

Task:**Application field:** Electronics**Material:** LiMn₂O₄ und LiMnPO₄**Feed size:** 0.09 mm**Feed quantity:** 4 g**Material specification(s):** dry, hard brittle**Customer requirements(s):** 1 µm**Subsequent analysis:** not defined**Solution****Selected Instrument(s):** High Energy Ball Mill E_{max}
Vibratory Sieve Shaker AS 200 basic

Configuration(s)

Item nos.:

- 1 x High Energy Ball Mill Emax 200-230 V, 50/60 Hz
- 2 x Grinding jar Emax, zirconium oxide, 50 ml
- 1 x Grinding balls, zirconium oxide, Ø 0.1 mm, 500 g, approx. 135 ml
- 1 x Grinding balls, zirconium oxide, Ø 0.5 mm, 500 g, approx. 135 ml optional
- 1 x AS 200 basic, 230 V, 50 Hz
- 1 x Clamping device "comfort" for test sieves 200/203 mm ø
- 1 x Collecting pan stainless steel, ø 200x50 mm
- 1 x Test Sieve, ISO 3310/1, 200x50mm, 75µm, stainless steel, with compliance certificate acc. EN 10204 2.1
- 1 x Test Sieve, ISO 3310/1, 200x50mm, 355µm, stainless steel, with compliance certificate acc. EN 10204 2.1

Please note: Other electrical versions of the instrument(s) are available with different item numbers.

Parameter(s): Revolution speed 2000 rpm

Time:

pre-grinding 10 min

fine grinding 210 min

Achieved result(s):

d90 after 30 min fine grinding with 0.1 mm balls = 4.79 µm

d90 after 60 min fine grinding with 0.1 mm balls = 2.84 µm

d90 after 150 min fine grinding with 0.1 mm balls = 1.50 µm

d90 after 210 min fine grinding with 0.1 mm balls = 1.32 µm

Remark(s):

Grinding was done in 50 ml jar zirconium and 110 g grinding balls 0.5 mm at 2000 rpm. Ca 4 g sample (as well, filling with ca 17 ml sample would be better to prevent wear out) were mixed with the grinding balls and ethanol was added until a consistency of motor oil was achieved. Since the size of the starting material was more than $D_{100}=30\text{ }\mu\text{m}$, the sample had to be pre-milled using 0.5 mm grinding balls (balls have to be 3 x times bigger than initial particles). After 10 min, the size was reduced to $D_{100} < 20\text{ }\mu\text{m}$, so that the sample material could be separated from the 0.5 mm grinding balls.

Here, the Sieving Machine AS 200 with a $355\text{ }\mu\text{m}$ sieve and a collection pan was used. The sample was given on the sieve and sieving was done for 1 min. Then some more ethanol was used to wash out more sample from the grinding balls (several times, each with 1 min sieving).

The sample was added to the grinding jar containing 110 g of 0.1 mm grinding balls zirconium. It is important to adjust the consistency with ethanol (like motor oil). The mixture must not be too thin, since this will decrease grinding efficiency. On the other hand, if the viscosity is too high, no grinding can take place either. For unknown samples, it should be proven after ca. 5 min of grinding, if the viscosity is still ok, or if more liquid has to be added.

Fine grinding was performed at 2000 rpm for 210 min. After 210 min, only hardly further decrease of the sample was seen.

Recommendation:

