Difference between TPU ester and ether of Rainbow TPU

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I. introduction to TPU

Thermoplastic polyurethane elastomer, referred to as TPU, also known as PU thermoplastics, is a linear block copolymer composed of oligomer polyol soft segment and diisocyanate-chain extender hard segment.

The TPU molecule contains -nh-coo-group, and many of its properties depend on the type of long-chain diols, the hardness of which is proportional to the hard segment, the photoaging property of which can be improved by adding light stabilizers, and also on whether isocyanates are aromatic or aliphatic.

II. Classification of TPU

TPU (Thermoplastic Polyurethane) classification according to different standards.According to the soft segment structure can be divided into polyester type, polyether type and butadiene type, they contain ester, ether and butenyl, respectively.According to the hard segment structure, it can be divided into ammonia ester type and ammonia ester urea type.

According to the presence or absence of crosslinking can be divided into pure thermoplastic and semi-thermoplastic.The former has a pure linear structure and no crosslinked bonds.The latter contains a small amount of urea formate and other cross-linked bonds.

According to the synthesis process, it can be divided into bulk polymerization and solution polymerization.In bulk polymerization, prepolymerization method can be divided into prepolymerization method and one-step method according to the presence or non-prereaction. Prepolymerization method is to firstly react diisocyanate with macromolecule diol for a certain period of time, and then add chain extender to generate TPU.In one step, diisocyanate was mixed with macromolecule dialcohol and chain extender to produce TPU.Solution polymerization is to dissolve diisocyanate in solvent first, then add macromolecular diol to make it react for a certain time, and finally add chain extender to generate TPU.

According to the use of products can be divided into special-shaped parts (various mechanical parts), pipe materials (sheath, bar profile) and thin films (thin slices, sheet), as well as adhesives, coatings and fibers.

III. The difference between polyether TPU and polyester TPU

The soft segment of TPU can use a variety of polyols, which can be roughly divided into polyether series and polyester series.

Ether: high strength, resistance to hydrolysis and high resilience, good properties at low temperatures.

Ester: good tensile properties, flexural properties, wear resistance, solvent resistance and high temperature resistance.

The influence of the difference of soft segments on physical properties is as follows:

Tensile strength polyester series > polyether series

Tear strength polyester series > polyether series

Wear resistant polyester series > polyether series

Drug resistant polyester is > polyether

Transparent polyester is > polyether

Bacterial resistant polyester series < polyether series

Moisture evaporative polyester series < polyether series

Low temperature impact polyester series < polyether series

1. Differences in raw materials and formulas

(1) the main production materials of polyether TPU are 4-4 '-diphenylmethane diisocyanate (MDI), polytetrahydrofuran (PTMEG), 1, 4-butanediol (BDO), among which the amount of MDI is about 40%, PTMEG is about 40%, and BDO is about 20%

(2) polyester TPU production raw materials mainly include 4-4 '-diphenylmethane diisocyanate (MDI), 1, 4 -- butanediol (BDO) and adipic acid (AA), among which the amount of MDI is about 40%, AA is about 35% and BDO is about 25%

2. Molecular mass distribution and influence

The relative molecular weight distribution of polyether follows Poisson probability equation, and the relative molecular weight distribution is narrow.However, the relative molecular weight distribution of polyester diols obeys Flory probability distribution and has a wide relative molecular weight distribution.

The molecular weight of the soft segment has an effect on the mechanical properties of polyurethane. Generally speaking, assuming that the molecular weight of polyurethane is the same, if the soft segment is a polyester, the strength of polyurethane will increase with the increase of the molecular weight of polyester diol.If the soft segment is polyether, the strength of polyurethane decreases with the increase of molecular weight of polyether diol, but elongation increases.This is because the polyester soft segment itself has a strong polarity, a large molecular weight leads to a high structure regularity, which is beneficial to the improvement of strength, while the polyether soft segment has a weak polarity, if the molecular weight increases, the relative content of the hard segment in the polyurethane decreases and the strength decreases.

3. Comparison of mechanical properties:

Polyether, polyester and other oligomeric polyols constitute the soft segment.The soft segment accounts for the majority of polyurethane, and the properties of polyurethane prepared by different oligomer polyols and diisocyanates are different.The mechanical properties of polyurethane elastomer and foam obtained by using polar-strong polyester as soft section are better.The reason is that polyurethane made of polyester contains a large polar ester group. Not only can hydrogen bond be formed between the hard segment, but also the polar groups on the soft segment can partly form hydrogen bonds with the polar groups on the hard segment, so that the hard phase can be more evenly distributed in the soft phase and play the role of elastic crosslinking point.At room temperature, some polyesters can form soft segment crystallization, which affects the properties of polyurethane.The strength, oil resistance and thermal oxidation stability of polyester polyurethane are higher than PPG polyether, but its hydrolysis resistance is worse than that of polyether.

4. Comparison of hydrolysis stability:

The hydrolysis resistance of polyester thermoplastic polyurethane was improved after it was protected with carbonized diimide.Polyether ester thermoplastic polyurethane and polyether thermoplastic polyurethane have the best hydrolysis resistance at high temperature. Polyester is easily attacked by water molecules and breaks, and the acid produced by hydrolysis can catalyze further hydrolysis of polyester.The type of polyester has a certain effect on the physical properties and water resistance of elastomers.With the increase of methylene in polyester diol, the water resistance of polyurethane elastomer was improved.The content of ester group is small and its water resistance is good.Similarly, the water resistance of the polyurethane elastomers synthesized with long-chain diacids is better than that of the polyester-type polyurethane synthesized with short-chain diacids.

5. Comparison of microbial resistance:

Polyether soft or rigid thermoplastic polyurethanes and polyether or rigid thermoplastic polyurethanes are normally protected from microbial attack when in contact with wet soil for a long time.

IV. Analysis of causes of difference

1. Polyether polyols:

Polyether polyols are alcohol polymers or oligomers containing ether bonds and hydroxyl groups on the main linkage structure.Due to the low cohesion energy of ether bond in its structure and easy rotation, the polyurethane material prepared by it has good low-temperature smoothness and hydrolysis resistance. Although its mechanical properties are not as good as those of polyester polyol polyurethane, it has good chiral properties.The system has low viscosity and is easily miscible with isocyanate, auxiliary agent and other components.

2. Polyester polyols:

Polyester polyols are mainly products generated by polycondensation reaction between binary carboxylic acid and binary or above alcohols. Their junction features are macromolecules containing ester groups on the main chain of molecules and hydroxyl groups on the end groups, with a molecular weight of 500~3000.

Polyurethane materials based on polyester polyols usually have good mechanical properties, excellent oil resistance and abrasion resistance, but their hydrolytic resistance is poor, low temperature smoothness, the feel of their products, especially at low temperatures, is not as soft as polyether polyol polyurethane.The cohesive energy of polyester polyols is large, most of them are waxy solids at room temperature, and the viscosity after heating and melting is relatively large. Their mutual solubility with other raw materials used in polyurethane synthesis is far less than that of polyether polyols.

Detailed product information can be found on our company's website

www.rainbowtpu.com