ASHLAND

Cycletime Tips - General

Volume 8: Plastic and Moisture

By Mike Van Duine

This article will examine resin classifications related to moisture, the effects of moisture in the melt, and absorption rates of some plastics. The information will provide you with a better understanding of why we must dry certain resins and the consequences of short cuts.

Resin Classifications Related to Moisture
Non-Hygroscopic (polypropylene, polyethylene, styrene, PVC, etc.): These resins will not absorb moisture. However, under certain conditions, i.e., bringing resin from a cold warehouse or silo into a warm plant, condensation may then form on the surface of the pellet when the surface temperature is below the dew point of the surrounding air. If the resin is then processed, it will have an effect on both the parts and processing. So, it is necessary to dry this class of resins when conditions are favorable for condensation formation. Typically, a hot air drying system will do the trick to remove this surface moisture.

Hygroscopic (PET, PBT, nylon, polycarbonate, urethanes, etc.): These resins will readily absorb moisture and form a molecular bond within the polymer structure. If processed without proper drying, adverse effects may occur on the parts and resins. This class of resin will require drying with dehumidified hot air in order to remove the moisture prior to processing.

There is a third type of resin which does not fit directly into either class (acrylic, ABS, etc.). However, it shares some of their characteristics, i.e., it will absorb moisture and show signs of splay, but typically will not undergo any adverse effects as with the hygroscopic type resins.

Effects of Moisture in the Melt Plasticizer:
Water will act as a plasticizer in the melt, which will cause an increase in polymer flow. This condition is reversible provided hydrolysis has not occurred and the regrind can be redried and reused.

Vaporization:
Water will vaporize in the melt, and will occur as pressure on the melt is reduced. This is typically seen as bubbles and splay in or on molded parts. This, as well, is a reversible condition if hydrolysis has not occurred and the regrind can be redried and reused.

Hydrolysis:
This is a degradation process that occurs as a result of moisture not being dried from

hygroscopic resins prior to processing. This degradation to the resin is irreversible because of the molecular structure breakdown. The effect on the resin is a decrease in molecular weight and the results are a dramatic loss of physical properties, increased flow, flashing, drooling, etc. In this case, the material cannot be redried and reused. It should be scrapped.

Moisture Absorption Rates

Moisture absorption by plastics will occur at different rates and quantity. Below is a chart that shows rate of absorption, quantities, rate of hydrolysis, and maximum water content for processing various resins.

Material	Rate Absorption	% Rate of Absorption	Hydrolysis for Processing	Maximum % Water Content
Polycarbonate	Fast	.35	Fast	.02
Nylon				
6/6	Slow	8.5	Slow	.20
6/12	Slow	3.0	Slow	.20
12	Slow	1.55	Slow	.20
PET	Fast	.05	Fast	.02
Urethane	Fast		Fast	.01

Now that we have summarized the various ways moisture can affect plastics in the melt—how do we minimize or eliminate moisture-related problems? Well, of course, through proper drying techniques. However, if you are still having moisture-related problems and you missed the CycleTime Tips on the dryer system audit by Alan Larsen (May 1992), I would strongly suggest a review of it and your drying system.

Mike Van Duine is a General Polymers Technical Service Representative based in Lenexa, Kansas.