CHEMISTRY

Strange, Versatile Plastic

Polyethylene-made plates, cups and ice box dishes are tasteless, odorless and unbreakable. The plastic is also used for pipes in industry and tubes for surgery.

By MARTHA G. MORROW

➤ POLYETHYLENE, one of the newest of the plastics, is also one of the strangest:

Dishes of this gas-derived resin float on the sudsy water in which they are to be washed.

Few chemicals affect it, and even those in which it will dissolve must be heated before they act as a solvent.

Thin films of the plastic are soft and pliable, thick slabs of it are tough and horny.

Plates, cups and ice box dishes that are tasteless, odorless and unbreakable are made from polyethylene. Films of it provide packaging material for both commercial and home use. Bottles, tops, materials for shoes and handbags, and even drain pipes are created from this unique plastic.

As early as 1933 it was known that ethylene, used for anesthetics and to hasten the ripening of fruit and vegetables, could be polymerized, that is, linked together in long chains to form a resinous material. After pilot plant trials for several years, commercial quantities were first produced in the United States six years ago. Most of the early production of polyethylene was used to insulate high-frequency wire and cable, so essential to the war effort.

Made from Ethylene

This new material is made from ethylene at high temperatures and high pressures. Composed of long chains of hydro-carbon groups consisting of carbon atoms combined with twice as many hydrogen atoms, polyethylene shows great promise as a versatile plastic. Today, for instance:

Large pipes of polyethylene carry hot nitric acid in atomic energy plants, while tiny tubes of the plastic have been used to control bleeding stomach ulcers.

Bottles of polyethylene are strong enough to transport liquids great distances and under rough conditions, yet flexible enough for the containers to be used as atomizers upon reaching their destination.

During 1948, approximately 15,000,000 pounds of polyethylene were produced in this country. About 6,000,000 pounds were made into film for packaging everything from garden soil to frozen foods. This year Bakelite and duPont expect to more than triple production of this raw material so that an estimated 20,000,000 pounds will be used for film, an equal quantity for coating wire destined for television, radio and electronic applications, and another 8,000,000 or so for molded cups, plates and so on.

Polyethylene is the lightest of the plastics. It weighs less than an equal quantity of water, its specific gravity being .92. Thus pellets of the plastic float on water and even a polyethylene tumbler filled with water does not sink to the bottom.

It softens at a temperature a little below that of boiling water, and, therefore, dishes made of it should not be placed in boiling water. They may, however, be rinsed in very hot water (170 to 180 degrees Fahrenheit) without harm.

One of the outstanding characteristics of polyethylene is its chemical inertness. Few materials mar the good looks of its satiny surface. It is insoluble in all organic solvents at normal room temperature.

Acids Don't Stain

Vinegar, lemon juice and acetone, if left on the plastic, leave no mark or stain when wiped off. The plastic does dissolve in carbon tetrachloride (frequently used as a household cleaning fluid), but this material must be heated to about 140 degrees Fahrenheit to be effective.

This chemical inertness of polyethylene makes it more difficult to seal pieces together with a solvent than with heat. Thin films are usually sealed with a hot iron or similar equipment; thick pieces are welded together by using gas-welding equipment or hot air.

One of the advantages of polyethylene, on the other hand, is its inherent flexibility; thus no plasticizer need be used. The resin merely is heated, then molded into cups or extruded into thin films.

Impermeability to all but a very few liquids and gases, plus the fact that it is odorless and tasteless, is largely responsible for the success of polyethylene film.

Its uses range from washers for your sink or washbowl to disposable bottles for baby's milk to liners for drums in which chemicals are shipped.

A novelty woven fabric is being made from polyethylene. This material, developed specially for shoes and handbags, is made by slitting thin film into ribbons, folding it, and then weaving it into cloth with a pack weave. One of the advantages of this type of cloth over other plastic cloth is that it has enough body to hold its shape, while still retaining its flexibility.

Circular tubing as well as flat films of polyethylene are popular. Such tubing has transparent walls only .001 to .004 inch thick. Miles and miles of this tubing are made by forcing the hot plastic through a narrow circular opening. The tubes can be heat-sealed where desired, producing long or short bags without seams.

