

Importance of
PROPER PLASTICS DRYING
IN PROCESSING OF ENGINEERING PLASTICS

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ABSTRACT

Drying is the necessary criteria for quality processing of plastics, particularly with the increased usage of thermoplastics / engineering polymers / resins

Engineering polymers / resins absorb moisture during manufacturing, transportation and when in storage prior to processing. It can be safely assumed that all batches of resins potentially contain surplus/excessive moisture, regardless of the circumstances.

Thus, the moisture must be removed from the resins prior to processing. Excessive moisture in the resin results in severe material inconsistency during processing. Apart from resulting in sub-standard product, both in terms of appearance and property, moisture trapped inside the resin can cause silver streaking or splay. More disastrous can be damages, which are not visible.

Plastics resins which are affected by moisture, can be classified as:

- *Non-Hygroscopic*
- *Hygroscopic*

Non-Hygroscopic resins collect moisture only on the surface of the pallet. This surface moisture can be dried by exposing the resin to a continual blow of the hot air

Hygroscopic resins, collect moisture inside the core of the pallet and can be best dried by dehumidifying dryers.

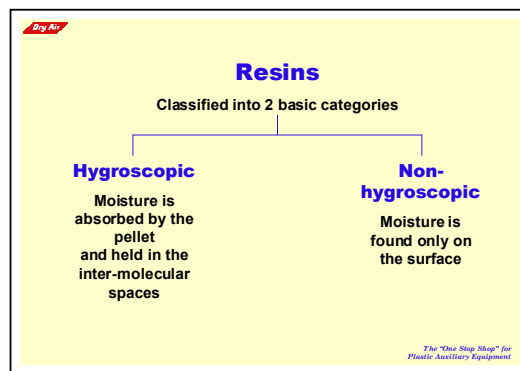
Hygroscopic resins like PA, ABS, PET, PC, PS etc., which have a high affinity for moisture, need to be dried thoroughly and properly to ensure quality finish of final product. Improper and inadequate drying can result in loss of structural, impact strength and tensile strength, cosmetic defects and many other moisture related defects and deficiencies.

In this paper we will elaborate, the importance of proper drying of engineering plastic resins, to maximize quality of moulded parts and minimize possibilities of degradation. We will also be discussing various variables of drying and equipment / methods available for effective drying of engineering plastic.

WHY IS PLASTICS DRYING IMPORTANT?

One of the most important and universal advantages of engineering plastics is their virtual freedom from attack by ambient moisture or from surface attacks compared to the rusting of steel or the atmospheric corrosion of copper and aluminium.

However, **plastics** in the **resin state** may be **hygroscopic** (moisture penetrates the pellets)



and **absorb moisture** from the **atmosphere** during **storage** or **before being processed**, which **adversely** affects the **final quality** of the moulded part.

Even **non-hygroscopic plastics** (moisture accumulates on the surface) are **susceptible** to **surface moisture** contamination that should be removed before processing.

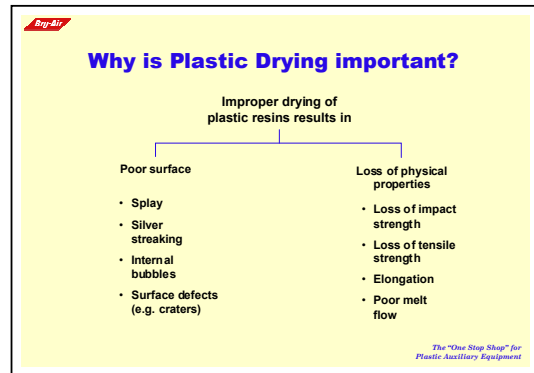
PROBLEMS DUE TO IMPROPER DRYING

Common problems of many resins like - *Nylon, ABS, Polythermide, Polysulphone, Polycarbonate* due to improper drying are -

1. SURFACE APPEARANCE

Moisture bubbles trapped in the resin can ruin a part's surface appearance by causing:

- Splay (splash type defects)
- Silver streaking
- Internal bubbles, and
- Surface defects (e.g. craters etc.)



2. PROPERTY PERFORMANCE

Moisture can cause a loss in material properties. Trapped moisture bubbles can cause voids in the interior of the part. Moisture can also cause a loss in molecular weight due to hydrolysis. (A chemical process of decomposition that occurs with the addition of water)

Loss of Physical properties may result in -

- Loss of impact strength
- Loss of tensile strength
- Elongation and
- Poorer melt flow.

For resins such as polycarbonate and polyester where impact strength is a critical property, dry resin is a must.

Hence, *proper drying* of many *plastic resins* is the *first critical* step towards obtaining *optimum performance* of molded parts and minimizing possibilities of *degradation*. Without exception, the longer and hotter a given forming operation is, the drier the pellets must be.

PROBLEMS OF MOISTURE IN PLASTIC PELLETS

Resin's Moisture Content

The amount of moisture a resin will absorb depends upon several key factors. Moisture content depends on the type of resin, for each resin has its own absorption characteristics. Some polymers have a greater affinity to water than others and therefore will absorb moisture more readily. Not only does every resin family have its own moisture absorption characteristics, but each resin grade does as well. The weather conditions or the moisture content of the air as well as the temperature of the ambient air and the pellets also affect the resin's moisture content

Drying Variables

Just as in moisture absorption, the variables that will affect moisture removal or drying are: the nature of the resin; the dryness of the air; the temperature of the air and the pellets; and the time that the resin is exposed to the air.

Proper Drying

Drying reverses the absorption process, removing moisture from the pellet to a very low level moisture content that is suitable for processing. Proper drying Improves processing consistency by removing moisture from the pellet prior to processing and preheating the material to predetermined temperature. The drying specifications outline three criteria; how 'dry' the air must be: how high the air temperature must be; and how long the resin must be dried.

Dry Air

The air used to dry the pellets must have a dew point of at least $-40^{\circ}\text{F}/^{\circ}\text{C}$ Only if the air is this dry, can a pellet reach the point of equilibrium to maintain a moisture level $\geq 0.05\%$. The drying temperatures and times specified assume that the air in the dryer will have a dew point of at least $-40^{\circ}\text{F}/^{\circ}\text{C}$ or lower.

Methods of Drying

There are three methods of resin drying;

- Manual Drying
- Hot air or Hopper Drying
- Dehumidifying Drying

Manual Drying

Manual drying is an outdated, labour intensive process, with high probability of spoilage of pallets because of improper control of temperature.

Hot Air or Hopper Drying

The hopper (Hot air) drying, on the other hand, allows for continuous drying in the hopper and is preferable for long runs but only for non-hygroscopic resins i.e where moisture is only on the surface of pallets.

Dehumidifying Drying

For hygroscopic resins i.e where moisture is inside the core of the pallet, dehumidifying drying is the only solution

VARIABLE THAT AFFECT THE DRYING OF RESINS

Effects of Air Temperature (Hot Air Drying)

The rate of moisture gain or loss along the solubility curve is quite dependent upon the temperature because of the strong effect on the diffusion rate of water molecules through the pellets.

Higher temperatures provide a lower RH, and hence the rate of

