Material Name: Polyamide, Nylon (PA)

Origin and Description

Polyamides, commonly known as Nylon, with an English name of Polyamide (PA) and a density of 1.15g/cm3, are thermoplastic resins with repeated amide group -- [NHCO] -- on the molecular main chain, including aliphatic PA, aliphatic PA and aromatic PA. Aliphatic PA varieties are numerous, with large yield and wide application. Its name is determined by the specific number of carbon atoms in the synthetic monomer. It was invented by the famous American chemist Carothers and his scientific research team.

Nylon is a term for polyamide fiber (polyamide), which can be made into long or short fibers. Nylon is the trade name of polyamide fiber, also known as Nylon. Polyamide (PA) is an aliphatic Polyamide which is bonded together by an amide bond [NHCO].

The molecular structure

Common nylon fibers can be divided into two categories.

A class of polyhexylenediamine adipate is obtained by condensation of diamine and diacid. The chemical structure formula of its long chain molecule is as follows:

H-[HN(CH2)XNHCO(CH2)YCO]-OH

The relative molecular weight of this type of polyamide is generally 17000-23000. Different polyamide products can be obtained according to the number of carbon atoms of binary amines and diacids used, and can be distinguished by the number added to the polyamide, in which the first number is the number of carbon atoms of binary amines, and the second number is the number of carbon atoms of diacids. For example, polyamide 66 indicates that it is made by polycondensation of hexylenediamine and adipic acid. Nylon 610 indicates that it is made from hexylenediamine and sebacic acid.

The other is obtained by caprolactam polycondensation or ring-opening polymerization. The chemical structure formula of its long chain molecules is as follows:

H-[NH(CH2)XCO]-OH

According to the number of carbon atoms in the unit structure, the names of different varieties can be obtained. For example, polyamide 6 indicates that it is obtained by cyclo-polymerization of caprolactam containing 6 carbon atoms.

Polyamide 6, polyamide 66 and other aliphatic polyamide fibers are all composed of linear macromolecules with amide bonds (-NHCO-). Polyamide fiber molecules have - CO-, -NH- groups, can form hydrogen bonds in molecules or molecules, can also be combined with other molecules, so polyamide fiber hygroscopic ability is better, and can form a better crystal structure.

Because the -CH2-(methylene) in polyamide molecule can only produce weak van der Waals force, the molecular chain curl of the -CH2- segment segment is larger. Due to the different number of today's CH2-, the bonding forms of inter-molecular hydrogen bonds are not completely the same, and the probability of molecular crimping is also different. In addition, some polyamide molecules have directivity. The orientation of molecules is different, and the structural properties of fibers are not exactly the same.

Morphological structure and application

The polyamide fiber obtained by melting spinning method has circular cross section and no special longitudinal structure. The filamentous fibrillar tissue can be observed under electron microscope, and the fibril width of polyamide 66 is about 10-15nm. For example, the polyamide fiber with special-shaped spinneret can be made into various special-shaped sections, such as polygonal, leaf-shaped, hollow and so on. Its focused state structure is closely related to the stretching and heat treatment during spinning. The macromolecular backbone of different polyamide fibers is composed of carbon and nitrogen atoms.

Profile-shaped fiber can change the elasticity of fiber, make fiber have special luster and puffing property, improve the fiber's holding property and covering ability, resist pilling, reduce static electricity and so on. Such as triangle fiber has flash effect; The five-leaf fiber has the luster of fat light, good hand feeling and anti-pilling; Hollow fiber due to internal cavity, small density, good heat preservation.

Polyamide has good comprehensive properties, including mechanical properties, heat resistance, abrasion resistance, chemical resistance and self-lubrication, low friction coefficient, flame retardant to some extent, easy processing, and suitable for reinforced modification with glass fiber and other fillers, so as to improve performance and expand application range.

Polyamide has various types, including PA6, PA66, PAII, PA12, PA46, PA610, PA612, PA1010, etc., as well as semi-aromatic PA6T and special nylon developed in recent years.

