

TABLETING →
DIRECT COMPRESSION →
AGGLOMERATED LACTOSE

Technical brochure
Tablettose®

MEGGLE's agglomerated lactose grades for direct compression: Tablettose®

General information

Direct compression (DC) tablet manufacture is a popular choice because it provides the least complex, most cost effective process to produce tablets compared to other tablet manufacturing approaches. Manufacturers can blend APIs with excipients and compress, making dosage forms simple to produce [1, 2].

DC technology and the use of modern tableting equipment require that excipients and APIs form a compactible mixture with excellent flowability and low particle segregation tendency [3].

In the pharmaceutical industry, lactose is one of the most commonly used excipients; however, like many other excipients, lactose may not be suitable for direct compression without modification due to insufficient powder flow or/and compaction properties (figure 1).

The brittle alpha-lactose monohydrate compactibility is strongly dependent on the powder surface area before compaction and the fragmentation produced during the compaction event. The binding capacity increases with increasing powder surface area, suggesting that the smaller the lactose particles become, the more compactibility improves. While the small particles offer relatively good dry binding properties, poor flowability makes milled alpha-lactose monohydrate unsuitable for direct compression. Coarser particle size alpha-lactose monohydrate

sieve fractions show good flow properties, but very poor compressibility [4].

For these reasons, MEGGLE developed directly compressible, agglomerated alpha-lactose monohydrate in the mid 1970s, combining the good flowability of coarse lactose and good compactibility of fine milled lactose. The product is marketed as the brand name Tablettose®. Tablettose® is manufactured by a continuous spray agglomeration process. Water is used as the binder and is sprayed onto fluidized fine milled lactose particles, creating liquid bridges to form agglomerated lactose. The added water is later evaporated and the liquid bridges are maintained. With this process, no amorphous lactose is produced, resulting in a very stable, non-hygroscopic, pure alpha-lactose monohydrate powder.

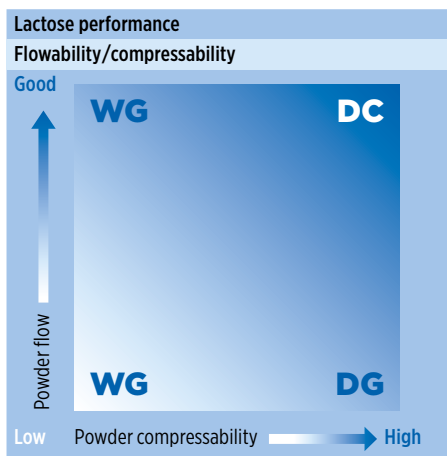
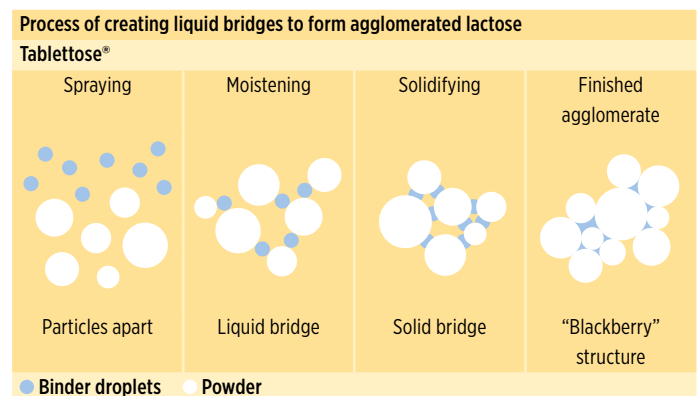


Figure 1: Powder blend compressibility and flowability requirements for various tableting technologies (DC is direct compression, WG is wet granulation, DG is dry granulation) [3].





Product description

MEGGLE's Tablettose® 80 was the first available agglomerated alpha-lactose monohydrate of its kind. Its agglomerates possess a size ranging from 0–630 µm. Tablettose® 80 is suitable for most low dosage formulations. Tablettose® 70 is manufactured using identical starting material; however, the particle size distribution is narrower. The content of fines smaller than 63 µm is reduced significantly and there are no particles larger than 500 µm, making Tablettose® 70 the excipient of choice for narrow particle size distribution and dust free production.

Tablettose® 100 is produced from a smaller starting particle size than the material used for Tablettose® 80 and Tablettose® 70. As a result, Tablettose® 100 has a higher dilution potential compared to Tablettose® 70 and Tablettose® 80 due to increased compactibility.

