ASHLAND

Cycletime Tips - General

Volume 29: Imbedded Particulate

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Imbedded particulate makes its way into your plastic article in three general ways:

1. already in the pellets from the manufacturer,
2. introduced by the processor, and/or
3. created during the process.

From the Manufacturer
Some resin types are more suspect than others for containing specks, mostly carbon, during the manufacture of the pellet. In addition, some manufacturing processes are "cleaner" than others.

A simple way to determine whether the problem is within the pellet as it is received is to perform a simple incoming inspection of the resin before the lot is released to production. Select an adequate sample size of pellets, spread the pellets onto a clean white surface or light table, then carefully separate pellets, which contain specks. Next, sort the contaminated pellets into the size ranges for the black specks. Establish two or three size categories from the barely visible (< 0.1mm) to the gross (> 1mm). This should provide good information to qualify lots of resin. The second piece of data needed is the weight ratio of each size range of contaminated pellets to total sample of pellets.

Now, the processor is able to compare the amount of scrap caused by imbedded particulate to the amount of "bad" pellets received within the lot of resin. Is the ratio more or less than found in sample? If the ratio is similar or less, then the material is the possible source. If this ratio is much higher, then the processor must look further for the main source of the problem.

Introduced by the processor
The first step is to prevent contamination of clean resin at the receiving dock. Take care to keep the container in good condition. External damage almost always results in contamination of the contents. Clean the outside of the container before removing the cover. Keep all containers covered. Keep all materials handling and conveying equipment surfaces free of dirt, dust and other resins. Pay close attention to dryers because the flow of dry air can keep the contaminant in constant agitation. Use filtered vents on loading systems to prevent the drawing-in of contaminants. Keep air filters clean in the loading and drying system.

Inspect the vinyl material conveying hoses. These have been the cause of specks in product caused as the resin pellets impact and abrade particles from the inside surface of the hose. Check to see if metal dust from material piping elbows and hopper loader surfaces have produced product defects similarly. If you observe problems in these areas, consider stainless steel elbows, hardened steel wear areas within the hopper loader and wear resistant hose for those most critical applications that require zero visible specks in the product.

Created During the Process

Fines are created by the process and then introduced by the processor. Although some fines are in the resin as it is received, the extent can be quantified using the same methodology as used to quantify specks in the pellets. Fines can show up in the product as black specks, white specks and white streaks.

Degradation of the polymer in the heating cylinder and in hot runner systems is typically a large source of carbon particulates. The breaking down of the polymer occurs in the cracks, crevices and dead spaces within the barrel, screw, screw non-return valve, barrel end cap, nozzle, nozzle tip, and hot runner system. Molten polymer invades these areas, sticks, hangs up and degrades over a period of time. Eventually, build-up, start-ups, shut-downs or any disruption in the cycle can cause this carbonized polymer to break off into the material stream.

High localized shear caused by sharp corners, flow restrictions, dead heater bands, the wrong screw design, and excessively high back pressure can also be a source of imbedded particulate. Do not forget worn screws, worn barrels, worn non-return valves. Ball check type non-return valves often cause higher shear than ring type valves. Ring valves are also not noted for having as many dead spots for material to collect and then degrade.

The screw must be smooth, free of pits and scratches and should be chrome plated. Caution: polycarbonate has been suspected of sticking to some marginal chrome plating and actually pulling up during processing. This occurs most often during start-up when the polycarbonate was left in the barrel. Also, polycarbonate reacts with some high iron steels when combined with high heat and pressure causing rapid degradation of the polymer.

Polymer degradation is aggravated by high moisture content in the polymer, the presence of other non-compatible material, and/or poor regrind.

Purging

Ask ten processors for the best purging procedure and you'll likely get twelve or more responses. Why no consensus? Maybe it's the infinite possible combinations of materials, equipment and personal preferences.

However, most purging compounds contain a scouring action by abrasive additives, low melt flow polymer carrier, a chemical cleaning agent or a combination of the three.

Several suppliers of purge agents recommend the addition of water to the mixture. The water turns into steam which gets into those hang-up areas to help remove the degraded polymer.

Caution:
The purging procedure is more dangerous than normal processing. Some purging compounds create increased pressure inside the processing equipment. Personal protection equipment and awareness are essential. Consider removing nozzles, barrel end caps, and other possible restrictions to polymer flow. Often fumes are created which are offensive and irritating. Make sure whatever compound or blend that you use is compatible with the outgoing and incoming polymers. Also make sure that the mixture will remain stable at in-use temperatures. Because of the possible danger in experimenting, it is strongly recommended that you use commercially available purging agents, follow the instructions and recommendations carefully and take note to all cautions offered by the material manufacturers.

Summary
The answers are clean resin, clean equipment and proper processing. A scientific approach to prevention and detection will reduce your time spent on imbedded particulates problems.

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