazards of this product in use are judged to be small and in storage somewhat less than would be presented by common newsprint paper in the same form and quantity."

In those uses where plain or variegated colors of great depth, brilliancy, and richness are desired, Tenite is unsurpassed. It is the only type of molding compound commercially used in transparent colors, including a clear transparent.

These qualities of Tenite have led to its selection for a wide variety of products—including combs, pencils, toothbrushes, goggle frames, automobile hardware, handles, illuminated panels, spools, cores, fishing-reel ends, and many other special appliances.

UNIFORM QUALITY OF TENITE

Like other Eastman cellulose products, Tenite is a material of exceptional uniformity. The cellulose acetate used in its manufacture is of the same high degree of purity as that used in making Eastman safety motion picture film and Eastman acetate yarn. It is produced in the same machines and is under the same strict laboratory control at every stage of production.

The plasticizers used in Tenite represent years of research and experience of its makers in the application of plasticizers to the manufacture of film and other cellulose products. Tenite dyes and pigments are of the most stable types with respect to both light and heat.

The special process which permits making Tenite without the necessity of aging insures that any piece of Tenite will have the same composition at the center as on the surface. This makes for a molded product of extremely uniform composition.

In order that one lot of Tenite shall be identical in composition with one made at another time, not only are the formulas identical, but the material in each individual case is tested before shipment for flow and strength of molded product, and examined for color match and cleanliness.

FORMS OF TENITE

Tenite is available in the following forms, colors, and degrees of flow:

Physical Forms

SLABS—up to 20″ x 25″, $\frac{3}{16}$″ to $\frac{1}{2}$″ thick.
GRANULATIONS—$\frac{3}{32}$″ to $\frac{5}{16}$″; also preforming grade.

Special forms for particular applications.

Color and Transparency

TRANSPARENT—all colors and crystal.
TRANSLUCENT—slightly pigmented, all colors.
OPAQUE —all colors.
VARIEGATED —configurations of mixed colors.
PEARL —variegated, with iridescent pearly luster.

Degrees of Flow	*Approx. Molding Temp.—°F*
H —Hard	340
MH—Medium Hard	325
M —Medium	310
MS —Medium Soft	295
S —Soft	280

The specific gravity of Tenite is 1.28 for transparent colors; a very little higher for pigmented colors.

CHOICE OF PHYSICAL FORMS

Granulation is most suitable for a mold having a relatively narrow cross-section and deep cavity. Slabs are best suited to a thin molded article where there is no great depth of cavity and where the granulation would have a tendency to spill out.

Other things being equal, it is better to use Tenite in slab form than in granulation, for the following reasons:

1. A slab piece is susceptible to preheating, and when it is placed in a hot mold, the mold can be closed immediately. The total time cycle then becomes largely a question of the speed with which the mold can be chilled.

2. Slab stock, before molding, is as dense as the finished molded piece, while the bulk of granulation relative to the finished molded piece is approximately in the ratio of 2½ to 1. The use of slab stock therefore frequently reduces the size of the mold necessary and thereby not only the cost of the mold, but also the time cycle, since there is less metal to be alternately heated and chilled.

3. It is much easier to get an accurate mold charge by cutting a slab of Tenite to dimension, thus controlling the charge by volume, rather than by weighing each individual cavity charge from a granulation.

4. While Tenite in the preforming grade can be "pilled," the use of slab stock in blanks eliminates the possibility of contamination in the additional operation of preforming. Preforms also have a tendency to crumble at the edges, being merely a compressed granulation.

5. With pale translucent colors, as well as transparent colors, it is much easier to keep slab stock clean. If a piece of slab stock gets dirty, it can be wiped off, but if granulation becomes contaminated it is sure to show the dirt in the finished piece.

6. There is less chance of securing an imperfectly molded piece from slab stock than from a granulation. A piece molded from a slab is flowed into shape, while a piece molded from a granulation might be said to involve both flowing and welding of the granular particles.

