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RESEARCH FABRICATION OF FIBERS AND FILMS

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ABSTRACT:

This article examines the fibers and films produced various methods of producing films and fibers by melting polymers under pressure are described. The change in thermal conductivity curves according to the type and amount of fillers added to thermoplastic polymers is explained by diagrams.

KEYWORDS: Polymer, film, thermoplastic, fiber, temperature, melt spinning.

INTRODUCTION:

In today's fast-paced time, synthetic raw materials are replacing natural materials. in particular, polymerized polymer materials have become the main raw material for the manufacturing industry. Polyethylene, polypropylene, phenol-formaldehyde and other types of polymers are widely used in industry. The advantage of thermoplastic polymers is that they can be recycled. we can also see this process in the production of film and fiber.

METHODS AND OBJECTS OF RESEARCH

The process by which fibers are formed from bulk polymer material is termed spinning. Most often, fibers are spun from the molten state in a process called *melt spinning*. The material to be spun is first heated until it forms a relatively viscous liquid. Next, it is pumped through a plate called a *spinneret,* which contains numerous small, typically round holes. As the molten material passes through each of these orifices, a single fiber is formed, which is rapidly solidified by cooling with air blowers or a water bath.

The fiber polymers are capable of being drawn into long filaments having at least a 100:1 length-to-diameter ratio. Most commercial fiber polymers are used in the textile industry, being woven or knit into cloth or fabric. In addition, the aramid fibers are employed in composite materials. To be useful as a textile material, a fiber polymer must have a host of rather restrictive physical and chemical properties. While in use, fibers may be subjected to a variety of mechanical deformations—stretching, twisting, shearing, and abrasion. Consequently, they must have a high tensile strength (over a relatively wide temperature range) and a high modulus of elasticity, as well as abrasion resistance. These properties are governed by the chemistry of the polymer chains and also by the fiber-drawing process. The molecular weight of fiber materials should be relatively high or the molten material will be too weak and will break during the drawing process. Also, because the tensile strength increases with degree of crystallinity, the structure and configuration of the chains should allow the production of a highly crystalline polymer. That translates into a requirement for linear and unbranched chains that are symmetrical and have regular repeat units. Polar groups in the polymer also improve the fiber-forming properties by increasing both

crystallinity and the intermolecular forces between the chains. Convenience in washing and maintaining clothing depends primarily on the thermal properties of the fiber polymer, that is, its melting and glass transition temperatures. Furthermore, fiber polymers must exhibit chemical stability to a rather extensive variety of environments, including acids, bases, bleaches, dry-cleaning solvents, and sunlight. In addition, they must be relatively nonflammable and amenable to drying.

The crystallinity of a spun fiber will depend on its rate of cooling during spinning. The strength of fibers is improved by a post forming process called drawing. During this process the molecular chains become oriented in the direction of drawing (Figure 1,d), such that the tensile strength, modulus of elasticity, and toughness are improved. The cross section of melt-spun, drawn fibers is nearly circular, and the properties are uniform throughout the cross section. Two other techniques that involve producing fibers from solutions of dissolved polymers are dry spinning and wet spinning. For dry spinning the polymer is dissolved in a volatile solvent. The polymer-solvent solution is then pumped through a spinneret into a heated zone; here the fibers solidify as the solvent evaporates. In wet spinning, the fibers are formed by passing a polymer-solvent solution through a spinneret directly into a second solvent that causes the polymer fiber to come out of (i.e., precipitate from) the solution. For both of these techniques, a skin first forms on the surface of the fiber. Subsequently, some shrinkage occurs such that the fiber shrivels up (like a raisin); this leads to a very irregular cross-section profile, which causes the fiber to become stiffer (i.e., increases the modulus of elasticity).

Polymeric materials have found widespread use in the form of thin films. Films having thicknesses between 0.025 and 0.125 mm (0.001 and 0.005 in.) are fabricated and used extensively as bags for packaging food products and other merchandise, as textile products, and in a host of other uses. Important characteristics of the materials produced and used as films include low density, a high degree of flexibility, high tensile and tear strengths, and resistance to attack by moisture and other chemicals, and low permeability to some gases, especially water vapor. Some of the polymers that meet these criteria and are manufactured in film form are polyethylene, polypropylene, cellophane, and cellulose acetate.

Many films are simply extruded through a thin die slit; this may be followed by a rolling (calendering) or drawing operation that serves to reduce thickness and improve strength. Alternatively, film may be blown: continuous tubing is extruded through an annular die; then, by maintaining a carefully controlled positive gas pressure inside the tube and by drawing the film in the axial direction as it emerges from the die, the material expands around this trapped air bubble like a balloon (Figure 2). As a result the wall thickness is continuously reduced to produce a thin cylindrical film that can be sealed at the end to make garbage bags, or may be cut and laid flat to make a film. This is termed a biaxial drawing process and produces films that are strong in both stretching directions. Some of the newer films are produced by coextrusion; that is, multilayers of more than one polymer type are extruded simultaneously.