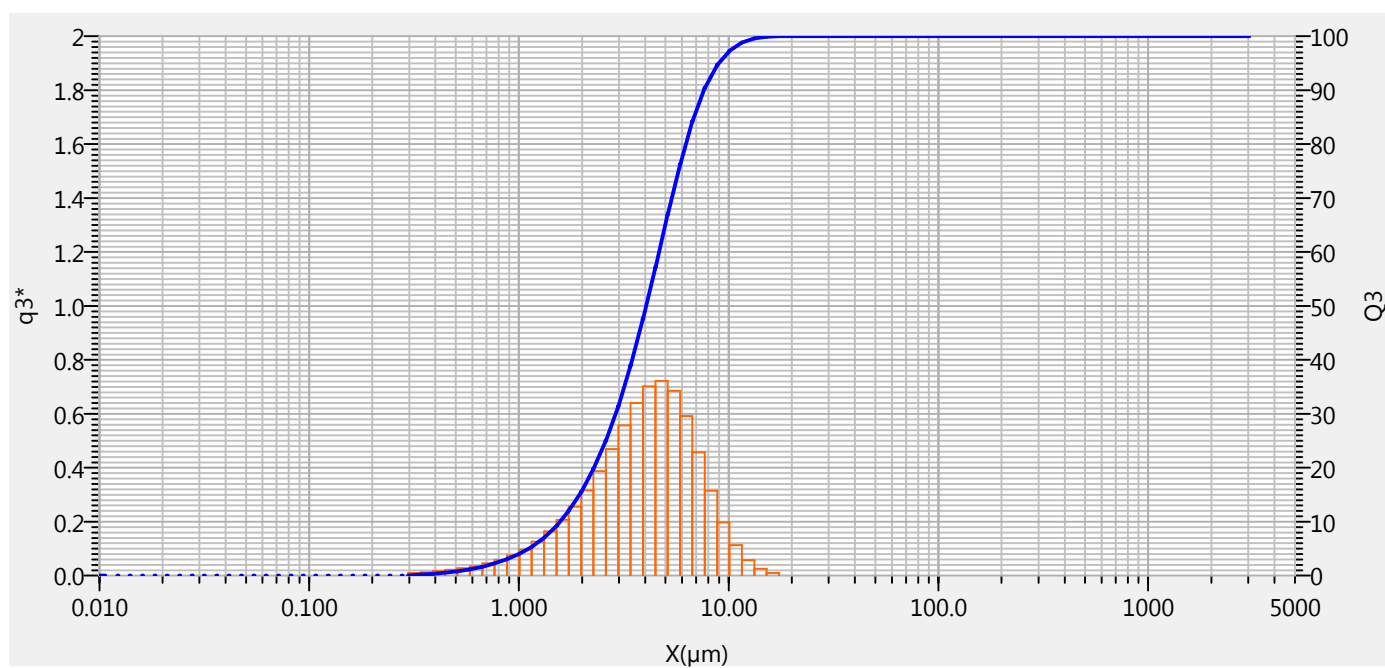
The High Energy Ball Mill Emax is suitable to grind the sample material under the above mentioned conditions.

Laser Scattering Particle Size Distribution Analyzer Partica LA-960

HORIBA LA960 for windows [Nass] Ver2.20

ID# : 201504201333547
 Bezeichnung : emax 10 min 0.5 mm balls
 Transmission (R) : 97.2 (%)
 Transmission (B) : 93.6 (%)
 Ultraschall : 00:18 (7)
 Zirkulationsgeschwindigkeit : 6
 Rührgeschwindigkeit : 6
 Art der Verteilung : Volumen
 Source :
 Datenaufnahme Probe (LD) : 15000
 Datenaufnahme Probe (LED) : 15000

Median : 4.04391(μm)
 Durchschnittswert : 4.40669(μm)
 x(Q)-Wert : (2)10.00 (%) - 1.5704(μm)
 : (5)50.00 (%) - 4.0439(μm)
 : (9)90.00 (%) - 7.6397(μm)