7. Beautifully grained variegated effects are obtainable through the use of slab stock. Variegated colors may be obtained by mixing granulations of contrasting shades, but they lack the distinctive grain or striated effects procurable by molding slab stock.

Users of Tenite often find it advantageous to purchase stock in the form of rectangular or square blanks cut to the size in which they plan to use it. Particularly is this true where the molding sheet is very heavy, say from ¼″ to ½″, since it is difficult to heat such stock sufficiently well to get a smooth shear cut by the use of the steam table facilities ordinarily used by the molding trade. This cutting is done at a small additional charge.

CHOICE OF DEGREE OF FLOW

In the large majority of cases, medium flow is most suitable. Medium hard is used where somewhat greater rigidity is required, still retaining the tough resilient character of Tenite. The hard flow is used where the stiffest finished article is desired.

Medium flow Tenite has the greatest resistance to impact, being better in this respect than either medium hard or hard. Medium soft and soft are used to secure increased flowing properties.

The lower the pressure and temperature at which the grade of Tenite flows, the softer is the finished piece.

All of the five grades in which Tenite is regularly supplied make excellent finished molded pieces; but for any particular application one grade is definitely better adapted than another, and on that account it is desirable when writing for samples or information to mention the application which is under consideration.

MOLD DESIGN

Tenite may be molded in either positive or flash type molds.

The most important consideration is that the mold be designed for rapid and uniform heating and cooling. Being a truly thermoplastic material, Tenite is molded by the application of heat and pressure, followed by a chilling of the mold. To obtain a short molding cycle, the mold is preferably channeled so as to permit steam and cold water to be alternately circulated in the metal immediately surrounding the mold cavity.

Tenite may be molded in a hand mold or other unchanneled mold which secures its heat as well as the chilling action from the press platens, but the cycle is longer.

Quick heating and cooling is not so much a function of the amount of steam and water used as the amount of contact they have with the metal near the cavity. It is often possible to thread or step the wall which is in contact with the steam and cooling water so as to increase the area of metal exposed. Another aid in accomplishing quick cooling is a manifold at each end of the die with supply and return pipes equal in capacity to a number of smaller pipes which lead through the die. It is sometimes advisable to flow the water around the cavity, making the cavity itself an insert in the mold plate. The water is made to flow around such cavities by the use of baffles.

Bearing in mind the desirability of uniform heating and chilling of the mold, it follows that chilling usually can be only as rapid as the speed with which the slowest cooling part can be reduced to the ejection temperature. The cavity portion of the mold is commonly the more susceptible to easy channeling to effect quick heating and cooling. Particular attention must, therefore, be given to achieving a design which will as quickly cool the force, since this is the part ordinarily farther removed from the mold channels.

On request the Tennessee Eastman Corporation will submit mold sketches for articles involving possible applications of Tenite, particularly with respect to the method of channeling to secure quick as well as uniform heating and cooling of the mold.

It is desirable in constructing molds for Tenite that there be no cracks into which the material can flow. This is because the material having once entered the crack does not cease to flow; each time the mold is heated the Tenite again becomes plastic and forces itself farther into the crack. The pressure may become so great as to strip the threads on screws holding the plates together.

Tenite stock should be kept dry. A satisfactory article cannot be molded from Tenite which is actually wet; the strength of the finished piece is impaired by the presence of moisture even though there are no visible defects. For this reason, there should be no steam or water leaks in or around the mold. Frequently, compressed air lines used for blowing out the mold cavities contain water from condensation. Such air lines should have a water filter.

The mold pieces should have a slight draft to facilitate ejection. If it is desired that a molded article hang to the force, the draft on that portion should be less than the draft of the cavity. Sometimes an undercut is intentionally molded on a piece to insure sticking to the mold force. Such an undercut is sheared off in the stripping operation.

A new mold, no matter how well polished, has microscopically minute undercuts which wear off, and thus the longer a mold is used the brighter the polish becomes and the less tendency there is for molded pieces to stick. That is, a mold usually has to be broken in before it runs perfectly smoothly, particularly where there is a vertical flow of the material. This applies to all molded plastics.