Regulatory & quality information

Tablettose® 70, Tablettose® 80, and Tablettose® 100 are MEGGLE's trade names for agglomerated alpha-lactose monohydrate and comply with the current harmonized Ph. Eur., USP-NF, and JP monographs. Specifications and regulatory documents can be downloaded from www.meggle-excipients.com.

Our pharma-dedicated production facility in Wasserburg, Germany is certified according to DIN ISO 9001:2015 and has implemented GMP according to the Joint IPEC-PQG (Good Manufacturing Practices Guide for Pharmaceutical Excipients) and USP-NF General Chapter <1078>. GOOD MANUFACTURING PRACTICES FOR BULK PHARMACEUTICAL EXCIPIENTS. MEGGLE has been an EXCiPACT™-certified excipient manufacturer and supplier since 2014.

The Wasserburg facility demonstrates MEGGLE's complete lactose production capability range, including sieving, milling, agglomeration, spray-drying, and co-processing. Additionally MEGGLE is a member of IPEC (International Pharmaceutical Excipients Council).

MEGGLE invests considerably in the sustainability of raw material sourcing, production standards, and efficiency. We are actively engaged in environmental protection. In order to guarantee the quality of our products, our commitment and adherence to established pharmaceutical standards remains our highest priority.

Application

Tablettose® was developed especially for direct compression processes. The following chart provides recommended areas of application.

- Direct compression
- Continuous applications
- Capsule and sachet filling
- Effervescent tablets
- Artificial sweetener tablets

BENEFITS

Tablettose®

- Low hygroscopicity
- Excellent stability
- Superior blending characteristics
- Good flowability
- Good compactibility
- Low moisture content
- Fast disintegration times

Particle size distribution (PSD)

Figure 2 shows typical particle size distribution data (obtained by laser diffraction) for MEGGLE's agglomerated lactose grades Tablettose®. Tablettose® 80 and Tablettose® 100 exhibit similar particle size distributions. Comparatively, Tablettose® 70 demonstrates a narrower particle size distribution due to fewer fines.

Figure 3 depicts the specified PSD range and typical average values by mechanical sieve shaker. These parameters are constantly monitored through in-process control (IPC) testing and are part of Tablettose®'s particle size distribution specification.

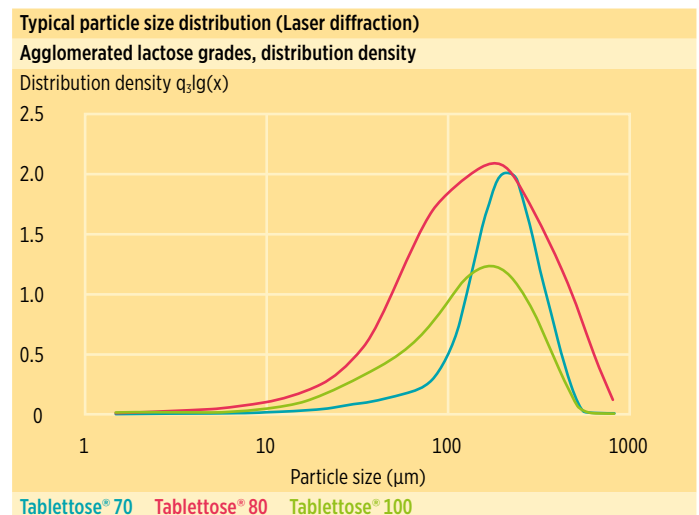
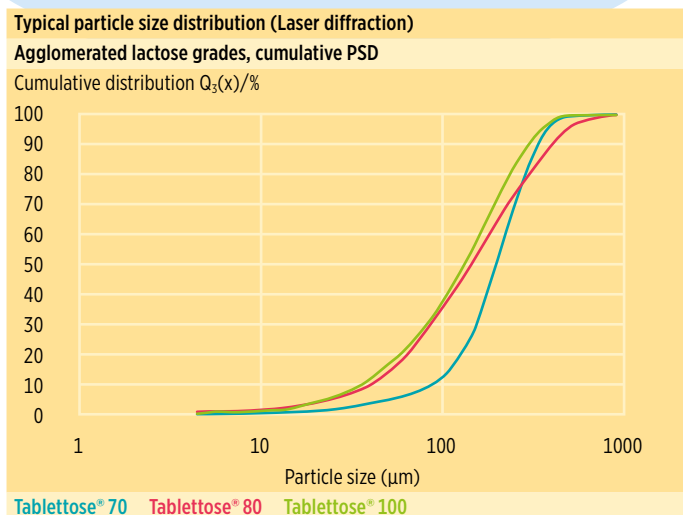


Figure 2: Typical cumulative PSD and distribution density of MEGGLE's Tablettose® 70, Tablettose® 80, and Tablettose® 100. Analyzed by Sympatec®/Helos & Rodos particle size analyzer.

