ASHLAND

Cycletime Tips - General

Volume 30: Drying and Brittleness

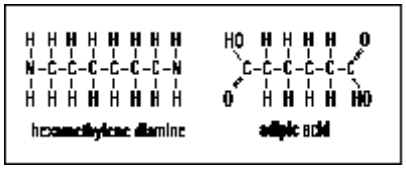
By Sean Mertes

Why Dry?
As almost everyone knows, there are certain materials that require drying and others that don't. Materials that require drying are called 'hygroscopic' meaning they absorb water from the atmosphere, and materials that do not absorb water are termed 'nonhygroscopic'.

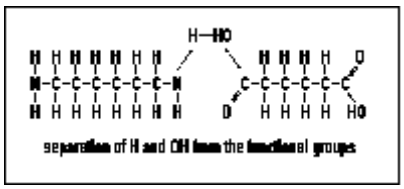
If material is processed wet, the outcome is generally detrimental to the finished product. Most likely, the finished parts will contain surface defects (splay), be very brittle, or will have poor impact strength.

Why does the part become brittle?
If you run your molding process with wet material you lose strength because the water that is contained in the material will act like scissors and split the molecules into shorter lengths (i.e. back to their original components). Since the strength of plastic is directly related to chain length, it is easy to understand that shorter molecules will not be as strong as longer molecules.

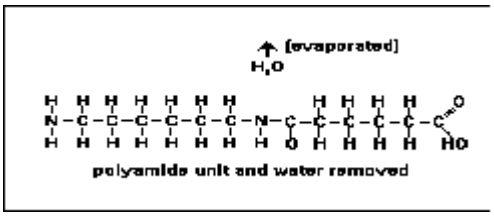
Here is a VERY simplified version of what happens:
The process that is used to link the molecules together during polymerization is called "polycondensation". In nylon, the hexamethylene diamine contains the amino functional group (H--N--H or NH2) and the adipic acid contains the carboxyl functional group (O=C--HO or COOH).



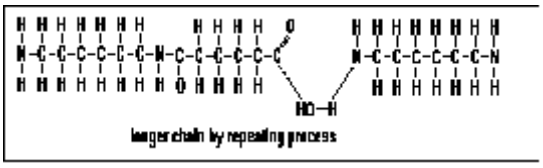
The components of H and OH are separated.



Water and macromolecule are formed. This water is then removed.



and the process repeats itself.



The water molecules separated in the reaction must be constantly removed during polycondensation in order to allow the reaction to continue and form very long chains.

If this material is processed incorrectly (i.e. wet) this process can reverse itself and the longer chain molecule will be spit into numerous smaller molecules. Note that once the process is reversed, the molder can no longer get the longer molecule back again. This is why improperly processed material should never be reground. Adding virgin material to this bad regrind only dilutes the problem. It does not fix it. As the old saying goes, “a chain is only as strong as its weakest link” and the weak link will now be this bad regrind.

Although the described process is for nylon, a similar polycondensation process occurs in polycarbonate and polyester resins.

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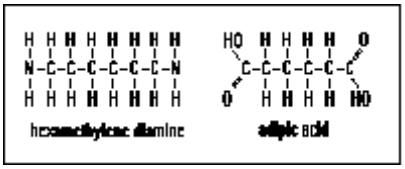

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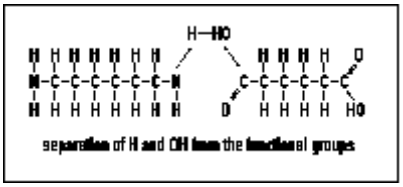

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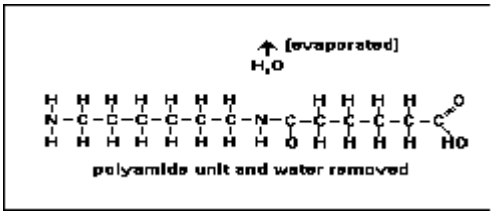

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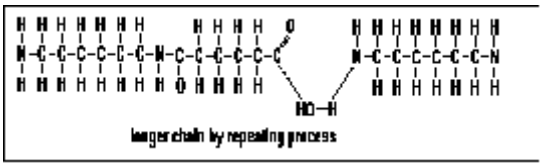

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