PMMDA GUIDE TO DRYERS

Guide to DRYERS

Introduction
This document has been compiled by the PMMDA to provide plastics processors with a guide to material drying and a code of practice against which dryer specifications can be measured.

The need for drying
Many thermoplastics absorb moisture during manufacturing, transport and storage. During the melt, hydrolysis can occur resulting in substandard finished products in terms of both physical properties and surface appearance. Drying prior to processing removes absorbed moisture preventing the occurrence of hydrolysis.

Glossary of terms

Aftercooler	For high temperature drying, a heat exchanger on the return air reducing the air temperature to maximise desiccant efficiency.
Carousel Dryer	Multiple desiccant cells mounted on a rotating carousel cycling through process drying, regeneration and cool down.
Cool Down	Cooling of desiccant cell after regeneration to maximise drying efficiency.
Dehumidified Drying	Use of heated, low dew point air, causing moisture to diffuse outwards from within the pellet.
Desiccant	Medium within the drier which extracts moisture from the re-circulating process air.
Dewpoint	The temperature at which condensation of moisture begins
Equilibrium	The rate of diffusion of moisture into and out of the pellet are equal, the moisture level of the material remaining constant and in equilibrium with the surrounding atmosphere.
Hydrolysis	A chemical breakdown of the molecular structure of the polymer in the melt due to the presence of water and heat.
Hygroscopic	Materials which absorb moisture within the pellet (dehumidified drying recommended).
Initial Moisture Content	Moisture content by weight prior to drying.
Non-Hygroscopic	Material which take on surface moisture only.
Regeneration	Heating of desiccant cell to high temperature to drive off absorbed moisture.
Residence Time	Dwell time of material in the drying hopper required to ensure proper drying
Residual Moisture Content	Moisture content by weight after drying
Single Desiccant Fixed Bed Dryer	One desiccant cell cycled through process drying, regeneration and cooldown.
Twin Tower Flat Bed Dryer	Two desiccant cells alternated between process drying and regeneration/cooldown.

Moisture Content of Air

Dewpoint (°c)	PPM (parts per million)
-50	39.4
-44	80.1
-40	126.9
-36	197.8
-32	303
-30	374
-26	564
-20	1015
-16	1480
-10	2562
0	6020

Dryer - Units of Measurement

Material throughput	kg/hr
Airflow	M^3/hr
Temperature	°c
Process Air Blower	kW
Regeneration air blower	kW
Process heater internal	kW
Process heater external	kW
Regeneration heater	kW
Total connected load	kW
Average running load	kW
Compressed air consumption	L/min
Compressed air pressure	Bar
After-cooler water flow	L/min @ °c
Dimensions (L x W x H)	mm
Weight	kg

Dryer - Specification

Type of blower	Root, side channel or other
Desiccant system	Silica gel or molecular sieve
Desiccant system	Fixed bed or carousel
Number of desiccant cells	Number
Weight of desiccant per cell	kg
After cooler	Yes/no
Control system type	Define
Regeneration control	Fixed time, dew-point, other
Filter alarm	Yes/no
Energy saver	Yes/no

Hopper - Units of Measurement

Hopper Volume	L
Hopper Heater	KW
Dimensions	mm

Hopper - Specification

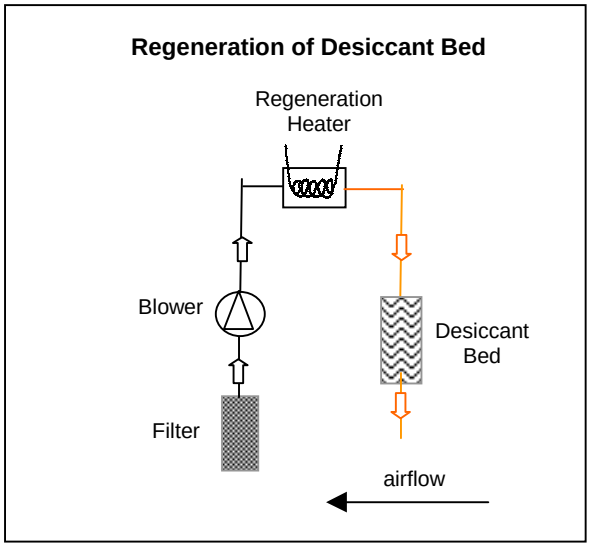
Construction (material contact points)	Mild steel, stainless steel, aluminium, G.R.P., others
Insulation	Yes / No
Insulation type	Define
Access Opening	Yes / No
Method of access	Define
Sight Glass	Yes / No
Mounting	Machine / Floor frame / Mobile
Drain Port	Yes / No
Material Shut-off	Yes / No
Material Shut-off Operation	Manual or automatic
Interconnecting Pipework Construction	Define
Delivery air pipework insulation	Yes / NO P

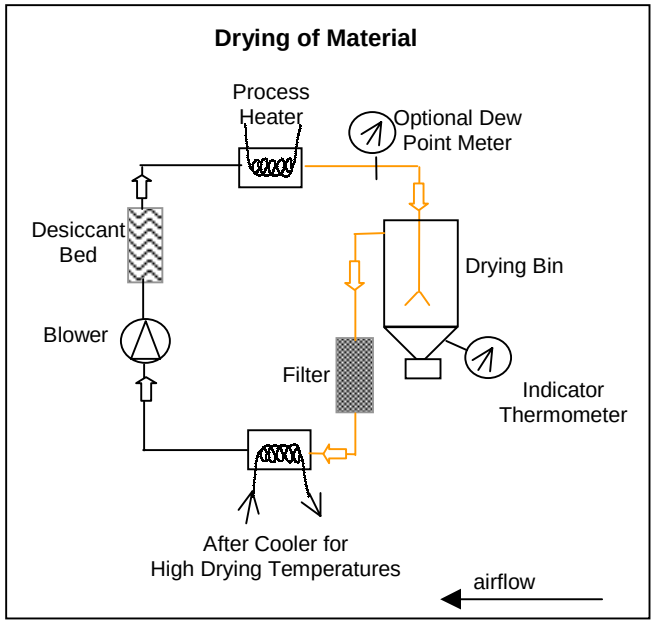
PMMDA Material Drying Parameter Guidelines

