

VINYLITE
TRADE MARK
EXTRUSION and MOLDING
Resins and Plastics

TECHNICAL DATA

MARCH 1953

B A K E L I T E C O M P A N Y

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION



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A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

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30 East 42nd Street, New York 17, N. Y.

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FOREWORD

Bakelite Company, a Division of Union Carbide and Carbon Corporation, is a supplier of a number of synthetic resins and plastics. These are available in a variety of forms and are suitable for use in a number of compounding, processing and fabricating techniques.

Included in this group of synthetic materials are a number of important members: VINYLITE Plastic flexible film and sheeting, rigid sheets, electrical insulating materials, extrusion and molding materials, and resins for calendering and the formulation of surface coatings; BAKELITE phenolic resins and plastics for use as molding materials and for the formulation of coating, adhesive, impregnating and sealing compositions; BAKELITE styrene*plastics for extrusion, molding, and surface coatings; and BAKELITE polyethylene resins and plastics for molding, extrusion and surface coatings.

The extrusion and molding of these important plastic materials has resulted in useful products that have been valuable assets to a number of industries. The information contained in this booklet should suggest many new applications and inquiries from all those interested in these materials are invited.

"VINYLTE" BRAND RESINS AND PLASTICS

Extrusion and Molding Materials

The superior properties imparted to products made from VINYLTE resins and plastics have been evidenced time and again—as film and sheeting, electrical insulating materials, and as surface coatings. These same superior properties can be imparted to a wide variety of applications by use of molding and extrusion techniques. They are tough, strong, light-in-weight, durable, and chemically inert. They can be compounded so that they are either rigid or as flexible as desired. The color range of these materials is virtually unlimited.

Extrusion and molding of VINYLTE plastic compounds are economical mass production methods by which outstanding articles have been created. The scope of the designer has been substantially broadened. Manufacturers have been benefitted by the availability of unique materials from which his products can be made. The consumer has found a host of quality products that serve his needs better.

Bakelite Company is a supplier of both VINYLTE plastic compounds for use in molding and extrusion techniques and VINYLTE resins from which these compounds may be formulated. In addition to the information contained in this booklet, more specific technical data may be obtained from any one of the sales offices listed on the back cover.

Formulation of "Vinylite" Plastic Extrusion and Molding Compounds

The compounds used for the extrusion and molding of VINYLTE plastics are scientific mixtures of several ingredients, each of which contributes valuable properties to the final product. These ingredients include the basic vinyl resin, plasticizer (if a flexible product is desired), stabilizers, lubricants, colorants, and fillers. The choice of any materials to be used is dependent on an analysis of properties which the final plastic product must possess.

Resins

VINYLTE resins for use in extrusion and molding compounds are high molecular weight organic substances synthesized by reacting vinyl chloride, a gas, with itself or with vinyl acetate, a liquid, so that the mole-

cules add together and form long chain compounds, which can be compared in structure to a string of paper clips. In appearance, after manufacture, the resins are fine, white powders, but after the application of heat, the resin particles fuse together. When the mass is cooled, a hard, rigid plastic results. This plastic will soften when heated above a definite temperature and thus allows its use in extrusion, molding, and calendering operations.

The properties of these resins can be modified by varying molecular weight or the ratio of vinyl chloride to vinyl acetate, and thus provide the formulator with a wide range of base resins for use in compounding.

These VINYLTE resins first became commercially available in 1934. Since then an intensive development program, which has involved thousands of chemical and processing experiments has been prosecuted to determine the resins and ingredients which are best suited for the various type compounds. From these many years of development have evolved the general-purpose and specialty compounds which are available today. Formulating and processing data is available for those companies that wish to manufacture their own compounds from VINYLTE Resins.

Plasticizers

Plasticizers are high boiling organic liquids or low melting solids which are added to the resins to make the final plastic compound flexible. Plasticizers accomplish this by separating the resin chains and reducing intermolecular forces, hence allowing the resin chains to move over each other more freely.

No one plasticizer has been found suitable for all types of vinyl plastic applications. A number are very useful as general-purpose plasticizers and others are available for use in specialty type compounds. For example, compounds for use in garden hoses must exhibit good resistance to water and sunlight, and must possess a high strength at elevated temperatures without being so stiff on a cool evening that the hose cannot be coiled. On the other hand, the flexibility, and hence the plasticizer requirements, of a compound for a deep freezer lid gasket are quite different. Here, the compound must possess good low temperature flexibility, good color, and must not mar paints and other

plastic components. The only high temperature requirement is that the compound must not exude plasticizer if the gasket is stored at room temperature or higher. Similarly, a compound for use as distributor cap nipples will require outstanding electrical properties as contrasted with the mechanical and color needs of a compound for vacuum cleaner bumpers.

Stabilizers

Stabilizers are added to vinyl resins for the purpose of stabilizing against the degrading action of heat and light. Compounds which are to be used in exclusively exterior applications are stabilized more strongly than compounds intended for interior use. This fact should be taken into consideration when specifying compounds.

