Plastics Processing Technology

Additives and Modifiers

In order to meet customer demands for additional properties for specific applications (changes in strength, density, color, thermal properties, and cost) most plastics used today are comprised of a polymer plus one or more additives or modifiers.

- *Reinforcements* are the most often used to enhance mechanical properties such as tensile strength and rigidity, and thermal properties, such as deflection temperature. Materials such as glass, carbon/graphite and mica are most often used.
- *Fillers* are materials added to plastics specifically to lower cost. They are compounded and pelletized with the plastic materials. Typical filler materials are wood flour, kaolin (clay), cotton and cloth.
- *Colorants* are usually an organic or inorganic dye or pigment. The amount of colorant added to plastic material is relative to the color of the base plastic. The colorant may be in the form of a powder, liquid, or pellets and added as percentage by weight.
- *Flame Retardants* slow the burning rate and/or prevent the plastic from supporting a flame in their selected plastic sufficiently to meet agency and consumer requirements.
- *Stabilizers* are additives that help to control or enhance specific properties. As with all additives, there may be negative aspects to their inclusion.
    - *Thermal* stabilizers improve the long-term stability of plastics when exposed to heat by widening the plastics temperature range,
    - *Plasticizers* make plastic (usually PVC) flexible. Plasticizers, over time, may become extracted. The milky mist that lingers on the inside of the windshield of a new car is plasticizer.
    - *UV light* stabilizers prevent the plastics tendency to fade and/or physically degrade when exposed to sunlight.
- Antistatic Agents. One advantage of plastic is its inherent dielectric properties. This can be a problem when static electricity needs to be dissipated. Antistatic agents are categorized by:
    - *Internal agents* are compounded in the plastic and migrate or "bloom" to the plastic surface due to their incompatibility with the plastic.
    - *External* agents are applied to the surface of a plastic part. External agents are more effective but are more short lived. Dryer sheets increase the surface conductivity of polymer fabric, and the clothes lose their static charge.
    - Ion discharge agents were developed for the electronics and packaging industries, which needed short-term static discharge dissipation. The surface static charge of the plastic is temporarily neutralized by exposing the part to a slightly ionic atmosphere whose charge is opposite to that of the plastic part.
- Biocides. May plastics attract undesirable life forms such as fungi and bacteria. Plastics have also been known to be a food source for rodents and roaches. A more common biocide is the insecticide in pet flea collars. The biocide migrates to the surface of the extruded vinyl collar.
- *Foaming agents* provide the cellular plastic characteristics needed in the insulation, construction and packaging industry. All plastics can be foamed using:
    - *Internal blowing agents* which decompose within a specific temperature range producing a gas, usually nitrogen.
    - *External agents* are usually gases (steam or nitrogen) that are physically introduced into the plastic melt.
    - *Microballons or microspheres* are small, hallow spheres that are mixed with the plastic producing a product called syntactic foam.
- *Regrind* introduction allows a plastics processor to get the maximum material usage; however, the regrind is not exactly the same as virgin material and may negatively affect the process. The plastic product designer should specify the maximum regrind allowed for a particular part, directly on the print. This includes specifying "No Regrind Allowed" if that is what is required. For more detailed information refer to the text " Plastics Processing Technology" by Edward A. Muccio.

Adding Regrind to Virgin Plastic.

During the granulating process, several control factors are often overlooked that can result in loss of material, loss of product, and even damage to the processing equipment:

- *Contamination* can result from mixing different plastics, nonplastic material (i.e. paper or cardboard), metal (from the granulator itself or from foreign objects).
- *Wide variation in granulate particle size* results from improper granulator set-up. This can interfere with mixing and reprocessing.
- *Fines* (small dustlike particles of regrind, created during the granulation process), tend to heat up and degrade quickly when they are reprocessed, because of their small mass. Larger plastic pellets can overheat and burn during melting, causing black specks in the plastic part that are both visually and mechanically degrading. Fines can be minimized by proper granulator set-up, screening, and loading of the regrind.
- *Fluff* (a low-density, fibrous form of regrind) may occur as the plastic is "shaved" or "skived" by the granulator. Fluff changes the regrind density significantly and can also prevent proper mixing. Fluff, like fines, should be removed prior to mixing.
- *Regrind in the final mix* results from compounding regrind by volume. All regrind should be compounded with the virgin material by weight only, because the bulk density of the regrind will be different from that of the virgin pellets. Regrind in the final mix can cause variation in the plastic product performance.

NOTE

Regrind should never be stored, labeled or inventoried with the same part number as that of virgin material

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