Material	Drying Temp (°c)	Bulk Density (kg/L)	Residence Time (hr)	Initial Moisture Content (%)	Residual Moisture Content (%)	Airflow Requ. (Nm3/kg/hr)
ABS	80	0.6	2-3	0.2	0.02	1.3 - 1.7
CA	75	0.5	2-3	1.0	0.02	1.8 - 2.5
CAB	75	0.5	2-3	0.8	0.02	2.2 - 2.5
CP	75	0.6	2-3	1.0	0.02	2.1 - 2.5
LCP	150	0.6	4	0.04	0.02	1.3
PA	70-80	0.65	3-6	1.0	0.05	1.7 - 2.2
PBT	120-140	0.7	4	0.3	0.02	1.3 - 1.7
PC	120	0.7	2-3	0.3	0.01	1.3
PE	90**	0.6	1	>0.01	>0.01	1.3 - 1.7
PE (40% black)	90	0.6	3	0.8	0.02	2.2 - 2.4
PEEK	150	0.6	3-4	0.4	0.02	1.3 - 1.7
PEI	150	0.6	3-4	0.25	0.02	1.3
PEN	170	0.85	5	0.01	0.005	1.7 - 2.5
PES	150-180*	0.7	4	0.8	0.02	1.4 - 1.7
PET (inj)	110-120	0.85	3-4	0.04	0.02	1.2
PET (preform/Extrusion)	160-180	0.85	6	0.08	0.005	1.7 - 2.5
PETG	60-70	0.6	4-6	0.5	0.02	1.7
PI	120-140	0.6	3	0.4	0.02	1.1 - 1.3
PMMA	70-100	0.65	3	0.5	0.02-	1.4 - 1.7
POM	95-110	0.6	3	0.2	0.02	1.2 - 1.7
PP	90	0.5	1	>0.01	0.02-	1.3 - 1.7
PPO	110-125	0.5	2	0.13	0.04	1.3 - 1.5
PPS	140-150	0.6	3-4	0.1	0.02	1.3
PS	80**	0.5	1	>0.01	0.02	1.1 - 1.3
PSU	120-170*	0.65	4	0.3	0.02	1.3 - 1.4
PUR	89-90	0.7	3	0.2	0.02	1.8 - 2.0
PVC	70**	0.5	1	0.1	0.02	1.1 - 1.5
SAN	80	0.5	2-3	0.1	0.05	1.2 - 1.5
SB	80	0.6	2	0.2	0.05	1.2 - 1.5
TPE	105	0.7	3	0.1	0.02	2.1

* Higher temperatures are for extrusion grades
** Surface moisture removal

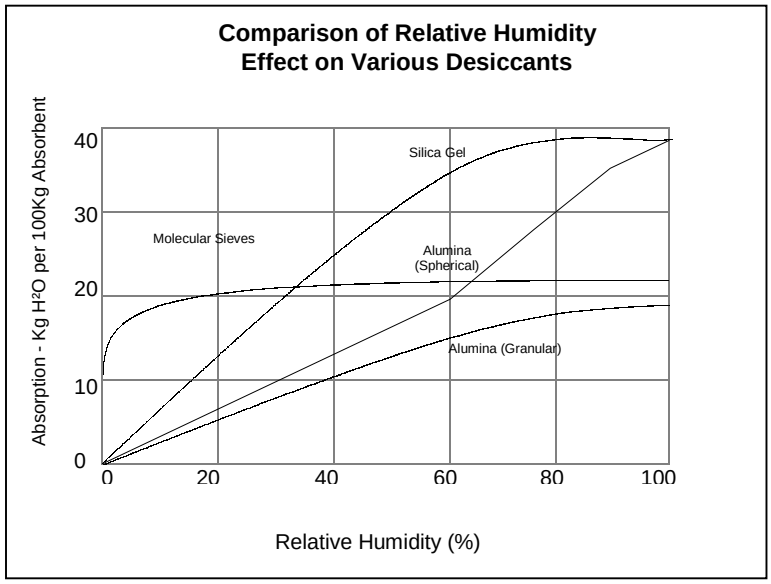
NB: PMMDA Guidelines only. Consult material supplier for details.





Molecular Seive vs. Silica Gel Desiccant

Heating of air produces a reduction in it's relative humidity. Low dew-point desiccant dryers provide far lower moisture contents than heated air alone. The accompanying graph illustrates the greater affinity for moisture of molecular sieve over silica gel or other types of desiccants at extremely low relative humidities,



Dehumidified Drying

Sizing	Material throughput (kg/hr) x air flow requirement (Nm³/kg/hr) = Dryer air flow required (m³/hr)
	Material throughput (kg/hr) x residence time (hr) : bulk density (kg/l) = Minimum hopper size required (L)
Drying Hints	Over drying may lead to material degradation and processing problems
	Pre-dry for stipulated residence time prior to processing
	If material is stored in outdoor silos, consider conveying to indoor day bin prior to drying.
	Poor filter maintenance is a common cause of reduced drying performance.

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