Colorants

VINYLITE resins are essentially colorless and hence permit the use of a wide variety of coloring agents. The principal limitations to the use of any colorant involve possible undesirable chemical interaction with the other ingredients in the plastic, or a tendency of the colorant to bleed in the presence of oils or liquids. The light stability of any colorant must also be considered when formulating compounds, especially for exterior use. The end-use and the exact color of the final compound dictate the colorants to be used in its formulation.

Lubricants

Lubricants are oils or waxes or other chemicals which are incorporated into plastics to prevent sticking dur-

ing hot compounding, molding, and extrusion operations. A lubricant does this by forming a thin film on the hot metal surfaces of the equipment. Lubricants are selected according to the type of fabrication method to be used.

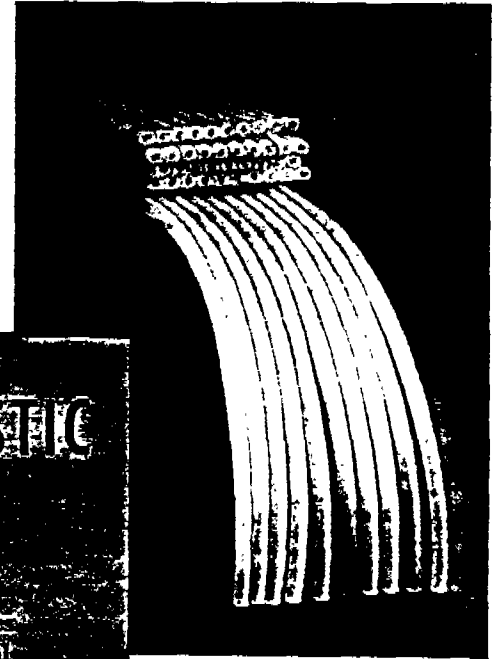
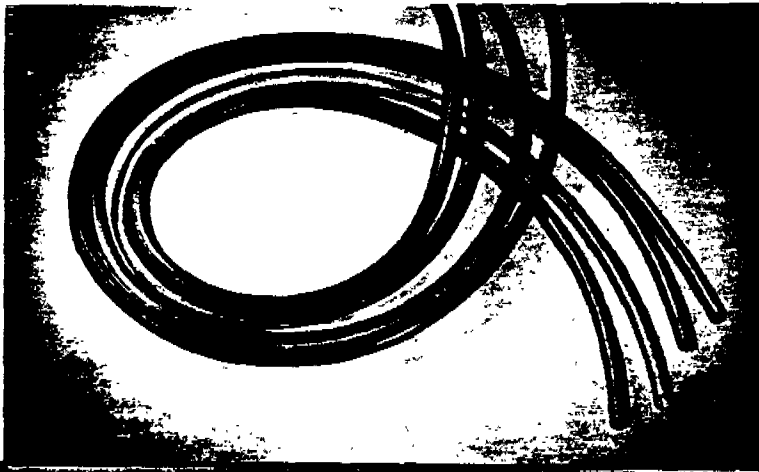
Fillers

Economical mineral fillers are sometimes used to extend the resin. This is done only when the properties of unfilled VINYLITE plastic compounds are much superior to those actually needed by an application. An excess of filler, however, results in drastic reduction of the outstanding properties available with unfilled formulations.

Development Requests

Occasionally a new application will arise which cannot use any of the many general-purpose and specialty type compounds available. If the use of a plastic compound in such an application appears reasonable, the laboratories of Bakelite Company will assist in developing a compound to meet the requirements of this application.

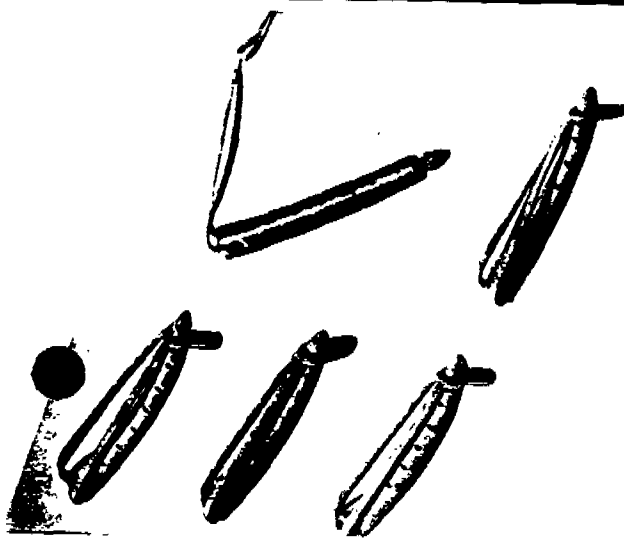
When a new compound is requested for a special application, the problem is assigned to a group of engineers and chemists in the various development laboratories. These engineers and chemists are experienced in plastics and plastics processing and have at their disposal the latest of modern laboratory and industrial plastics equipment. In addition to their own extensive personal experiences, these engineers are assisted by the many thousands of chemical, mechanical, weathering, and processing experiments which have been conducted in the past.



APPLICATIONS OF "VINYLITE" PLASTIC

Extrusion and Molding Compounds

VINYLITE Plastic Extrusion and Molding compounds serve a multitude of uses. The following pages show some of the extruding applications of these materials and explain the properties which make them suitable for these applications.

