# The Drying of Engineering Plastics

## Basic requirements prior to processing plastic pellets for moulding

Not hygroscopic resins like PVC, Polystyrene and unfillled Polyethylen resp. Polypropylen can contain moisture only on there surface. But all engineering plastics are more or less hygroscopic. They can and will absorb moisture from the atmosphere into the pellet to contain it in there internal structure. If the pellets are not dried before processing, the water will react with the molten polymer at the processing temperature. The result is a change to the molecular structure of the polymer. This chemical reaction is known as hydrolysis and is reducing the molecular weight of a mouldet part.

Products moulded under these conditions will have lesser physical properties such as reduced tensile and impact stengths.

Polyamide is for example one of the most hygroscopic plastic materials in commen use. The moisture content of nylon moulding resins is a particularly importance parameter with a direct effect on moulding, on mechanical properties, on the viscosity of the melt and on the appearance of the moulded parts. This shows why all plastic processors have to realize the importance of proper drying for moulding high quality products!

## Drying Of Plastics By Hot-Air Systems

Basic plastics like for example PVC, Polystyrene or unfilled PE resp. PP are carrying moisture on the surface of their pellets as a result of temperature and humidity. These materials can normaly be dried by using only hot air.

As shown in Fig.1 the Hot-Air Driers take the ambient air heated up to the recommended drying temperature for a given resin for circulating through the resin hopper.

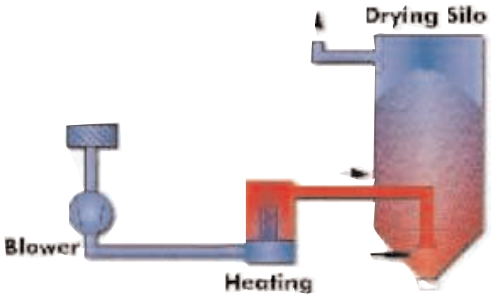


Fig. 1

In this system the drying result is limited by the ambient air conditions. In case of for example 25 °C temperature and 80 % R.H. the air is containing 19 g H2O / cbm air! Heating up the air from 25 °C to more than 80 °C is reducing the R.H to less than 10 % but there are still 19 g of water per cbm drying air. Fig.2

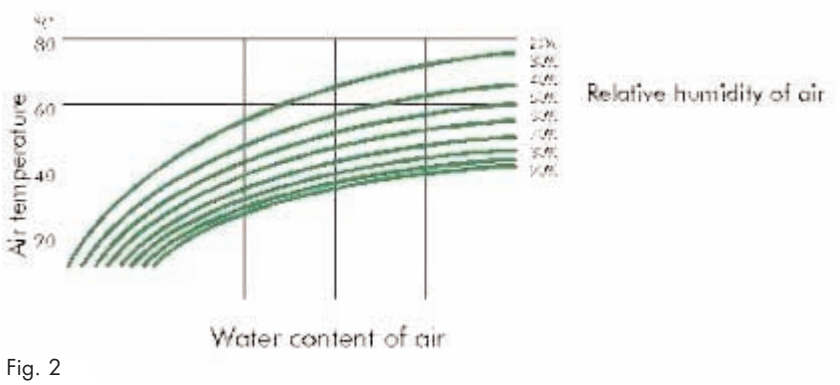


Fig. 2

The drying result in case of using Hot-Air-Driers is allways dependant on the condition of the ambient air.

## Drying Of Hygroscopic Plastics By Desiccant-Dryers

All hygroscopical resins like f.e. ABS, PA, PC , PET, PMMA and other materials can only be effectively dried by hot, predried (desiccated) air. They work absolutely independant from the conditions of the ambient air. The circulating air is passing a desiccant material like Silicagel or Molecular sieves. Fig. 3.