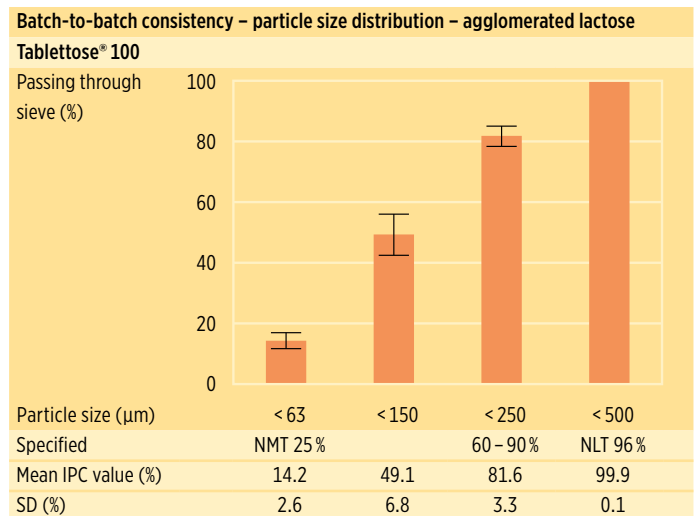
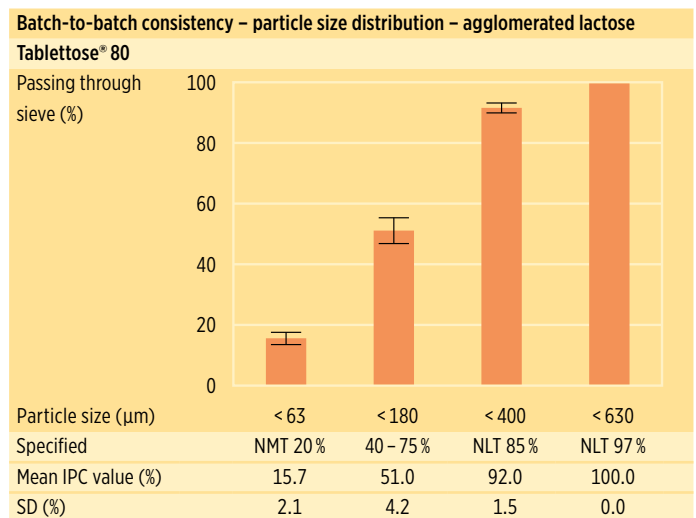
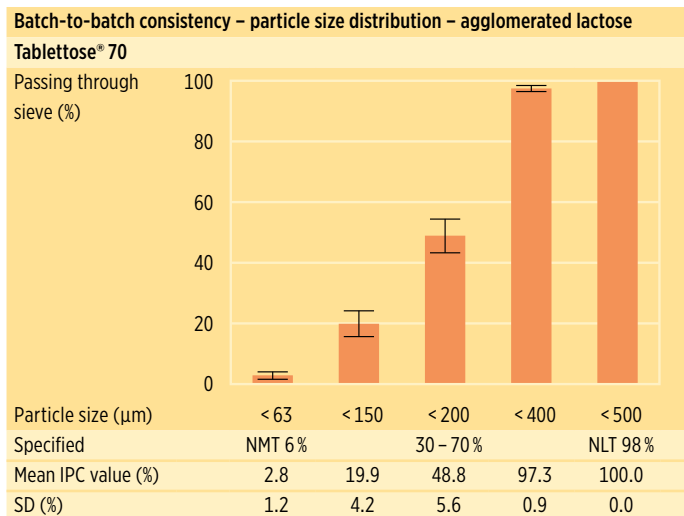
Figure 3: Specified PSDs for MEGGLE's agglomerated lactose grades by mechanical sieve shaker in bold letters. Typical values obtained from a permanent in-process control are shown for information only.

