APPLICATION NOTE

Powder Coatings and Particle Size Measurement

Background

Powder coatings—substances that are protective, decorative, or both—are formed by the application of a coating powder to a substrate and fusing the coating into a continuous film by the application of heat or radiant energy. Coating powders are finely divided particles of organic polymer that generally contain pigments, fillers, and additives that remain finely divided during storage under suitable conditions. In contrast to liquid coatings, which may contain volatile organic solvents, powder coatings can achieve the same or better characteristics of quality, durability, and corrosion resistance. Production costs are lower than those for liquid coatings, because powder coating is a highly efficient process that requires less energy and labor. Since powder coatings have no volatile organic solvents, an attractive benefit is elimination of organic solvent emissions and reduced waste disposal.

There are several advantages to using powder coatings compared to liquid coatings:

- Special effect coatings are more easily accommodated
- Horizontally and vertically coated surfaces are more similar
- Near zero Volatile Organic
- Compounds (VOC) and less hazardous waste
- Thicker coatings for better protection and less running
- Overspray can be recycled

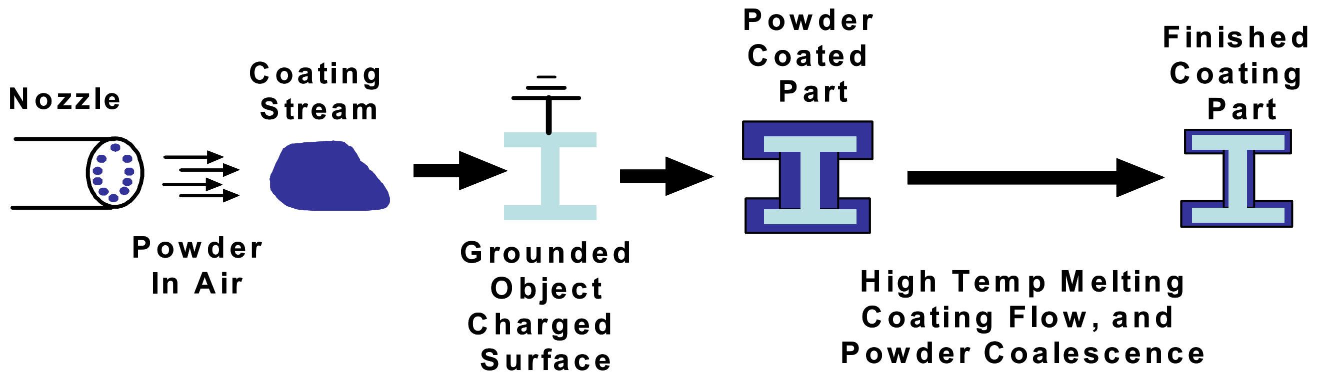
The performance of a powder coating is influenced by a variety of factors. Powder particle size can have a major influence on many properties, including handling, charging, delivery, and coating characteristics. The formulations may vary depending on application requirements of thickness, object shape, and ambient conditions. Thermoset powder coatings react with other compounds in the coating during baking of the finished object. This increases performance. Thermoplastic powder coatings do not contain additional chemicals but are coated directly as a final coating.

The Process

The powder coating process begins with application of a negative charge to the surface of an object, usually by an electrical ground. The powder coating is given a charge opposite to that applied to the object, then directed in an air stream under pressure toward the object. When the powder particle is sufficiently close to the charged object, electrostatic attraction dominates and promotes attachment of the powder to the item. Initial handling, recovery, and recycling of the powder can cause an increase of fines, which, during normal processing, can deposit in pumps or nozzles. Under application pressure these deposits can cause uneven delivery, resulting in uneven or blotchy films. Production and deposition of fines, resulting from particle attrition due to high pressure in the process, can eventually cause the process to shut down completely.

The amount of fines also can affect the overall charge profile of the powder, since fines can be charged more efficiently. If sufficient fines are absent, wraparound can be diminished because fines are more easily influenced by an electrostatic field. Coarse particles have greater mass, and therefore a lower charge/mass ratio; this causes reduced efficiency in tracing the applied electrical field around the object. Incomplete and marginal coating may result. The fines have a higher charge/mass ratio; this results in a thinner film thickness because coating build-up is limited to the electrical field, which diminishes as film thickness increases.

Powder coating manufacture involves several steps including mixing, extrusion, cooling, kibbling (breaking the extruded mass into chips), grinding, classification, sieving, homogenization, and blending. Pin mills are usually used for grinding which by its operation allows for some classification where small particles being produced exit the mill and larger particles are retained until smaller size is attained.



The Problem

As noted above, particle size strongly influences film thickness because fines produce thin initial powder coats and coarse particles produce thick initial powder coats. As a result, the heated coats melt at different rates, decreasing the smoothness of the final coating. This is generally known as "orange peel" in all coatings industries. Orange peel can also be related to the electrostatic process or rheological factors of the powder, both of which are highly dependent upon particle size.