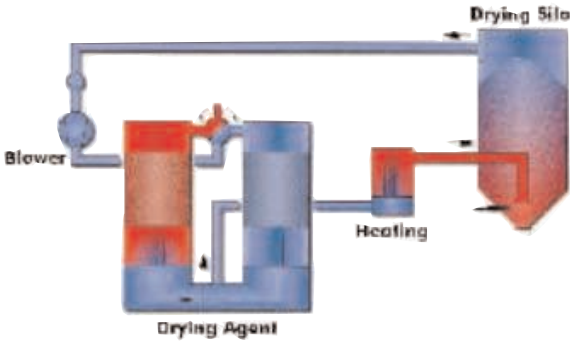


Fig. 3

Molecular sieves can absorb moisture up to 15% of their own weight. They are normally multibed driers with two or more desiccant beds and are able to dry the air in a closed air circulation system to a dew point of –30 °C to - 50 °C!

The dew point is the temperature where the moisture of the air becomes condensat (fog) while cooling down and is an absolute measured value for the containing moisture independant from air temperatures.

In relation to air with 25 °C, 80 % R.H. and 19 g H2O per cbm typically air in a desiccant drier with dew point - 30 °C is containing only 0,31 g H2O per cbm !

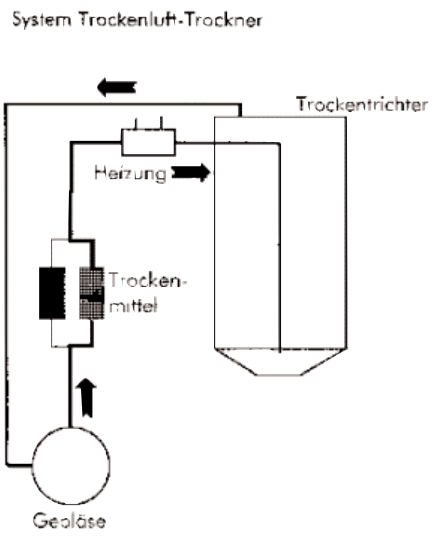


Fig. 4

Fig. 4 shows the difference in drying engineering plastics with Hot-Air – Driers and Desiccant Driers. Only Desiccant Driers can cover the requirements of engineering plastics to dry the resin before processing to a moisture rate of 0,05 to 0,02 %. But not only the dew point is an important indicator for proper drying conditions.

## Drying Temperature

Each resin must be dried at a specific temperature as given by the resin supplier.

Drying at temperatures below the recommended set point will prevent the absorbed moisture from being driven out of the pellets as needed where the moisture can be taken by the dry air to the desiccant bed.

Exceeding the temperature above the recommended set point will cause softening or melting of the pellets to the point of sticking together or it will f. e. in case of nylons degrade the colour of the white resin.

The air temperature should be measured at the inlet of the drying hopper and controlled per the recommended drying temperature for a given resin.

## Drying Time and Resident Time

For each resin also a specific drying time is given. But in most cases there is a different amount of predried resin taken from the drying hopper, depending on the various number of moulding machines and various processing capacities. The drying time is the time requested at a particular dew point and a particular temperature to dry the plastic material to a set degree of residual humidity!

The resident time is then the actual time that the resin is under the condition of the dryer. This time depends on the size of the drying hopper and the throughput.

Is the actual resident time shorter than the given drying time there is a risk for processing not properly dried material with reduced optical and mechanical properties.

A much longer resident time as the given drying time can cause a degradation of the physical performance and/or wasting energy.

## Requirements to the Drying Silo

The size of the drying silos should be adjusted to the requested drying time. In case of varying throughputs there should be the possibility to adjust either the useful storage volume or to adapt the dry air supply to the requirements.

Only a constant material flow over the whole silo diameter will ensure a constant drying result!

For quick material changes a drying silo should have good cleaning possibilities and no hidden edges.

## Basic Requirements for Drying Engineering Plastics

- Drying of the different plastic materials to a residual humidity of 0,1 to 0,02 % and in special cases up to 0,002 % (PET Preforms)
- Drying temperatures of 65 °C to 180 °C (149 °F to 356 °F) should be possible
- Quantity of dried air with 1-4 m? per kg/hr of material throughput
- Dew point of dried air from –25 °C to –30 °C (-13 °F to –22 °F)
- Resident times of 1 h to 6 h
- Adjustment of drying to varying throughputs
- Access to the drying silo for easy cleaning in case of material change