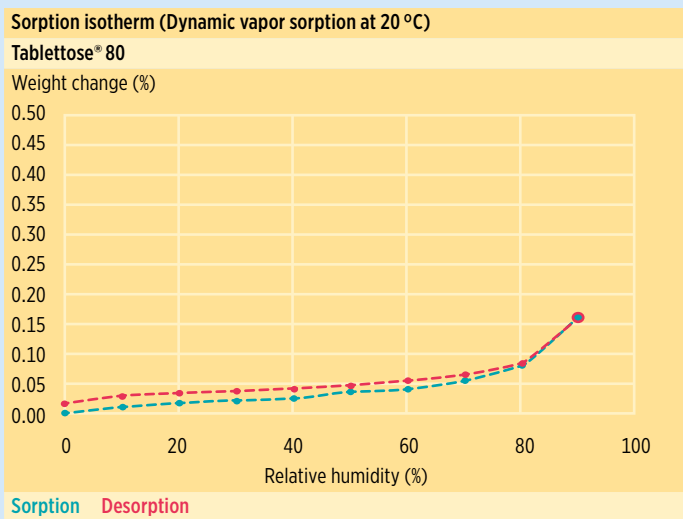
Sieve data – agglomerated lactose				
	Lactose type	Tablettose® 70	Tablettose® 80	Tablettose® 100
		specified/typical	specified/typical	specified/typical
Particle size distribution	< 63 μm	NMT 6%/ 3%	NMT 20%/ 16%	NMT 25%/ 14%
Method:	< 150 μm	/ 20%		/ 49%
Mechanical sieve shaker	< 180 μm		40–75%/ 51%	
	< 200 μm	30–70%/ 49%		
	< 250 μm			60–90%/ 82%
	< 400 μm	/ 97%	NLT 85%/ 92%	
	< 500 μm	NLT 98%/100%		NLT 96%/100%
	< 630 μm		NLT 97%/100%	

Batch-to-batch consistency

Batch-to-batch consistency for all lactose products can be attributed to MEGGLE's long history and experience in lactose manufacture, and broad technical expertise. Constant in-process and final product testing ensures consistency and quality (**figure 4**).

Figure 4: Particle size distribution batch-to-batch consistency of *Tablettose®* by mechanical sieve shaker. Data obtained from a permanent in-process control (IPC) of subsequent batches over 12 months.





Isotherms

MEGGLE's agglomerated lactose products do not adsorb significant amounts of water below 80% relative humidity (20 °C). **Figure 5** shows sorption and desorption isotherm for Tablettose® 80.

Figure 5: Sorption-desorption isotherms (20 °C) of Tablettose® 80. Analysis performed by SPSx-1µ moisture sorption test system.



Figure 6: SEM images of MEGGLE's Tablettose® by ZEISS Ultra55 FESEM (U=5 kV; Au/Pd sputtered).

Scanning electron micrograph (SEM)

Tablettose® agglomerates typically have a rough, structured surface, which can be seen in **figure 6**. Due its characteristic shape, Tablettose® provides stable, homogenous mixtures with other excipients and APIs.

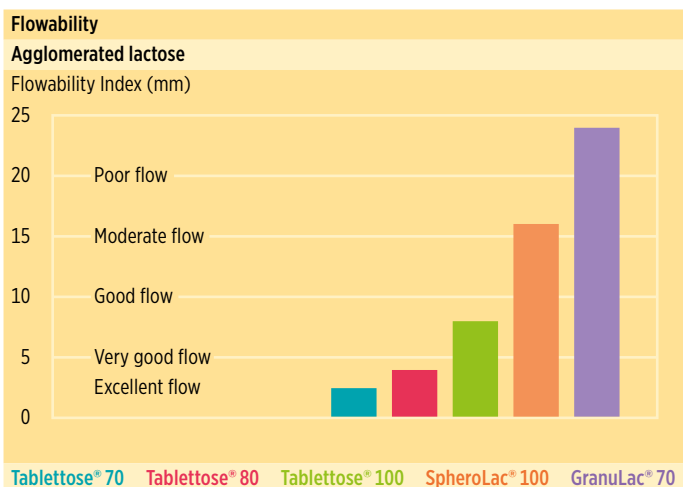


Figure 7: Flowability index of Tablettose® grades compared to unmodified lactose grades.

