“Drying Options for Extrusion”

by
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Types of Drying Systems

- Hot Air Dryers & Crystallizing Dryers
- Vacuum Dryers
- IR Dryers
- De-humidifying Dryers
  - Desiccant - Dual Bed
  - Desiccant – Cartridge
  - Compressed Air Systems

Hot Air Dryers - *Strengths*

- Low Cost
- Pre-heat materials
- Crystallize with agitation
- Higher product quality
- Higher throughputs

Hot Air Dryers - *Weaknesses*

- Surface drying only
- High heating cost
- Large foot print
- Can create dusting

Vacuum Drying Systems - *Strengths*

- Heat sensitive materials
- Crystallizing capabilities
- Low oxygen drying
- De-volitization

Vacuum Drying Systems - *Weaknesses*

- High cost
- Maintenance intensive
- Batch drying
- High energy cost

Infrared Dryers - *Strengths*

- Energy efficient
- Low dust levels
- Crystallizes PET
- Short residence time

Infrared Dryers - *Weaknesses*

- Higher capital cost
- Maintenance intensive
- Requires finish drying below 100 ppm
- New/unproven technology

De-humidifying Dryers - *Strengths*

- Very low moisture
- Energy efficient heating
- Closed loop system
- Numerous suppliers
- Compressed air versions

De-humidifying Dryers - *Weaknesses*

- High capital cost
- Can be maintenance intensive
- Less than 1% incoming moisture
- Large footprint

Hot Air/Crystallizing Dryers

- Non-Hydroscopic Resins
- PE, PP, PS, PVC
- Moisture on outside of pellet
- Condensation during winter months
- Both dry and pre-heat prior to extrusion
- PE @ 175 degrees F…5 – 10% higher output
- Agitated hoppers for crystallization of PET

Vacuum Drying Systems

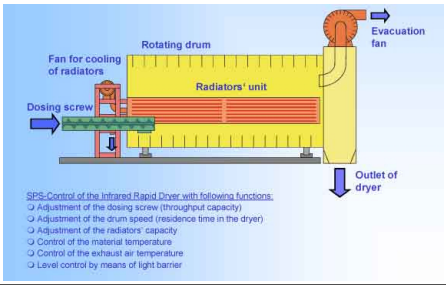
- Not typical for extrusion
- Will not be covered in this presentation
- Request further information

Infrared Drying Systems

- Both batch and continuous systems
- Batch - turning material in a mixer/blender
- Continuous - conveys and meters material
- Vibratory feeder into a fluted drum
- Continuous most suitable for extrusion
- Fast crystallizing and preheating of resin

Continuous IR Dryers

IR System Operation



Per the Manufacturer:

Advantages in comparison to conventional drying systems

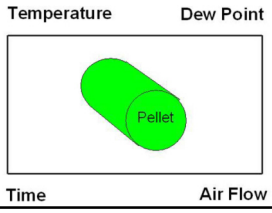
- crystallization and drying in one process step
- reducing of the drying time from hours to minutes
- fully continuous process
- smooth material handling
- no separation of products with different bulk densities
- high efficiency, reduced energy consumption
- no additional drying aids necessary
- simple handling and installation

De-humidifying/Desiccant Dryers

- For Hygroscopic Resins
- Nylon, ABS, Acrylic, PU, PC, PET, PBT
- Strong affinity for moisture
- Absorb onto their molecular structure
- Absorption to equilibrium with surroundings
- Drying to equilibrium

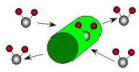
Desiccant Dryer Basics

Fundamental Drying Parameters

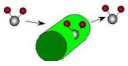


Desiccant Dryer Basics

Drying Temperature

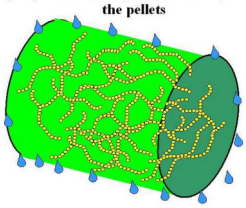


Heat is the first fundamental drying parameter.
Heat is the driving force in drying.
If the pellet is not heated it will not release all of its absorbed moisture.



Desiccant Dryer Basics

The low vapor pressure [Dewpoint] of the dry air surrounding the pellets



causes the freed moisture molecules to migrate to the surface of the pellet

Desiccant Dryer Basics

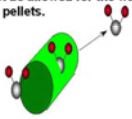
Drying Time

Drying Time is the third fundamental drying parameter

Plastic pellets do not dry out instantaneously

The pellets must first be heated to allow the water molecules free movement.

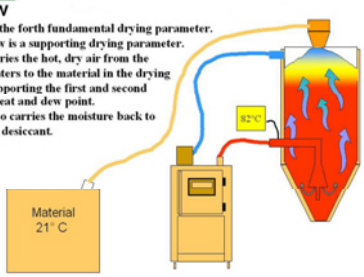
Second, time must be allowed for the water molecules to defuse to the surface of the pellets.



Desiccant Dryer Basics

Airflow

Air flow is the forth fundamental drying parameter.
The air flow is a supporting drying parameter.
The air carries the hot, dry air from the dryer's heaters to the material in the drying hopper, supporting the first and second drying of heat and dew point.
The air also carries the moisture back to the dryer's desiccant.