Chromium plating of a mold is desirable to maintain the permanent polish, although it is sometimes impossible to plate sufficiently uniformly in remote interior angles of a mold so that no subsequent peeling will occur. A thickness of .0002″ is recommended for chrome plating flashed directly on the steel without any intermediate layer of copper.

Sometimes a lubricant is helpful, particularly in the case of a new mold. Carnauba or Montan wax is recommended. Carnauba wax has the advantage of being almost colorless. It is best applied by using it in the form of a very fine powder. A cloth bag containing the powdered wax is struck against the surface of the mold, and sufficient powder flies out to give a very, very thin film of wax. This method gives also reasonably uniform distribution of the lubricant. More than the minutest film will cause a blemish in the molded piece.

INJECTION MOLDING

Tenite is admirably adapted to injection molding (also referred to as extrusion and transfer molding). In this process, Tenite is placed in a cylinder where it is heated, progressively or otherwise, and then forced through a narrow orifice or gate into the mold cavity, by pneumatic or hydraulic pressure.

Injection molding is advantageously employed for the casting of certain pieces which would be difficult to make by ordinary pressure molding. For example, it is used where the molding composition is obliged to flow around delicate inserts which might be displaced by pressure before the Tenite is entirely plastic.

Small molded pieces have been made by injection of Tenite into an unheated mold, with a consequent gain in speed of operation. Obviously the plastic material must be injected into the mold so quickly in this case that it has no opportunity to become partially set, or an imperfect molded piece will result. Thus, up to the present time the advantage of this method has been confined to the molding of small pieces.

An advantage of injection molding which applies only to a thermoplastic such as Tenite is the fact that it is unnecessary to clean out the pressure chamber, the channels and the gates through which the plastic flows, between successive shots. In fact, the charge which can be placed in the pressure chamber, in the case of Tenite, is limited only by the two considerations of the capacity of the pressure chamber and adequate heating of the material from the side walls of the cylinder.

PREFORMING

Tenite is preformed in the usual type of automatic preforming press with either single or multiple punches and dies. It may also be preformed in a rotary preforming machine, although the punch type is usually better in that it furnishes greater pressure. More pressure is required to preform Tenite than is required with the phenolic molding compositions, when the operation is done without heat. To secure the most solid preforms, it is recommended that a small electric coil be attached to the under side of the plate holding the preforming die. This procedure makes it possible to preform with less pressure.

Particular attention is called to the necessity of extreme cleanliness in preforming light colors—a consideration which exists in the case of any molding composition in delicate tints.

Cleanliness is, of course, essential not only in preforming, but at all times, in the handling of Tenite, particularly in its

granulated form. Tenite granulations are shipped in sealed fiber drums, which should be kept covered except when the material is being withdrawn.

MOLDING PRESSURE AND TEMPERATURE

Usually a pressure of 2,000 pounds per square inch is adequate, although production sometimes may be increased by using higher pressure.

The molding temperature most desirable must be determined by experiment; however, the temperatures shown under "Degrees of Flow" have been found generally satisfactory.

In calculating steam pressure for these appropriate average mold temperatures, allowance must be made for the heating efficiency of the press or mold. A hand mold which secures its heat by conduction from the press platens will require a much higher steam pressure than a channeled mold where the steam runs through the mold itself.

The speed of operation can be increased by preheating the Tenite on a steam table to a uniform temperature about 40 degrees above the recommended mold temperature.

Reasonably uniform heating of the mold is very desirable to secure perfect castings. Too much heat on the casting as a whole or on a part of it will cause "heat marks" which have the appearance of surface air locks. Excessive heat will cause blisters and bubbles. Insufficient heat will give inadequate flow to fill the cavity completely, or will cause an incompletely welded piece, lacking in strength.

Chilling is accomplished by running cold water through the channels of the mold, or through the press platens in the case of a hand mold. A casting should be chilled to the extent of dropping the mold temperature about 150 degrees F. below the molding temperature. Where specifications allow very little tolerance and when the piece has very thin sections, it is desirable to chill further.