Functional related characteristics

Powder flow

It is well known that particle size and shape influence powder flowability. Particles less than 100 µm tend to be more cohesive and less freely flowing, whereas larger, denser particles tend to be more freely flowing. Particle morphology also significantly affects powder flow characteristics. **Figure 7** demonstrates that particle shape and structure are as important as particle size distribution for powder flowability. Due to its “blackberry” or “popcorn” structure, agglomerated lactose has a nearly spherical shape, resulting in a lower flowability index (powder through an orifice) compared to sieved (SpheroLac®100) or milled (GranuLac® 70) lactose.

Flowability can also be described by the Hausner ratio, Carr's index, or angle of repose. A Hausner ratio below 1.25 or Carr's index below 20 indicates that powders are freely flowing. Angle of repose describes "good flowability" between 31–35°, and in general, worsens with steeper angles. **Figure 8** shows typical flowability indices for *Tablettose*® grades, indicating the very good flowability possessed by agglomerated lactose.

Flowability					
Agglomerated lactose					
	Angle of repose (°)	Density bulk (g/l)	Density tapped (g/l)	Hausner ratio	Carr's index (%)
<i>Tablettose</i> ® 70	31	530	640	1.21	17
<i>Tablettose</i> ® 80	34	620	770	1.24	19
<i>Tablettose</i> ® 100	32	580	720	1.24	19

Figure 8: Typical powder technological flowability values for *Tablettose*® grades. Pharmacopoeial methods were deployed.

Powder compressibility

Figure 9 shows that tablets made with *Tablettose*® 70 and *Tablettose*® 80 possess similar compaction profiles. *Tablettose*® 100 exhibits increased compactibility as shown by harder tablets over the same compaction force range. This is due to the finer initial particle size, which increases the material's binding capacity.

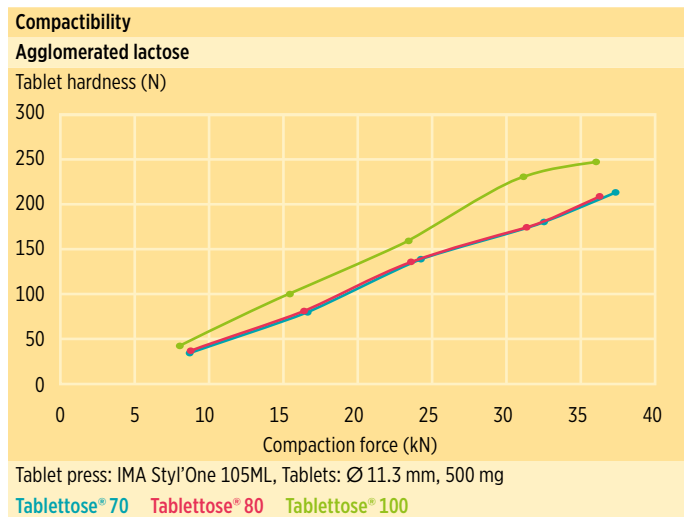


Figure 9: Compaction force – tablet hardness profile of *Tablettose*® grades.

Packaging and shelf life

Packaging material complies with Regulation (EC) No.1935/2004 and 21 CFR 174, 175, 176, 177 and 178. Stability tests have been performed according to ICH guidelines and an ongoing stability program is implemented. **Figure 10** provides an overview about packaging size and material, and product shelf life.

Packaging and shelf life			
<i>Tablettose</i> ®			
	Size	Material	Shelf life
<i>Tablettose</i> ® 70	20 kg	Paper bag with PE-EVOH-PE inliner	36 Months
<i>Tablettose</i> ® 80	25 kg		24 Months
<i>Tablettose</i> ® 100	25 kg		

Figure 10: Packaging and shelf life of MEGGLE's agglomerated lactose grades.



Literature

- [1] Meeus, L. (2011). Direct Compression versus Granulation. *Pharmaceutical Technology*, 23(3).
- [2] Kristensen, H. G., Schaefer, T. (1987). Granulation: A Review on Pharmaceutical Wet-Granulation. *Drug Development and Industrial Pharmacy*, 13(4-5), 803-872.
- [3] Miinea, L. A., Mehta, R., Kallam, M., Farina, J. A., Deorkar, N. (2011). Evaluation and Characteristics of a New Direct Compression Performance Excipient, 35(3).
- [4] Bolhuis, G. K., Zuurman, K. (1995). Tableting Properties of Experimental and Commercially Available Lactose Granulations for Direct Compression. *Drug Development and Industrial Pharmacy*, 21(18), 2057-2071.

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