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Toyobo Develops Excellent Flame-retardant Polyester Resins

Toyobo Co., Ltd. has developed excellent flame-retardant polyester resins which are copolymerized with a high concentration of phosphorus. Flame-retardant fillers and organic phosphorus flame retardants have conventionally been used to give fire resistance to molding materials and adhesives, but with problems such as bleed-out* and a decline in adhesion properties. Toyobo has now developed two types of new flame retardants that can resolve these problems: one for molding materials and the other for adhesives.

*Bleed-out: Process whereby various additives emerge on the resin surface.

1. Development Background

With the growing demand for fire-resistant resins for diverse electric and electronic materials, flame-retardant fillers, which contain halogen, are often used to provide fire resistance. However, there are concerns regarding the harmful impact of these materials on the human body and the environment, since they still contain halogen and substances thought to be toxic.

Molding materials require the addition of large quantities of flame-retardant fillers, which causes the problems of increased weight and reduced transparency. Consequently, new flame-retardant polyester resins that can replace fillers are desired, particularly for applications where transparency is needed.

In adhesives as well, flame-retardant fillers frequently decrease adhesion properties, regardless of whether or not they contain halogen. Organic phosphorus flame retardants easily bleed-out because of their low molecular weight, and also have the problem of decreasing adhesion properties.

To date, flame-retardant polyester resins copolymerized with phosphorus have almost never been sold (according to Toyobo investigations). Toyobo has combined the following technologies, which the Company already holds, to develop high molecular weight flame-retardant polyester resins copolymerized with a high concentration of phosphorus (hereafter, "new flame-retardant polyester resins)."

- The technology for high-concentration copolymerization of phosphorus organic monomers in polyester resins, fostered in developing our existing flame-retardant polyester fiber TOYOBO HEIM®, giving the polyester resin a high molecular weight.

- The technology to give adhesive properties to polyester resins and make them solvent soluble, fostered in developing adhesives applications for our existing VYLON® copolyester resins.

2. Product Characteristics

(1) High Fire Resistance (Phosphorus Concentration) and High Molecular Weight

The new flame-retardant polyester resins have high fire resistance, and their phosphorus concentration is at the highest level among flame-retardant resins presently sold on the market. Because of the high phosphorus concentration, the amounts added can be adjusted in line with the application and fire-resistance demands, and the phosphorus concentration can be modulated at a high level. There is no bleed-out because the phosphorus is copolymerized and the retardant has a high molecular weight.

(2) Halogen Free

The new flame-retardant polyester resins contain no halogen.

(3) Can be Blended with Various Polymers

Because the flame retardant is a phosphorus organic monomer copolymerized with polyester, it has high compatibility and can be blended with polyethylene terephthalate (PET), polytrimethylene terephthalate (PTT), polybutylene terephthalate (PBT) and other polyesters and with polylactic acid and other polymers with ester linkages.

(4) Two Types: One for Molding Materials and One for Adhesives

① Molding Materials

By compounding a suitable fire resistance master batch*, the problem of an increase in molding materials weight which occurs when fillers are used is avoided, and there is no loss of transparency. Adding 20% or more of the flame retardant enables the manufacturing of products that meet the UL V-0, which are the international flame resistance standards.

*Master Batch: Resin with high concentrations of additives compounded in the same materials used in the finished product.

② Adhesives

There is no bleed-out and no decline in adhesive properties, compared with the addition of separate flame retardants.

	Use	Phosphorus concentration (ppm)	Glass point (°C)	Limiting viscosity	Average molecular weight	Solvent solubility
①	Molding materials	30,000	70	0.64		Difficult
②	Adhesives	28,000 ~39,000	4~68		10,000 ~30,000	Easy

*Note: The above figures are representative values, not specifications.

3. Future Developments and Sales Plans

Toyobo has already initiated sales for molding materials and electronics materials. The Company is developing sales in Japan and overseas, aiming at revenues of ¥1.0 billion in 2012.

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