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Particle Sizes of Milk Powders Part I

First of a 2 Part Series
Part I - Particle Size in Milk Powder and Its Importance
Part II - Particle Size - Methods of Measurement

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Particle Size in Milk Powder

Particle size is an important physical property of milk powder and can relate to its appearance, reconstitution and flow characteristics. A milk powder particle generally consists of a continuous mass of amorphous lactose and other components in which fat globules, casein micelles, and serum proteins are embedded. The particles also contain vacuoles of occluded air where particle surfaces are not in contact. The surface of spray-dried particles is usually smooth but also may be wrinkled. Conditions such as higher inlet air temperature and larger temperature differences between the hot air and powder particles may contribute to wrinkles (1).

The presence of particles of different morphology in the same sample can be attributed to the different drying conditions to which the individual particles were exposed. Particle size can be influenced by the milk characteristics, processing conditions and the type of equipment used in the drying process. For example, a higher total solids in the condensed milk causes a larger particle size while a low concentrate viscosity reduces particle size. Atomization parameters influence product shape and size distribution of powder particles making it possible to control powder particle size. A spray-dried particle using centrifugal atomization will give a larger particle than the pressure nozzle atomization (2).

Spray-dried powder particles usually are spherical with diameters in the range of 10-250 µm. Rapid dispersion requires a particle size of approximately 150-200 µm diameter. The particles in agglomerated milk powder are larger, irregular in shape and contain very few separate small particles. Agglomeration causes an increase in the amount of air incorporated between the powder particle. The air is replaced by water during reconstitution. Hence, the agglomerates are readily dispersed and dissolve quickly (1).

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The following table shows particle size distribution of spray dried milk powder:

Type of dryer	% of Particles				
	0-60µm	60-120µm	120-180µm	180-240µm	over 240µm
Pressure atomization	12.1	44.8	24.1	12.8	6.7
Centrifugal atomization	2.0	31.2	24.0	18.6	24.0

Source: Drying of Milk and Milk Powders, 1971

Importance of Particle Size in Milk Powder

Milk powder quality can be greatly affected by particle size and is of critical importance when evaluating quality standards in milk powder. The size of the milk powder particles that are used in manufacturing of various food products can influence certain characteristics of the end product such as taste and how well particles go into solution. Understanding and controlling particle size distribution in the raw material can be critical to the success of today's manufacturing process.

Particle size in milk powder can affect powder reconstitution properties. Difference in particle size can lead to stratification of the powder with the higher solids concentrated at the top which will affect reconstitution of the dry product. Wettability and dispersibility of milk powder can also be influenced by particle size. Small particle size and symmetrical shape enhance close packing of particles and thus inhibit penetration of water. Larger particles more irregular in shape provide more space in the interstices for wetting. Generally large particles of dry milks exhibit good dispersibility. Dispersibility decreases as percentage of fine particles below 90 µm increases (2). Flowability also depends on particle size and shape. Large particles tend to flow more easily than smaller particles. Shape and size of the particles will affect the closeness of the particle pack, which in turn will affect the powder bulk density.

References:

1) Caric, M. 1994. "Concentrated and Dried Dairy Products". VCH Publishers, New York.
2) Singh, H. and Newstead, 1992. Aspects of proteins in Milk Powder Manufacture. Chapter in "Advanced Dairy Chemistry," ed. P.F. Fox, pp. 735-765. Elsevier Applied Science, New York.

Part II, Particle Size - Methods of Measurement, will follow next month

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Part II, Particle Size - Methods of

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