The Solution

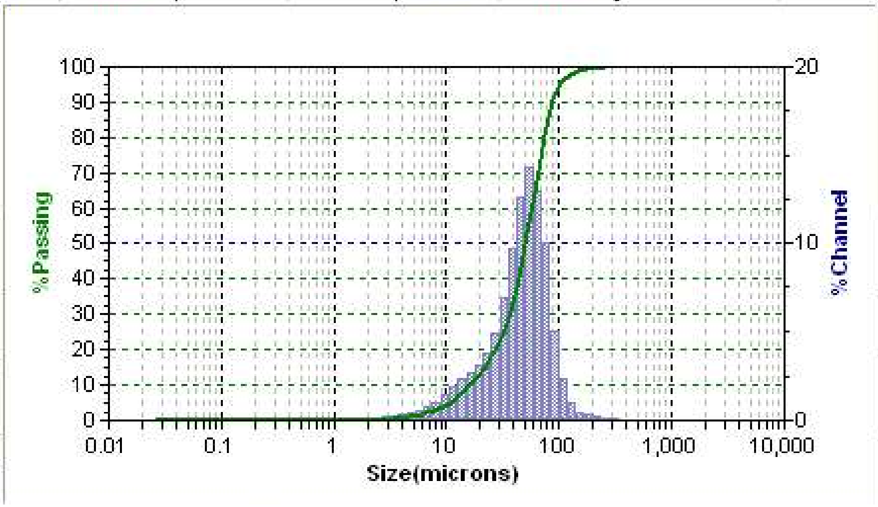
It is evident that the importance of particle size to powder processing should not be underestimated. Microtrac MRB particle size analyzers can measure powder coatings in the dry state. Generally, the powder coatings are smaller than 250 microns (60 mesh, U.S.). The Turbotrac dry feeder with the Microtrac MRB S3500 will provide data over the range 0.2 to 2000 microns within 30 seconds with a Standard Operating Procedure (SOP).

The advantage of dry measurement of the coatings is that the material is used as a dry powder. However, low-energy dry-dispersion systems must be used to avoid potential further milling, thus biasing the reported particle size to fine sizes. This could lead to inadvertent mill changes or recycling of recovered powder. Turbotrac's adjustable dispersion energy, avoids disruption/milling of powder during the measurement. Equally important is the potential for segregation of powder during movement of the powder. The Turbotrac avoids measurement segregation by eliminating vibrational movement of the powder to the laser. Powder coating is transferred to a sample trough. The particle size measurement of the sample is performed by an aspiration tube that moves along the trough and conveys sample to the Microtrac sensing region. Since the aspiration tube moves toward the sample and not vice versa, segregation effects are avoided, and thus more accurate particle size is provided.

- Summary -		- Size % -		- Percentiles -	
Data	Value	Size(um)	%Tile	%Tile	Size(um)
MV(um):	53.03	10.00	4.33	10.00	16.26
MN(um):	5.73	20.00	13.38	20.00	27.33
MA(um):	31.82	100.0	94.44	30.00	36.44
CS:	1.89E-01	200.0	99.52	40.00	43.72
SD:	27.67	250.0	99.76	50.00	50.34
		300.0	99.93	60.00	56.94
Mz:	50.53			70.00	64.35
σι:	27.76			80.00	73.69
Ski:	0.0752			90.00	87.29
Kg:	1.032			95.00	102.7

- Peaks Summary -		
Dia(um)	Vol%	Width
50.34	100.0	55.33

UDef Name	UDef Data



Dry Powder Coating measured using Microtrac S3500 with Turbotrac

Microtrac MRB S3500 with Turbotrac

Microtrac MRB's Laser Diffraction analyzers employ a patented Modified Mie Theory for calculating particle size distributions. This algorithm provides:

1. Correction that compensates for the reflection from spherical particles which eliminates false fines modes and
2. Compensation for non-spherical particles, which standard Mie Theory can't handle, because it was developed for only spherical particles.

In our three-laser product line there are also options for choosing 3 red or 1 red and 2 blue lasers for more accurate sizing at the very bottom end of the range.

Microtrac FLEX software contains all necessary features to allow further data analysis as desired. In addition, data can be exported automatically to LIMS, LAN systems as well as other standard programs such as Microsoft Excel.

Production under ISO 9001 certification assures customers of unsurpassed consistency and quality of all components. Expert knowledge since 1976, first Laser Diffraction analyzer commercialized. and 35 years of laser diffraction experience in all facets of particle size, electronics, and computer technology assure our customers of the best possible technical support and customer values.

Capabilities

- Dry feeder, Turbotrac, avoids segregation and flowability issues of vibratory feeders.
- Effective with narrow and broad distributions.
- Modular design provides small footprint.
- Simplicity of operation.
- Patented Modified Mie Theory.