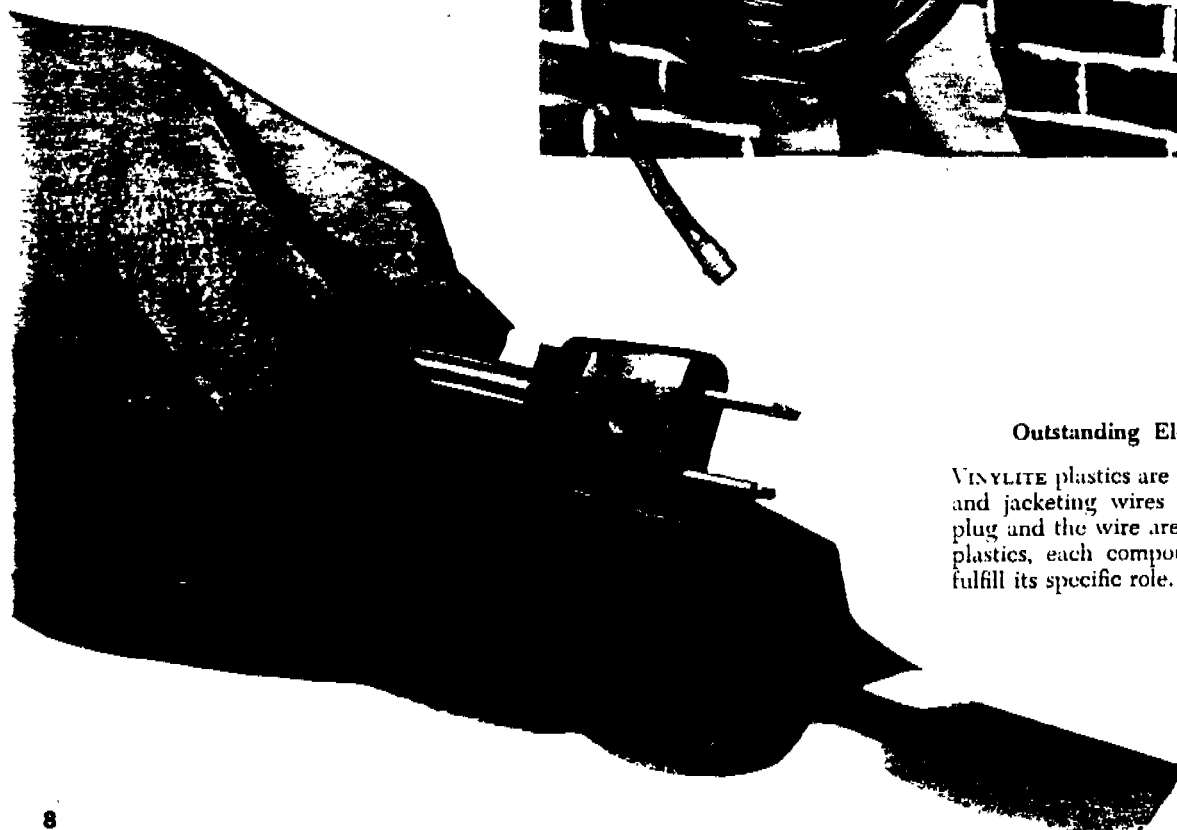


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"VINYLLITE" PLASTIC ELASTOMERIC EXTRUSION COMPOUNDS

Resist Sunlight and Oxidation

Garden hose extruded from VINYLLITE plastics resists the action of sunlight, oxygen, water, oils, greases and other agents which rot most hoses. These plastic hoses are lightweight and strong; and they possess high scuff resistance and excellent color stability. VINYLLITE plastics are used both as the sole material in hoses or as a jacket over cotton-braided, rubber core hoses. Both types are products that sell - because they utilize the colors and long life of properly formulated plastic compounds.



Outstanding Electrical Properties

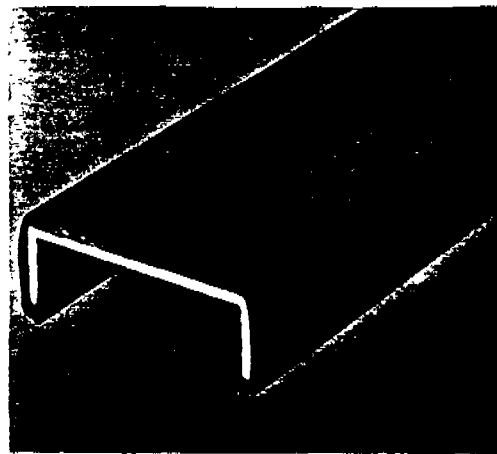
VINYLLITE plastics are outstanding for insulating and jacketing wires and cables. The electric plug and the wire are insulated with VINYLLITE plastics, each compound being formulated to fulfill its specific role.

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Good gloss, smart colors

Flexible costume belting and straps extruded from VINYLITE plastics are glossy, smart appearing, and colorful. Such belting is often embossed or printed to produce a wide variety of styles and designs.