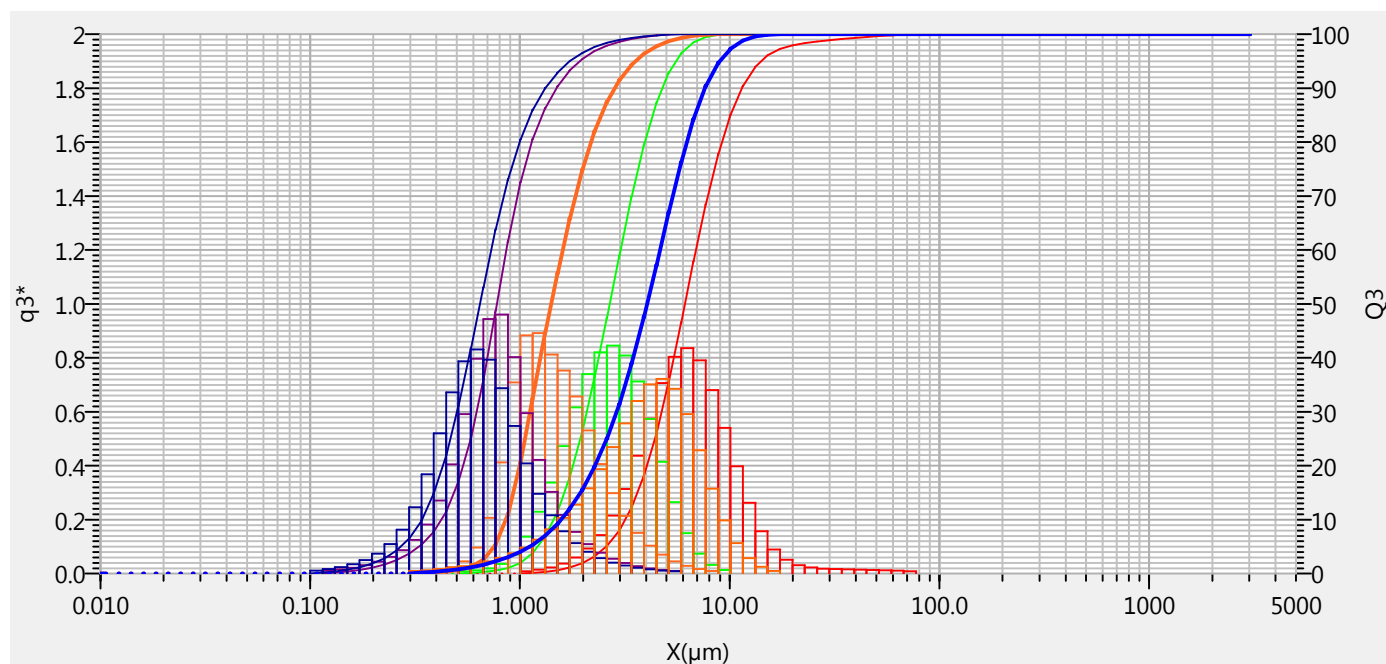


Laser Scattering Particle Size Distribution Analyzer Partica LA-960

HORIBA LA960 for windows [Nass] Ver2.20

ID# : 201504221143895
 Bezeichnung : emax 10 and 210 min 0.1 mm balls
 Transmission (R) : 96.5 (%)
 Transmission (B) : 89.7 (%)
 Ultraschall : 00:44 (7)
 Zirkulationsgeschwindigkeit : 8
 Rührgeschwindigkeit : 8
 Art der Verteilung : Volumen
 Quelle :
 Datenaufnahme Probe (LD) : 20000
 Datenaufnahme Probe (LED) : 20000

Median : 0.64588(μm)
 Durchschnittswert : 0.78031(μm)
 x(Q)-Wert : (2)10.00 (%) - 0.3412(μm)
 : (6)50.00 (%) - 0.6459(μm)
 : (8)90.00 (%) - 1.3227(μm)



Bezeichnung	Darstellung	D(v,0.1)	D(v,0.5)	D(v,0.9)	Standardabw.
emax 5 min 0.5 mm balls		3.17746(μm)	6.12723(μm)	11.45958(μm)	5.7463(μm)
emax 10 and 30 min 0.1 mm balls		1.44653(μm)	2.68145(μm)	4.78532(μm)	1.3592(μm)
emax 10 and 60 0.1 mm balls		0.85873(μm)	1.40992(μm)	2.83940(μm)	0.9677(μm)
emax 10 and 150 min 0.1 mm balls		0.42216(μm)	0.77770(μm)	1.49451(μm)	0.5743(μm)
emax 10 and 210 min 0.1 mm balls		0.34118(μm)	0.64588(μm)	1.32272(μm)	0.5455(μm)
emax 10 min 0.5 mm balls		1.57038(μm)	4.04391(μm)	7.63970(μm)	2.4584(μm)