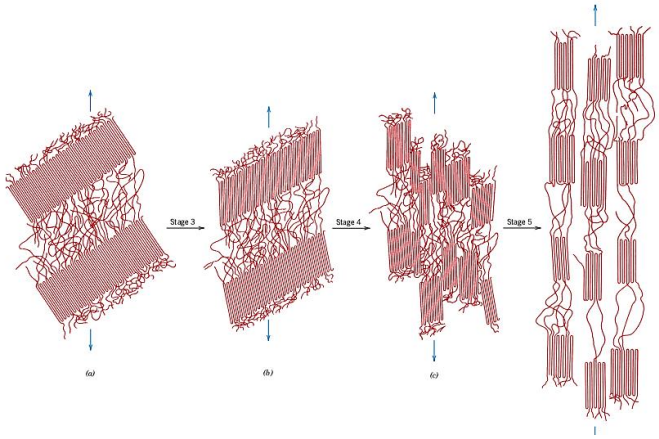

Figure 1. Stages in the plastic deformation of a semicrystalline polymer. (a) Two adjacent chain-folded lamellae and interlamellar amorphous material after elastic deformation. (b) Tilting of lamellar chain folds. (c) Separation of crystalline block segments. (d) Orientation of block segments and tie chains with the tensile axis in the final plastic deformation stage.

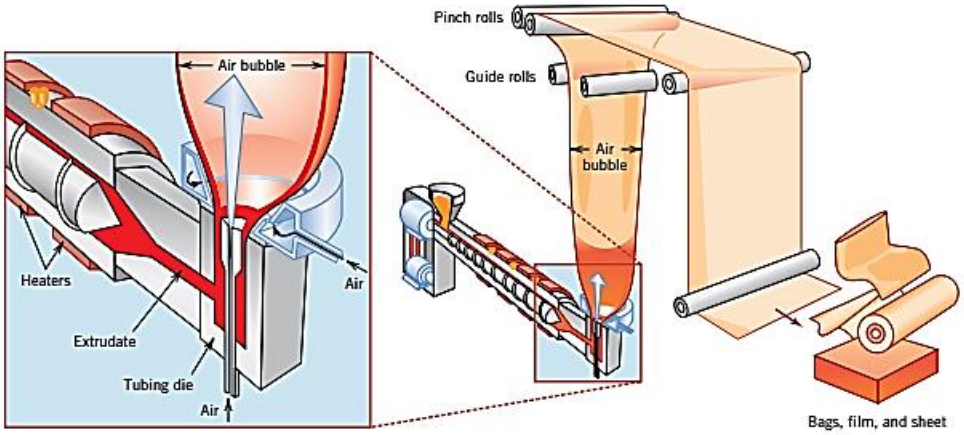

Figure 2. Schematic diagram of an apparatus that is used to form thin polymer films.

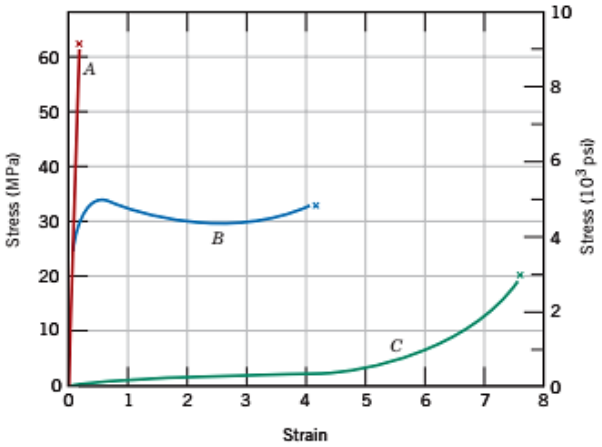

Figure 3. The stress–strain behavior for brittle (curve A), plastic (curve B), and highly elastic (elastomeric) (curve C) polymers.

STRESS–STRAIN BEHAVIOR:

• On the basis of stress–strain behavior, polymers fall within three general classifications (Figure 3): brittle (curve A), plastic (curve B), and highly elastic (curve C).

• Polymers are neither as strong nor as stiff as metals. However, their high flexibilities, low densities, and resistance to corrosion make them the materials of choice for many applications.

• The mechanical properties of polymers are sensitive to changes in temperature and strain rate. With either rising temperature or decreasing strain rate, modulus of elasticity diminishes, tensile strength decreases, and ductility increases.

Conclusion:

In conclusion, it should be noted that as the manufacturing industry improves polymer materials to replace natural materials and metals, the speed and quality of production increases. films and fibers are used in all areas of mechanical engineering. This article describes the methods of production and modification of films and fibers using modern methods.

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