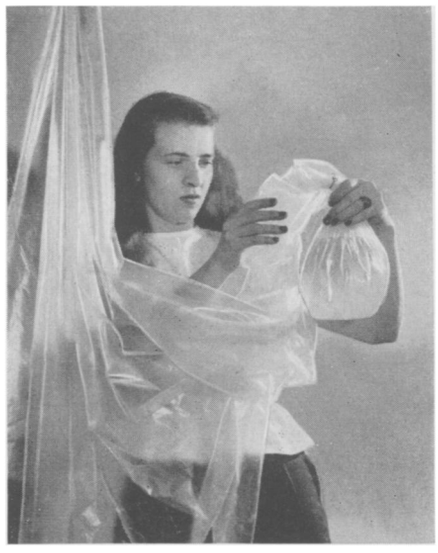
Thin films of polyethylene are also being used to protect paper, cloth and metal. A coating only .0015 inch thick, for instance, converts shelf paper into a washable article giving long service.

This very thin coating can be applied either to paper or cloth in two ways. It can be put on by knives that place a fine layer on the material as it passes beneath them. Or an extremely thin polyethylene film can be laminated to the paper or cloth with an adhesive.

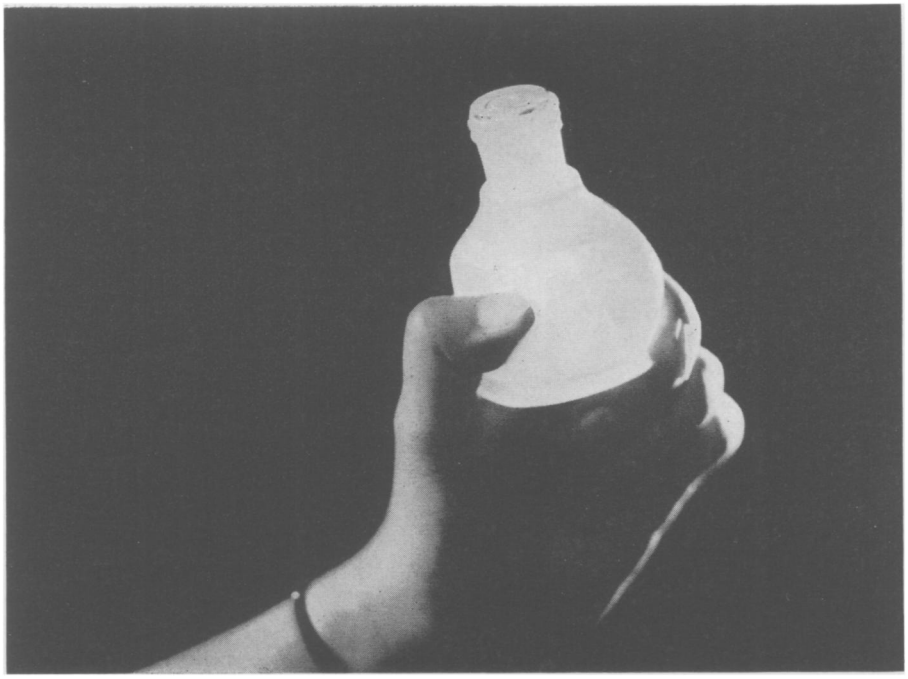
By either of these methods, however, 15 pounds of polyethylene will coat 3,000 square feet with a layer .0015 inch thick. That means the coating is about one-half as thick as the page of the daily newspaper which you read. Thin as this layer is, it provides all the necessary protection to the underlying cloth or paper.

In general, polyethylene resins are fabricated in almost exactly the same manner and in many of the same types of machinery as other thermoplastic materials. The principal differences between this and other plastics is that polyethylene softens and becomes quite fluid at a lower temperature. On the other hand, it can be molded at extremely high temperatures.

At the higher temperatures, however, shrinkage becomes a problem. Thus, in the molding of polyethylene, dies must be



TOUGH BUT PLIABLE—Thin, transparent polyethylene plastic has outstanding qualities for keeping what's inside in and what's outside out. This makes it useful for packaging foods.



FLEXIBLE CONTAINER—Squeezable bottle made of polyethylene is both a container and an atomizer, being used for nosedrops and deodorants.

designed to allow for the material to shrink as much as 4% as it cools, although other adjustments can reduce this to as little as 2½%. Thick sections also require special cooling techniques to avoid the formation of voids or bubbles in the center.

