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Short Communication

Polyethylene Terephthalate Structural Configuration, Properties and its Chemical Uses

Sherly Jones*

Department of Chemical Engineering, University of Canterbury, Christchurch, New Zealand

DESCRIPTION

Polyethylene terephthalate (PET or PETE) is a tough and durable synthetic resin fibre and part of the polyester family of polymers. PET is spun for permanent pressing fabrics and blown into disposable beverage bottles [1]. PET is produced by the polymerization of ethylene glycol and terephthalic acid. Ethylene glycol is a colourless liquid obtained from ethylene and terephthalic acid and it is a crystalline solid obtained from xylene. When heated together under the action of a chemical catalyst, ethylene glycol and terephthalic acid produce PET in the form of a viscous molten that can be directly spun or solidified for further processing into plastic. In chemical terms, ethylene glycol is a diol, an alcohol whose molecular structure contains two hydroxyl groups (OH) and terephthalic acid is an aromatic di-carboxylic acid, an acid whose molecular structure contains a large (or aromatic) carbon ring six-membered and two carboxyl groups (CO_2H) [2]. Under the influence of heat and catalysts, the hydroxyl and carboxyl groups react to form an ester group (COO), which serves as a chemical bond connecting several PET units in the long-chain polymer. Water is also created as a by-product.

The presence of a large aromatic ring in the repeating units of PET gives the polymer considerable stiffness and strength, especially when the polymer chains are arranged together in an ordered arrangement by elongation [3]. In this semi-crystalline form, PET is converted into a high tenacity textile market under the brand name Dacron by the American company. The stiffness of PET fibers makes them very resistant to deformation, so they have very good resistance to fabric wrinkling. They are often used in durable blends with other fibres such as rayon, wool and cotton, enhancing the inherent properties of these fibres while also contributing to the fabric's resilience from wrinkling. PET is also made into yarn stuffing to insulate clothing, furniture and pillows, when made in the form of fine thread it is used in rayon, and in the form of a large-diameter thread, it is used in carpets. Industrial applications of PET include fibres for automotive tires, conveyor belts and drive belts, reinforcement for fire hoses and sprinklers, and seat belts (an application where it has largely replaced nylon) [4]. Non-woven fabrics are used to stabilize drains and rails, bedding and nonwovens are used as covers for disposable diapers and medical clothing. PET is the largest synthetic fibre by product weight and value.

At a slightly higher molecular weight, PET is made into a high strength plastic that can be shaped by all the common methods employed with other thermoplastics. PET films are produced by extrusion. Molten PET can be blow-moulded into transparent containers of high strength and rigidity that are virtually impermeable to gas and liquid. In this form, PET has become widely used in carbonated beverage bottles and in jars for food processed at low temperatures [5]. The low softening temperature of PET is approximately 70°C which prevents it from being used as a container for hot foods and it is the most widely recycled plastic. In the United States, only 20% of PET materials are recycled. PET bottles and containers are commonly melted down and spun into fibres for fibrefill or carpets. When collected in a suitably pure state, PET can be recycled into its original uses, and methods have been devised for breaking the polymer down into its chemical precursors for resynthesizing into PET. The recycling code number for PET is 1. PET was first prepared in the UK by J. Rex Whinfield and James T. Dickson of the Calico Printer Association during a study on phthalic acid that began in 1940. Due to wartime limitations, the specifications Patents for this new material were not immediately published. The production of terylenebrand PET yarn by Imperial Chemical started in 1954. Meanwhile, in 1945, DuPont independently developed a convenient preparation process from terephthalic acid, and in 1953 the company began manufacturing Dacron fibres. It quickly became the most produced synthetic fibre in the world. In the 1970, improved stretch moulding processes were introduced to allow PET to be produced into durable, crystalline and beverage bottles has become second in importance in manufacturing yarns.

Correspondence to: Sherly Jones, Department of Chemical Engineering, University of Canterbury, Christchurch, New Zealand, E-mail: Jonesherl@uc.nz

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