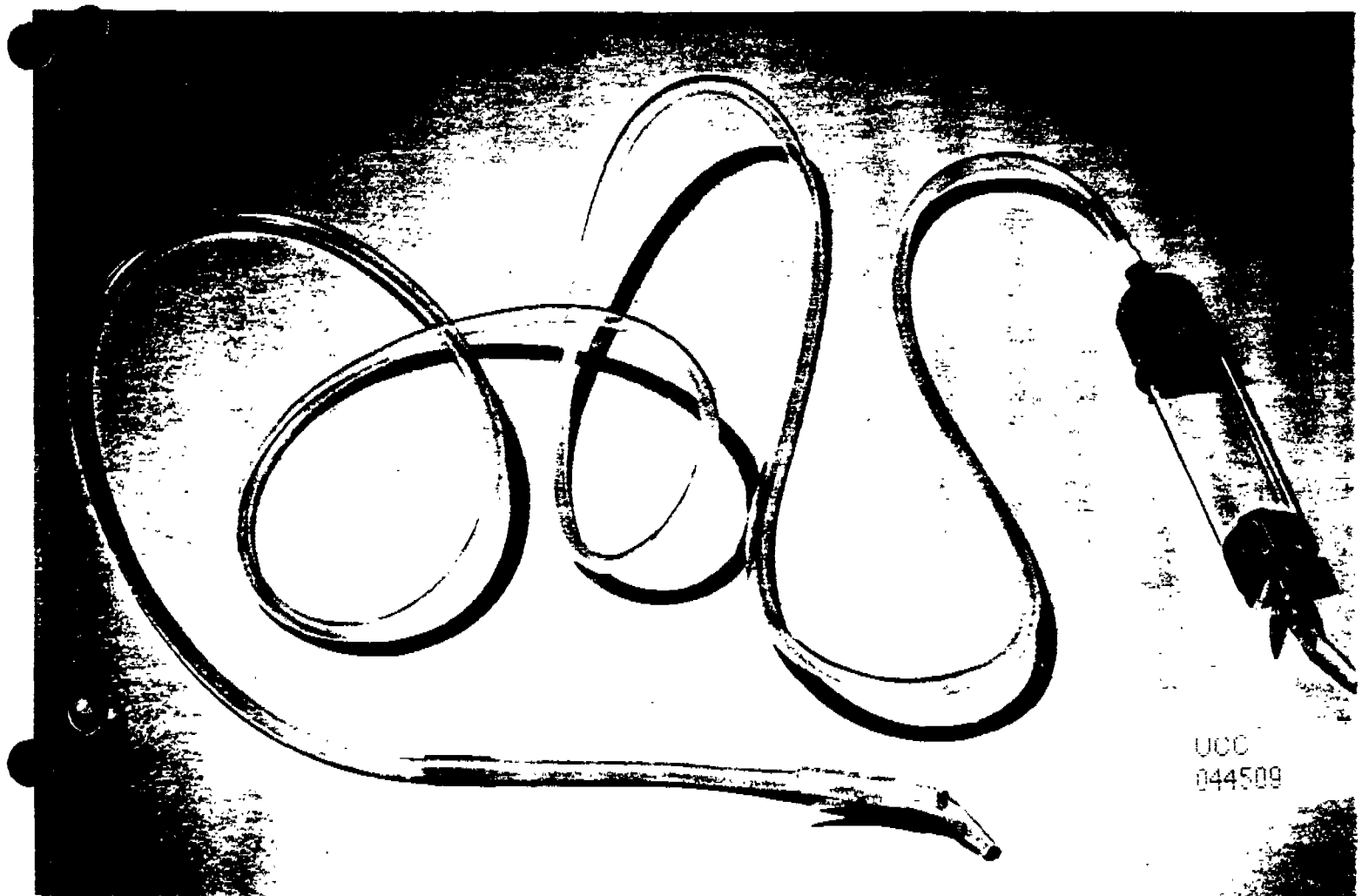


Resist Abrasion and Scuffing

Treads for ladders used in sleeping cars resist abrasion, scuffing, and exhibit excellent non-skid characteristics. Well designed, the tread is easily extruded and fits snugly to the steps to give a durable, low cost step-ensemble. Tough and durable gaskets, welting and other complex shapes also are produced easily from VINYLITE plastics.

