

Wood (dried; natural and previously treated)

Protocol number: M130152

Industry: Biology, Agriculture and forestry

Feed Size: < 3 cm

Desired Fineness: < 500 µm

Quantity: 1-2 g

Recommendation: A pre grinding of sample is obligate. We recommend using a Universal Cutting Mill PULVERISETTE 19 for coarse comminution to < 1 mm. For a mostly powder fine quality of ground wood, several machines might come into question for this task. A Vibratory Micro Mill PULVERISETTE 0 or a Planetary Micro Mill PULVERISETTE 7 classic line can be used to achieve the desired level of fineness.

Result 1

Universal Cutting Mill PULVERISETTE 19

Rotor with V-cutting edges and fixed knives made of hardmetal tungsten carbide (WC) – also standard rotor should be suitable for this task too.

+ sieve cassette 1,0 mm trapezoidal perforation.



Material attributes: sample: spruce - dried - natural

Feed quantity: 2,4 g (3 pieces)

Feed Size: < 3 cm

Grinding time: 30 s

Final fineness: < 1 mm

Comments: Majority of sample was ground within 30 seconds. Afterwards, no significant amount fell into the collecting vessel. A bit of sample remains loose on top of the sieve cassettes openings and in the area of the first fixed knife. This is a typical residue inside the grinding chamber.

All residues have been removed easily by vacuuming with a soft brush.

Some fragments have been able to pass the trapezoidal openings longitudinal. For this, up to 3-4 mm long fragments can be found in the ground sample. Also smaller sieve cassettes can be used, but a powder fine kind of sample will not be achieved with a cutting mill.

Pictures: Resulting particles after grinding with 1,0 mm trapezoidal perforated sieve cassette.



Opened grinding chamber after 1 minutes; rotor is still on its shaft; sieve cassette in position. Only small amounts of residues are left loose inside and can be removed easily.



Result 2

Vibratory Micro Mill PULVERISETTE 0

Amplitude: 2,0 mm

Grinding set made of zirconium oxide
+ Cryo-Box



Material attributes: pre ground sample: spruce - dried – natural

Feed quantity: 1,0 g

Feed Size: < 1 mm (see result 1)

Additive: + liquid nitrogen (N₂ - ~ 2 liters)

Grinding time: 10 min

Final fineness: powder with a few longer fibers

Comments: Grinding set and sample got placed into the optional cryo-box and got fixed on the vibrating plate of the Vibratory Micro Mill. The complete inside of the cryo-box was chilled with liquid N₂. Afterwards, we started the grinding process. Because of evaporation of N₂, liquid nitrogen has to be refilled constantly to the feeding funnel during the grinding process. We recommend maintain a level of nitrogen about 1/3 of the filling of the mortar. For about 10 minutes of grinding, about 1,5 – 2 liters of liquid nitrogen have been used. Afterwards, the sample has been brushed out of the cold grinding set. Sample is lightly sticking to the grinding set, so a cleaning step with sand and water has been performed afterwards to remove all residues properly. We are guessing that a simultaneous grinding with a bit of sand or aluminum oxide might improve the grinding process (achievable fineness).

Pictures: About 1 gram of pre ground wood before the grinding trial has been started.

After 10 minutes of grinding, this sample already starts sticking lightly to mortar and grinding balls. Sample needed to be brushed off.



Result 3

Planetary Micro Mill PULVERISETTE 7 classic line

main disk speed: 800 rpm

12 ml grinding bowl made of zirconium oxide
+ 6x 10 mm Ø zirconium oxide grinding balls
+ nitrogen sleeve for external bowl chilling with N₂



Material attributes: pre ground sample: spruce - dried – natural

Feed quantity: 1 g

Feed Size: < 1 mm (see result 1)

Additive: + N₂ for external chilling

Grinding time: 10 min

Final fineness: fine powder

Comments: The grinding bowl has been placed into the sleeve for external nitrogen chilling and the sleeves got placed into the holder on the main disk. Now the clamping screw got tightened, followed to the lock nut which makes sure the system will stay in position during operation.

Now the sleeve got filled with a couple of ml of nitrogen to chill the bowl. After the nitrogen evaporated, the machine was started for a programmed grinding time of 2,5 minutes.

After 2,5 min of grinding, the bowls is still chilled (< 20°C); We pre chilled the bowl externally with nitrogen and proceeded this way until 10 minutes of grinding time got reached.

After 10 minutes, the sample is sticking lightly to the bowl and grinding balls. This usually happens when a d₅₀ < 30 µm is reached.

Because of light diffraction, the ground particles appear lighter compared to the original sample.

Pictures: 12 ml bowl fixed on the holder together with the nitrogen sleeve. The bowl was chilled externally before sample was ground for 2,5 minutes.



Result 4

Vibratory Micro Mill PULVERISETTE 0

Amplitude: 2,0 mm

Grinding set made of zirconium oxide
+ Cryo-Box



Material attributes: pre ground sample: spruce - pre treated sample

Feed quantity: 1,0 g

Feed Size: < 1 mm (pre ground analogue result 1)

Additive: + liquid nitrogen (N₂ - ~ 2,5 liters)
+ 3g Al₂O₃ powder

Grinding time: 15 min

Final fineness: powder with a few longer fibers

Comments: Pretreated sample was pre ground analogue result 1; afterwards, about 3 grams of aluminum oxide have been fed to the grinding set as well.

We are guessing that the sharp particles of corundum will be helpful to comminute fibrous materials.

After a total grinding time of ~ 15 min, the sample is fine ground. Still a few fibrous particles can be spotted, the amount of longer particles is lesser compared to the result 2.

Result 5

Planetary Micro Mill PULVERISETTE 7 classic line

main disk speed: 800 rpm

12 ml grinding bowl made of zirconium oxide
+ 6x 10 mm Ø zirconium oxide grinding balls
+ nitrogen sleeve for external bowl chilling with N₂



Material attributes: pre ground sample: spruce - pre treated sample

Feed quantity: 1 g

Feed Size: < 1 mm (see result 1)

Additive: + N₂ for external chilling

Grinding time: 10 min

Final fineness: fine powder

Comments: Also the pre cut sample of pre treated sample of spruce was used with a Planetary Micro Mill PULVERISETTE 7 classic line.

As shown in result 3, this sample was ground to a fine powder within 10 minutes of grinding. Longer particles could not be spotted without using a magnifying glass.

To hinder a cross contamination, we recommend a cleaning step by short time grinding with sand and water before the equipment should be used again.

Pictures: Left in picture: pre ground sample with Universal Cutting Mill and 1,0 mm sieve cassette. Right in picture: sample which was dry ground for 10 minutes with Planetary Micro Mill PULVERISETTE 7 classic line (lightly started to stick on the 6x 10 mm Ø grinding balls made of zirconium oxide).