CHARGING THE MOLD

The mold charge should be just sufficient to fill out the cavity, with a small amount of overflow to give the necessary back pressure in the open or flash type mold. An excessive charge is wasteful, slows the time cycle, and sometimes causes heat marks because of the higher temperature or prolonged heating required to flow out the excess.

In loading by volume, it will be found much more satisfactory to use blanks cut to size from slabs rather than to use a granulation. The mold charge can be much better controlled through the use of slabs.

A mold can be charged with granulation measured either by weight or by volume. The second is obviously the less expensive method, particularly in the case of a large multiple-cavity mold, where a loading tray is used and all cavities are filled at once by a slide dumping device.

The flash type mold is perfectly adapted to loading granulation by volume, but for a mold of a positive or confined type the charge must usually be weighed. It is possible to get a more accurate charge by weight than by volume when using a granulation, because the method of filling a volume measure will make the density vary slightly from one time to the next. The slightest jar acts to tamp the granulation and thus give a greater weight for the same apparent bulk.

A mold can be loaded more quickly by using a loading tray than by placing pieces cut from slab stock individually in the cavities. Sometimes blanks from the slab stock are placed in the cavity from a loading tray, thereby combining the advantages of both granulation and slab stock so far as speed is concerned.

In such cases, it is desirable to have more than one loading tray in order that the slab stock may be preheated on a steam table when it is already in the loading tray, thus eliminating the surface cooling which inevitably occurs when preheated blanks are transferred to a tray. Steam or electric table heating is to be preferred to oven preheating of Tenite blanks, because it gives an intimate contact with the heating medium and thus quickens softening.

The use of a mold with a common loading cavity frequently has certain advantages, among which is speed of loading. Where a number of small pieces are to be made, the granulation is poured over the cavities in the lower plate without any particular attention to uniform distribution. In such a mold there is but a single force piece. It is necessary to weigh but one mold charge. A secondary advantage of this procedure is that all the pieces when ejected are held together by a thin flash easily broken apart. Frequently it proves possible to remove all the flash at one time by a gang punch, taking advantage of the tough quality of Tenite which makes the pieces hang together on this thin flash—the quality which at the same time so admirably adapts Tenite to the punching operation.

A common loading cavity is not advisable where there are interchangeable dies contained in one mold, placed in it as inserts. The reason for this is that the material finds its way into the crack between the insert and the body of the mold.

It is essential that the Tenite be thoroughly heated before the final pressure is put on; this is usually accomplished by closing a press with a low-pressure hydraulic supply first, then following with hydraulic high-pressure. When the mold is closed, cold water is turned into the channels of the mold until the temperature has dropped to the ejection point. The mold is then opened and the casting is removed. Since no chemical action takes place when Tenite is heated, there is no advantage in keeping the press or material hot any longer than is required for closing the mold. In fact, the speed of the molding operation depends almost entirely upon the rapidity with which the mold can be heated and cooled.

Sometimes the shape required in a molded piece tends to create air locks. In such cases it may be helpful to almost close the mold, slightly open it enough to relieve the pressure, and then immediately close it. This will let out air which might otherwise be trapped. The practice is variously called "breathing," "gassing," and "blowing" the mold.

It is most unusual for this procedure to be found necessary in molding Tenite, as with Tenite air has a tendency to free itself and get out better than in the case of most molding compositions. Surface depressions which are actually "heat marks" are frequently mistaken for the effect of air locks, particularly in flash type molds. The remedy for heat marks is, as mentioned elsewhere, less heat.

Being thermoplastic, Tenite overflow and trim scrap can be remolded. Defective molded pieces can also frequently be salvaged by the simple process of remolding and the addition of a small amount of new material.

MACHINING TENITE MOLDED PIECES

In general, it is much better to finish a Tenite molded piece —an operation usually comprising nothing more than removal of the flash or overflow fin from the molding operation—by an action which is of a cutting nature, rather than a filing or sanding nature. The reason for this lies in the toughness of Tenite. A material which is relatively brittle, such as the phenolic or urea resin compositions, lends itself to filing, sanding, or burring. It is preferable to turn, punch, or scrape a Tenite article.