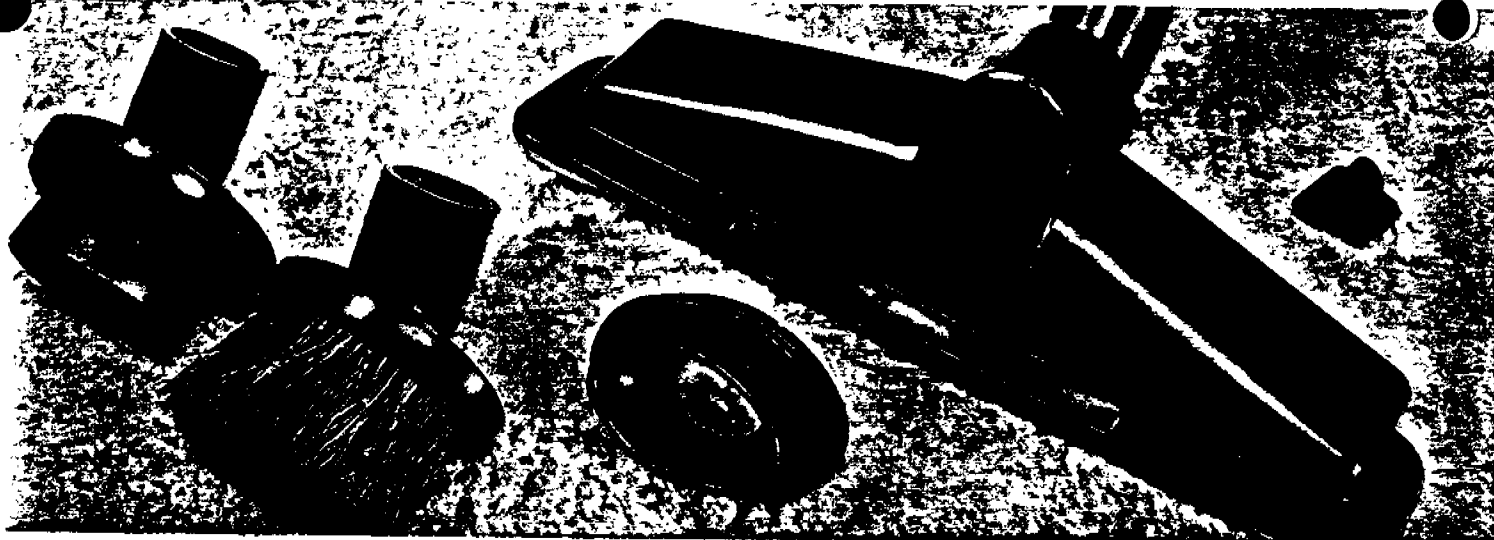
Chemically Inert

Intravenous tubing for use in blood transfusions is extruded from VINYLITE plastics. The chemical inertness, the flexibility, and the ease of handling of this tubing demonstrate the outstanding properties available in VINYLITE plastics.



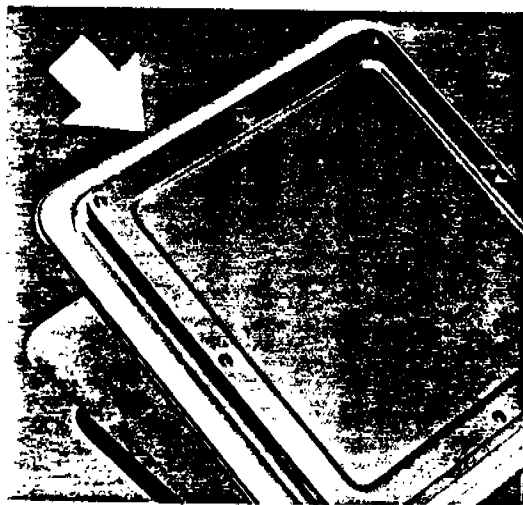
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"VINYLTE" PLASTIC ELASTOMERIC MOLDING COMPOUNDS



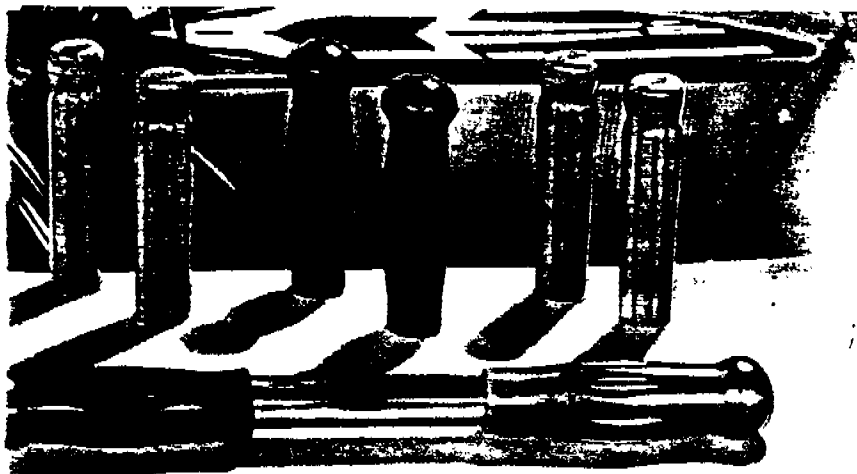
Pleasing Appearance and Smart Colors

Vacuum cleaner bumpers molded from VINYLITE plastics are tough, resilient, economical to mold, and have a smart, pleasing appearance. Stock, made-to-order, or special color matched compounds assure colors that match, complement, or contrast with the colors of the other parts of the cleaner.



Low Temperature Flexibility

This gasket for an ice cream freezer lid is manufactured from a compound formulated to be flexible at room temperatures and at temperatures below freezing. In addition to life-long low temperature flexibility, the gasket has a clean, glossy color and resists the action of food fats and greases.



