

Applications and Development Trend of Plastics in Household Appliance Industry

Plastics can be generally categorized into general plastics, engineering plastics and thermoset plastics. General plastics includes: PP, ABS terpolymer, PS and PE; engineering plastics includes: PA, PC, PBT, PET, POM and PPO, etc.; thermoset plastics includes: polyurethane resin, phenolic resin and epoxy resin, etc.. Of which, engineering plastics is undoubtedly increasing most quickly.

1. Growing Applications in Household Appliance Industry

1. Present Status of Plastics in Household Appliance

- Plastics can be broadly used in household appliance industry due to its inherent characteristics:
- Lower density, which can reduce the weight of household appliances for lightweight production.
- Good impact resistance, satisfactory hand feeling, excellent resistance to wearing, vibration, sound absorption and good insulation to electricity, heat and sound; so it can be widely used to produce electrical insulating/heat insulating materials and acoustical absorbing materials.
- Good processability, ease-of-forming, which can simplify the processing of the components with complex shape and form the complicated products at once time for efficient batch production in a cost-effective manner. If calculated by the unit volume, the production cost of plastics parts is only 1/10 of nonferrous metal.
- High design freedom of plastic materials, enabling flexible appearance design of the household appliances.
- Strong resistance to chemical substances such as: acid, alkali and salt; so partial damage of the plastic materials may not cause corrosion like metal materials.
- Good recoverability and environmental friendliness, helping to meet the requirements for recyclable and sustainable development.

2. Main Varieties of Plastics for Household Appliance

Thermoplastic plastics account for approximate 90% of plastic materials for household appliance, and the remaining are thermoset plastics. Among thermoplastic plastic materials, most of them are general plastics, e.g.: PP, PS, PVC and PE, etc. The available engineering plastics mainly include: ABS, AS,

PA, PC, POM, PPO, PPS, PET, PBT, PMMA, LCP, PEEK, PSF and PUR. Thermoset plastics generally contain polyurethane resin, phenolic resin and epoxy resin, etc.

ABS, polystyrene and synthetic polypropylene are most commonly-used plastic materials. PP can be used in barrel rolls and also fabricated into internal barrel of dishwasher. Bosch-Siemens Group has launched a PP internal-barrel dishwasher, which can endure 80°C cleaning agent for dishwasher with stable performance and color. It is predicted that PP will be widely used in other internal devices of dishwasher in the future, such as steel hinges and steel brackets of PVC coating in addition to internal barrel. Lining materials of refrigerator door are turning from HIPS to ABS, which can reduce wall thickness or cost without affecting the strength of components. Thermoplastic ABS often requires pressure assistance to obtain better accuracy during the processing process. With more refined design of lining, there is a higher requirement for processing accuracy. Refrigerator manufacturers are even considering of how to produce outside door of refrigerator with plastics.

PS was mainly used to produce transparent parts of household appliance, but now it is widely used as foamed packing materials. HIPS is usually used to produce door liner, inner container, vegetable box, meat tray, icebox, TV cabinet, computer, recorder, air conditioner, dust collector, telephone set, electronic organ and other household appliances' cabinet, boxes of audio/video discs and keyboard. Among HIPS, those models presenting high lustre, high flow and resistance to environment stress cracking are developed most quickly.

PVC is rarely applied in household appliance, but generally as gland strip and small injection moldings of refrigerator; however, thanks to lower cost of PVC/ABS and PVC/PS, they can be used to fabricate flame retardance components of TV cabinet, electric fan, blower, refrigerator's internal barrel and dust collector, in lieu of ABS and HIPS.

PE is mainly used to produce non-bearing parts of household appliances, such as corrugated pipes in washing machine and dust collector. Amongst engineering plastics for household appliance, ABS ranks top first for its amount of usage, and is primarily applied to fabricate refrigerator liner, TV cabinet, computer, recorder, air conditioner, duct collector, telephone set and electronic

organ as well as housings and interiors of other small household appliances. The transparent external parts of household appliances and internal transparent parts of refrigerator are made of ABS.