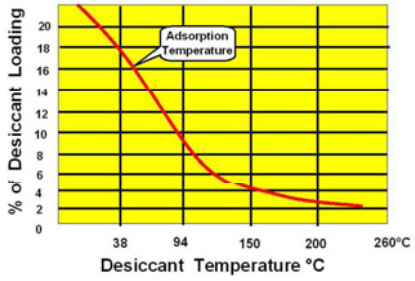
Desiccant Dryer Basics

Molecular Sieve Desiccant

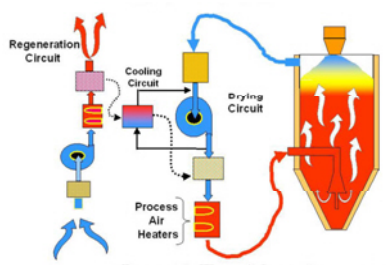
1. The most commonly used desiccant in polymer dryers
2. Crystalline metal aluminosilicates
3. Sieves or filters molecules of a particular size. [Water]

Important item to remember !
Desiccant Water Loading Capacity
Is dependent on the
desiccant's temperature

Desiccant Dryer Basics

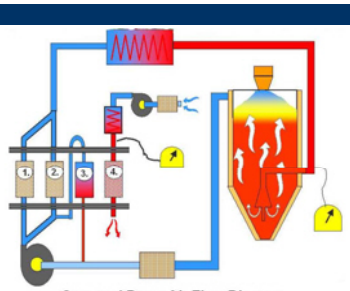


Desiccant Dryer Basics



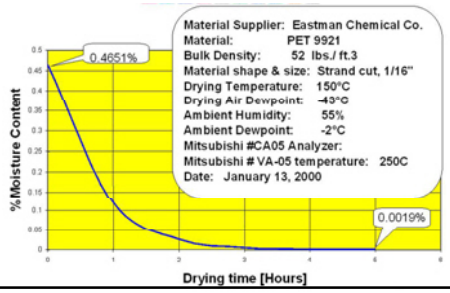
Dryer Air Flow Schematic

Desiccant Dryer Basics

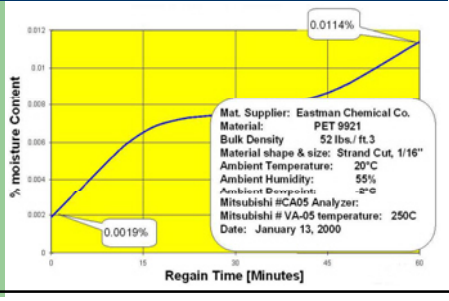


Carousel Dryer Air Flow Diagram

Desiccant Dryer Basics



Desiccant Dryer Basics



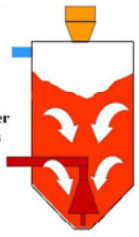
Additional Considerations

Drying Hopper Design

- Mass Material Flow
- Even air Distribution
- Material Heat retention

Additional Considerations

Funnel flow

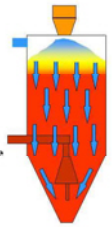


Funnel flow occurs when material flows faster through the center of the hopper than it does along the side wall.
Funnel flow results in a shorter drying time of the material flowing through the center of the hopper and a longer drying time of material along the hopper side walls.

Additional Considerations

Mass Flow

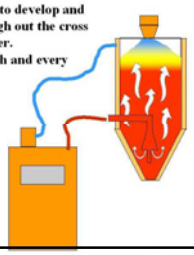
All material flows through the hopper at the same rate.
Mass flow provides equal drying time of all the material as it flows through the hopper.



Additional Considerations

Air Flow/Distribution:

Air volume must be high enough to develop and maintain even distribution through out the cross sectional area of the drying hopper.
The drying air must envelope each and every pellet within the hopper.

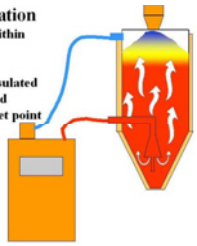


Additional Considerations

Insulated Hoppers:

Result in efficient operation

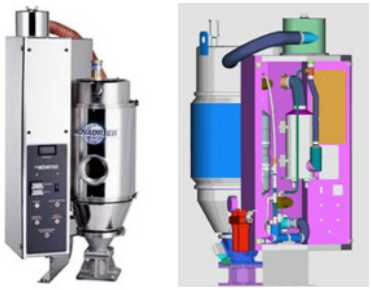
- Heat energy is contained within the drying hopper.
- Material adjacent to the insulated hopper walls is heated to and maintained at the selected set point temperature.



Compressed Air Dryers

- Desiccant free drying for most resins
- No moving parts – less maintenance
- Works with any compressed air source
- Limited suppliers – new technology
- Low throughputs – 150 to 200 PPH
- Suitable for hydroscopic additives

Compressed Air Dryers



Summary

- Hot air dryers for surface moisture/preheat
- Agitated hopper for crystallizing
- IR dryers in the near future
- Desiccant dryers for hygroscopic materials
- Consistent dew point, efficient regeneration
- Hopper design is critical
  - Mass flow - even heating
- Compressed air systems for low throughput

Suppliers

Company	Resin Drying Products	Location
The Conair Group	Hot Air and Dehumidifying Dryers and Crystallizers	Pittsburgh, PA
Foremost Machine Builders	Hot Air and Dehumidifying Dryers	Fairfield, New Jersey
Universal Dynamics	Hot Air and Dehumidifying Dryers and Crystallizers	Virginia
Process Control Corporation	Hot Air and Dehumidifying Dryers	Atlanta, Georgia
Kreyenborg GmbH	IR Drying Systems	Atlanta, GA/Germany
L-R Systems	Hot Air and Dehumidifying Dryers	New Lenox, IL
Maguire	Hot Air and Dehumidifying Dryers	Aston, PA
Novatec, Inc.	Hot Air and Dehumidifying Dryers and Crystallizers	Baltimore, MD
Thoreson McCosh	Hot Air and Dehumidifying Dryers	Troy, MI