Films of polyethylene are outstanding for their folding resistance. They may be creased, yet readily spring back into shape when released. Also these films do not become brittle upon long exposure to freezing and below-freezing temperatures. They have a soft, warm and somewhat waxy feel. Thick sections of the plastic bounce when dropped.

Polyethylene is highly transparent in thin layers immediately over an object, but it is translucent when thick. It naturally is colorless, with a "frosty" appearance. Dyes and pigments may be added, however, to produce a wide variety of colors.

Polyethylene, like many other plastics, is produced in a variety of grades, each with different physical properties. In some grades, many more atoms of hydrogen and carbon —but always the same proportion of two atoms of hydrogen to one of carbon—are linked together to form each molecule of polyethylene than in others. Thus some have a much higher molecular weight than others.

Polyethylene of very low molecular weight is a grease or wax; that of medium molecular weight is a soft wax-like resin; and that of very high molecular weight, the kind used in articles being sold now, is tough and horny. In all cases, however, the molecules are formed of carbon atoms joined together to form long chains.

Would you like to examine some polyethylene products yourself? A bouncing measuring cup (1, 1½ and 2-ounce) with an air- and liquid-tight cover is included in a kit assembled for you by Science Service. Samples of polyethylene resin, tubing, coated papers and cloth, and woven fabric as well as explanatory material will be sent you for only 50 cents. Write Science Service, 1719 N Street, N. W., Washington 6, D. C.

Science News Letter, July 16, 1949

NUTRITION

New Food Process Danger

➤ WARNING of a possible danger of a chemical contamination of food from a new food process was issued by the Council on Foods and Nutrition of the American Medical Association.

The process consists in adding chemicals to foods such as bakery products to make them stay fresh longer, or to give them a smoother texture or some other attractive quality. The chemicals, of which there are hundreds, are known as "surface-active" compounds. Some of the most widely used are derived from polyoxyethylene combined with fatty acids and sometimes with a special alcohol known as sorbitol.

The process is viewed with alarm, Dr. James R. Wilson, secretary of the Council, states in the JOURNAL OF THE A. M. A. (July 2), because little is known about the poisonous effect of the surface-active compounds being added to the food or what effect they have in reducing nourishing value.

The food to which the compounds are added are usually smooth-textured, have more sales appeal and contain less fat. In bread and bakery products there may also be lowering of important food ingredients because the compounds have the ability to produce the same properties of "freshness" as the nonfat milk solids.

If, in addition to bakery goods, these agents were added to such foods as ice cream, candy and peanut butter, the public would be consuming a large quantity of the compounds whose possible poisonous qualities are as yet unknown, Dr. Wilson pointed out.

"Unless the complete harmlessness of these agents can be demonstrated beyond reasonable doubt, they should not, in the Council's opinion, be employed in basic foods," he stated.

The second danger, that of reducing the nutritional value of food, stems from the fact that less fat, milk solids and sometimes eggs are required when the compounds are added to the food.

"Thus far, the use of these substances is limited," an editorial in the same issue of the JOURNAL declares, "but their possible range of application includes almost all foods containing starch or fat. When a chemical technologic aid may find its way into the daily diet of nearly everyone from infancy to the grave, the necessity for being assured of its safety becomes significantly increased."

The editorial concludes with the warning that it is an invitation to trouble to ignore the need for preliminary study.

The U. S. Food and Drug Administration in Washington is currently holding hearings on the use of these substances in bread. After all the evidence is in, Food and Drug is expected to issue a ruling, technically termed a "definition", as to whether such substances can be added and in what quantities and to what products.

Science News Letter, July 16, 1949

On This Week's Cover

➤ A FAIRY-LIKE creature with strange offspring is the golden-eyed lace-wing fly shown on the cover. Mother lace-wing has transparent lace-like wings of pale green hue and beady golden eyes that glisten in light. But her children, in the earlier stages of a strange life cycle, are another matter. They are the aphis lions which feed on plant lice. These aphis lions are so bloodthirsty when born that each egg is laid on the end of a separate tiny silken stalk so that the aphis lions will not eat each other.

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