AS can be used to produce vegetable dishes of refrigerators, electric switches and transparent parts of small appliances, etc. Thanks to its excellent toughness, transparency and high/low temperature properties and self-extinguishment, PC is extensively applied to manufacture transparent housings of blowers and electric heaters requiring for higher heat resistance and flame retardance. Additionally, PC also can be used to manufacture disc with demanding requirement for optical performance, while PC/ABS alloy is used for fabrication of the shells of mobile phones.

PA series are usually used to fabricate gears, bearings and sliding parts in household appliances.

With excellent comprehensive performance, POM was previously used to fabricate gears, shaft housings and sliding parts in household appliances. In recent years, POM alloy is widely used in precision members.

Modified PPO is a heat-resisting engineering plastic with excellent comprehensive performance and self-extinguishment, so it is usually used to produce spare parts, sockets, insulation supports, winding frames of TV, radios, etc. Fiber-reinforced PBT can be used to produce winding frames and transformer casings. PET is mainly used as the substrate of video cassettes. In recent years, due to lower price of PET, PET/general plastic blends can be extensively used in household appliances in replacement of other engineering plastics.

PPS, LCP and PEEK are generally used to produce precision members of high heating resistance, such as: connectors in computer; or produce elastic parts in household appliances, such as: sealing rings in electric cooker. PUR is mostly used as rigid foamed plastics for heat insulation in refrigerators and electric cookers.

Among thermoset plastics, Phenolic plastic is mainly used to produce bottom plates, switches, patch boards and fiber reinforced parts in electric household appliances; amino plastic is mainly used to produce rotary knobs,

heat-resisting cases and adornment veneers; epoxy resin is mainly used to produce printed circuit boards and encapsulating materials.

2. Development Trend of Plastics in Household Appliances Industry

1. Further Popularization of Applications for Recyclable Environment-Friendly Plastics

Environment-friendly plastics are used in a wider range of applications in the context of development of an environment-friendly world, e.g.: PP (polypropylene) is a nontoxic and odorless polymer, with a density of only $0.90\text{g/cm}^3 \sim 0.91\text{g/cm}^3$, so it is one of the lightest plastics.

Furthermore, biological plastics is more environmental-friendly due to easy natural degradation. Its applications in household appliances will be increased continuously, for example, SONY has started to develop the plant plastics for household appliances.

As household appliances in China reach the peak of decommissioning, China has become a big consumer of discarding the household appliances. Therefore, recycling of plastics from discarded household appliances becomes a common problem faced by the household appliances industry and plastics industry, so recycling of resources will serve as a new economic growth point. It is relatively easier to decompose and smash plastic parts because of their characteristics such as: ease of removal and recycling; the finer the plastic parts are decomposed, the value is higher. Hence, the technical advancement of plastics industry will drive the development of discarded household appliance recycling.

2. Growing Consumption of ABS Resin Plastics

Among engineering plastics for household appliances, ABS resin ranks top for its amount of usage, and is primarily applied to fabricate refrigerator liner, TV cabinet, computer, recorder, air conditioner, duct collector, telephone set and electronic organ as well as housings and interiors of other small household appliances. The transparent external parts of household appliances and internal transparent parts of refrigerator are made of ABS. As a kind of engineering thermoplastic resin with largest consumption in the world, 80% of ABS resin consumption in China is attributable to the production of household appliances. While ABS resin is one of main raw materials for household appliances, its market trend raises great concern of many household

appliances manufacturers, but the demand exceeds the supply.

3. Growing Applications of Antibacterial Plastic in Household Appliances

Antibacterial plastics a kind of new material presenting bacteriostasis and sterilization ability, is widely used in various household appliances. It serves as a green barrier to resist the bacteria and safeguard the human health. In recent years, antibacterial plastic is widespread and developed rapidly in domestic household appliances industry. A variety of antibacterial household appliances will become a mainstream in household appliance market in China.

Source : Shanghai Household Electric Appliance Profession Association