Resist Ozone

Electric sparks such as are encountered in automobile ignition distributors convert oxygen into highly destructive ozone. Tests which involved exposure to concentrated ozone at room temperature for over six hours have shown that distributor cap nipples molded from VINYLITE plastics (at extreme left in photograph) are unaffected by ozone. Natural and synthetic rubber nipples failed in the same test. Easy to mold, the plastic nipples stay soft and flexible for the life of the automobile.

Wide Range of Colors

Handle bar grips exemplify some of the smart colors which make a selling product. Because the colorants are properly selected, the colors will not bleed out or rub off onto a person's hands as was the case with former materials.



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Soft and Pliable—or Hard and Stiff

A wide range of flexibility is available when VINYLITE plastics are specified. The hair curlers shown exemplify a soft, pliable compound. These curlers, molded in one piece to save assembling costs, are so soft and flexible that they can be worn even while sleeping. They are permanently flexible and are unaffected by hair dressings, soap, and water.



Resist Scuffing and Abrasion

Tough VINYLITE plastics protect smart luggage from scuffs and kicks. Such edging is not only attractive but can be wiped clean with a damp cloth. And despite the large mold draft of this item, fill-out problems were reduced to a minimum with the use of VINYLITE plastics.

Low Cost

Babies' shoe lifts injection molded in one piece from VINYLITE plastics serve for either shoe and require no assembly operations. Faster cycles, fewer rejections, no assembly problems, and a durable plastic create an efficient, low cost article.



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"VINYLITE" RIGID EXTRUSION AND MOLDING COMPOUNDS

Long Lasting

Monofilaments extruded from VINYLITE rigid plastics for brooms and brushes are tough, long-lasting, resilient and easy to clean. They weigh one-third less than older materials and make a light-weight, easy-to-use broom or brush.

Attractive Colors

Stripping for finishing moleum edges makes a colorful and attractive article when extruded from VINYLITE rigid plastics. The stripping has to be tough and scuff and kick resistant to perform well in such an application.



Resist Chemicals

VINYLITE rigid plastics resist the action of most chemicals. They exhibit excellent resistance to mineral acids, dilute or concentrated, to sodium and potassium hydroxide, to hydrogen peroxide, chlorine water, tincture of iodine, and other corrosive chemicals. They exhibit good resistance to alcohols, oils, fats, and waxes. The photograph shows a solvent resistant cologne flask cap molded from VINYLITE rigid plastics.

However VINYLITE plastics are soluble in ketones, such as acetone, methyl ethyl ketone, and cyclohexanone; and they dissolve or swell in organic acids, esters, or others, depending upon the specific organic fluid. This highly selective resistance to solvents imparts good chemical resistance to articles made from these plastics, yet allows the use of solvents and solvent-base adhesives when joining and welding plastic items into complex shapes.

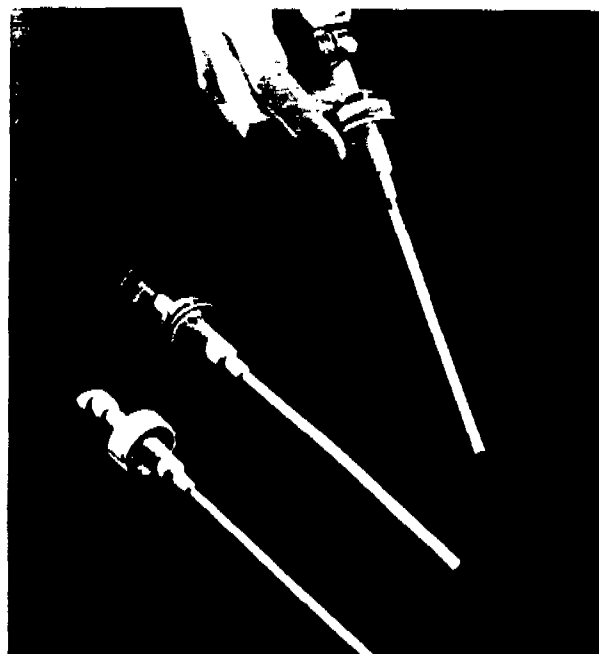


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High Fidelity, Unbreakable

Records molded from VINYLITE plastics reproduce all the notes — high or low — with supreme clarity and absence of needle scratch noises. They are virtually non-breakable and non-warping. These records, molded from compounds specially designed for phonograph records, have been tested for hours and hours in the laboratory and after even hundreds of playings their surface noise is less than that of many unplayed records produced from older materials.