Tenite is sawed with the greatest ease. To obtain the smoothest saw cut there should be little or no set to the saw. In drilling, a long taper to the flutes is desirable.

The operating speed in any machining operation on Tenite —whether sawing, drilling, or milling—should be such as to avoid overheating and consequent softening of the thermoplastic material.

Tenite machines as easily as wood, with the great added advantage that it possesses no grain structure, being entirely homogeneous. Thus the product is most suitable for the making of models or samples which in production are to be molded. This consideration is of immense value to the molder in that it permits him to make the most forceful sales appeal. He can show his customer, in a finished product, exactly what he can expect to receive as a molded piece, without experimental mold expense. The perfect cementability of Tenite to itself further facilitates such a procedure.

The Tennessee Eastman Corporation is always glad to cooperate with the molder by supplying blocks of Tenite to dimension for making such models, even though the thickness required is considerably greater than that normally supplied in a molding sheet.

PUNCHING AND STAMPING

The toughness of molded Tenite is such that it is possible to punch holes and slots in pieces which would shatter under the impact of this operation, if made from the phenolic or urea resin materials.

Although almost any type of hole or slot can be formed with Tenite in the course of the molding operation, such a procedure would sometimes make for complication and higher cost in what would otherwise be a relatively inexpensive mold. The fact that Tenite can be punched is thus a marked advantage over any other type of molding composition.

To secure the smoothest possible punched or sheared cut, it is desirable to warm the molded piece, but not in excess of 150° F. in cases where there are thin-wall sections and where at the same time there must not be the least shrinkage from the original dimensions of the molded part. When a thick section is to be punched, more heat may be used to advantage. The smoothest edge is, of course, obtainable with a punch and die shaped to the contour of the surface being perforated.

Included in the general field of punching operations, to which Tenite is so admirably adapted, is that of stamping decorative effects, trademarks, and brands. Of course, a trademark or brand can be molded into a Tenite article, but it sometimes happens that the same shape of piece will carry more than one brand. In such cases the ability of Tenite to take a neat, permanent and attractive stamp is most useful, saving the cost of an additional mold.

Brands are frequently punched in the surface of a Tenite molded article and filled in with an appropriate paint if it is desired that the brand be conspicuous. Gold, silver, or colored lettering and decorative effects are obtainable by stamping with metallic foils.

POLISHING

The finish on a Tenite molded piece is just as good as the finish on the mold. If a high polish is desired on the article, the cheapest and best way to obtain it is to give the surface of the mold a correspondingly good finish. However, it is often necessary to polish the line where the flash is removed. For this purpose buffing wheels are employed, usually with a rouge composition in brick form for convenience.

If an abrasive action is required prior to a final polish, Tenite pieces can be satisfactorily ashed by the use of powdered pumice stone used wet, with buffing wheels built up from muslin discs. Where a softer wheel is desirable in order to avoid rounding off delicate projections or changing critical dimensions, smaller muslin discs which serve as spacers are used between the larger buffing discs.

CEMENTING

Acetone is the most common solvent for Tenite. Acetone alone will cement Tenite to Tenite, but usually a better bond is secured by using a cement with some body. Such a cement may be made by using Tenite scrap dissolved in acetone. Owing to the presence of pigments in other than transparent Tenite, however, the bond is not so good as that secured by using a cement especially prepared for Tenite.

DELIVERY

Since the manufacturing process involves no period of aging, Tenite can ordinarily be made and shipped almost immediately upon receipt of orders.

The process which permits of this quick delivery applies to both small sample lots and large production quantities. Thus, quick delivery of sample lots has often helped a molder to secure business by enabling him in turn to submit samples of a molded product while the prospect's interest was still maintained. Quick delivery of production quantities eliminates the necessity for the molder to carry any sizable stock, which would entail additional investment and risk of obsolescence.

Further information regarding the adaptability of Tenite to any specific use will gladly be supplied by the Tennessee Eastman Corporation, Kingsport, Tennessee.

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