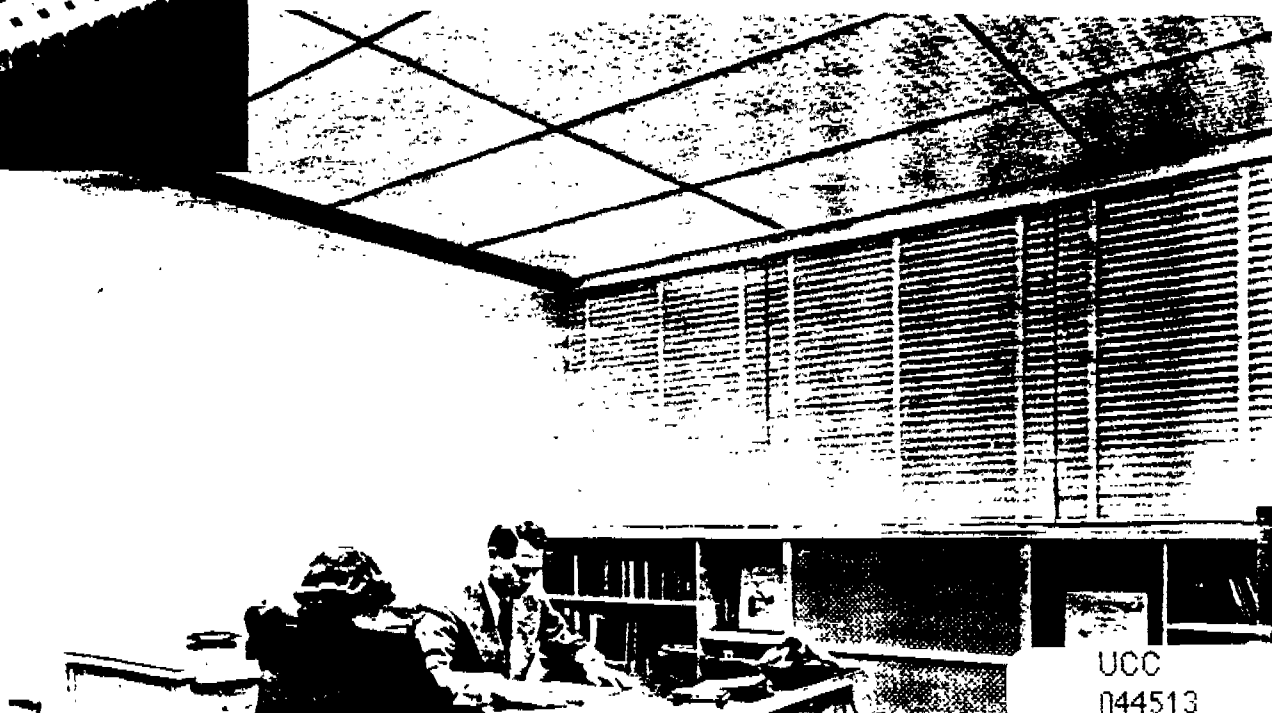
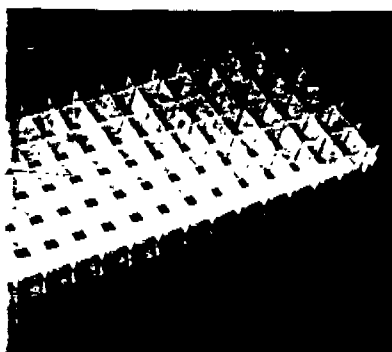
Excellent Dimensional Stability and Low Mold Shrinkage

For molding to close tolerances and for fabricating articles where an inch must remain an inch, VINYLITE rigid molding compounds are outstanding. The linear coefficient of thermal expansion in inches per degree Centigrade is 0.000069 and the mold shrinkage is 0.1 per cent, the lowest mold shrinkage of any commercial plastic.

VINYLITE rigid plastics were chosen for the dispenser unit shown in the photograph because of their excellent dimensional stability, their low mold shrinkage, their chemical resistance, and their ability to mold to a beautiful finish.

Non-Flammable

Ceiling louvres of VINYLITE rigid plastics are non-flammable, dimensionally stable and difficult to break. The optical properties of the special compound used in this application produce a ceiling that virtually glows from transmitted and reflected light.



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SOME SPECIAL PROPERTIES OF "VINYLITE" PLASTICS

The general properties of VINYLITE plastics which are available by means of correct and scientific formulation have been described on previous pages, and specific values of the properties of many popular VINYLITE plastic compounds are also reported on pages 17-20. A few special properties which require further discussion and the general limitations of VINYLITE plastic compounds are discussed on this page.

Water Absorption

Articles fabricated from VINYLITE rigid plastics have been immersed in warm water for a period of two years with water absorption in percent by weight being only 0.15%. The absorption of water by plasticized compounds is slightly higher, but in general the resistance to absorption is considered excellent. Average values of water absorbed by standard elastomeric compounds range from 0.06 to 0.30%. Values of soluble matter lost range from 0.05 to 0.30% (A.S.T.M. Test D 570-42).

Flame Resistance

VINYLITE plastics are classified as slow-burning or self-extinguishing materials. They will burn when exposed to a direct open flame though they exhibit marked resistance to burning and upon removal from the flame the burning decreases to a very low rate or ceases entirely, depending upon the particular compound. Rigid compounds are self-extinguishing, while the flammability for standard elastomeric compounds is only 0.25 - 0.35 sq. in. per sec. for .020" samples (ASTM Test D-568-43). Plasticized compounds can be formulated to be self-extinguishing.

Toxicity

While unmodified VINYLITE resins are of a very low order of toxicity, the toxicity of extrusion and molding compounds may be affected by the plasticizers, stabilizers, and other materials used. Suitable compounds must be selected by the fabricator for his own applications. Inquiry should be made in doubtful cases.

Weathering

When desired, compounds with substantially increased resistance to sunlight can be formulated.

High Temperatures

VINYLITE plastics are thermoplastic or heat softening by nature, and hence they are not recommended for applications where excessive or prolonged high temperatures are encountered. In general, molding and extrusion compounds are suitable at temperatures up to 60 deg. C (140 deg. F). However, for some special applications, compounds are available for use at temperatures approaching 100 deg. C (212 deg. F).

Plasticizer Migration

Many plasticizers which possess most of the desired properties, exhibit migration, i.e., the plasticizer will migrate slowly into adjoining materials such as polyethylene, polystyrene, and varnishes to their detriment. However, because some compounds possess considerably lower plasticizer migration than others, careful selection of the compound for a given application will generally avoid difficulties with plasticizer migration effects.

EXTRUSION AND MOLDING MATERIALS OF "VINYLTE" PLASTICS

<i>Stock and Made-to-Order Compounds</i>	Over two hundred stock and made-to-order VINYLTE Plastic Compounds are available from Bakelite Company for extrusion and molding. These materials offer a wide range of physical properties and colors for your selection. A Bakelite Technical Representative can furnish technical information pertinent to these compounds and can help select the proper compound for any application.
<i>Resins</i>	For those companies that wish to formulate their own plastic compounds, four resins — VINYLTE Resins VYNW, VYNS, VYHH and QYNA — which vary in molecular weight and chloride-acetate ratio — are available. A Bakelite Technical Representative can recommend a resin or resin mixtures and formulas for evaluation in the equipment available and for the applications intended.
<i>Extruded Items</i>	Bakelite Company does not offer items extruded from VINYLTE Plastics. However, an up-to-date list of extruders of VINYLTE Plastics and information concerning suppliers of certain size or shaped articles or type of custom work are available upon request.
<i>Molded Items</i>	Bakelite Company does not offer items molded from VINYLTE Plastics. However, an up-to-date list of molders of VINYLTE Plastics and information concerning suppliers of certain size or shaped articles or type of custom work are available upon request.
<i>Technical Assistance</i>	The Technical Representatives of Bakelite Company are available to assist in choosing the correct material, in eliminating molding and extrusion difficulties, or in obtaining technical information pertinent to plastic products.

Application	Flexible or Rigid	Extrusion or Molding	Appearance	Compound Number
Pump Sprayer for Bottles	R R R	M M X	translucent translucent opaque	VG-3624 Colors VG-3623 Colors VG-5885 Colors
Refrigerator Parts:				
door bumpers	F	M	opaque	VG-9960 Colors
shelf support grommets	F	M	opaque	VG-9960 Colors
container cover bumpers	F	M	opaque	VG-9960 Colors
tank hanger hole plugs	F	M	opaque	VG-9960 Colors
evaporator compartment door bumper	F	M	opaque	VG-9960 Colors
drip tray gaskets	F	M	opaque	VG-9960 Colors
breaker strips	R	X	opaque	VG-5885 Colors
Shoe Lifts	R R	M M	opaque opaque	VG-9980 Brown 08 VG-9930 Colors
Stair Treads	F	X	opaque	VG-5980 Colors
Tires for Toys	F	M	opaque	VG-7734 Colors
Typewriter type bar rests	F	X	opaque	VG-7770 Black 02
Vacuum Cleaner Parts:				
brush cups	F	M	opaque	VG-9970 Colors
brush nozzles	F	M	opaque	VG-9160 Colors
adapters	F	M	opaque	VG-9970 Colors
handles	F	M	opaque	VG-9970 Colors
bumpers	F	X	opaque	VG-5980 Colors
foot pedals	F	M	opaque	VG-9160 Colors
Upholstery Welting	F	X	opaque	VG-9930 Colors

Table I
"VINYLLITE" RESINS FOR EXTRUSION AND
MOLDING COMPOUNDS AVERAGE PROPERTIES

RESIN DESIGNATION	VYHM	VYNS	VYNW	QYNA
Appearance	Powdered White Solid	Powdered White Solid	Powdered White Solid	Powdered White Solid
Odor	All resins are substantially odorless.			
Approximate Composition— Vinyl Chloride—weight, % Vinyl Acetate —weight, %	85.0-88.0 12.0-15.0	88.5-91.5 8.5-11.5	96.0-97.0 3.0-4.0	100 —
Specific Gravity	1.36	1.36	1.39	1.40
Specific Viscosity* 1 2	0.536-0.567 —	0.875-0.925 —	— 0.21 min.	— 0.190-0.210
Screen Analysis— Minimum % through U.S.B.S. Screen No.	20 40 80	98 — —	99.5 99.0 50.0	— — —
Heating Loss, Maximum, %	2.0	1.0	1.0	—
Type of Use:	Sole resin or in resin mixtures for rigid compounds.	In resin mixtures for rigid and elasto- meric compounds.	Sole resin or in resin mixtures for rigid and elasto- meric compounds.	Sole resin or in resin mixtures for elastomeric com- pounds.

*1. 1.00 gm. resin per 100 cc. of solution in methyl isobutyl ketone at 20 deg. C.

2. 0.2 gm. resin per 100 cc. of nitrobenzene at 20 deg. C.

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