

LENZING™ Viscose, LENZING™ Modal and LENZING™ Lyocell are fully compostable in soil conditions.

Standard nonwoven and standard textile fiber types of LENZING™ Viscose (raw white and Color), LENZING™ Modal (raw white and Color), and LENZING™ Lyocell are fully compostable and biodegradable in soil conditions according to the European Norm EN 13432. This norm is the strictest of all existing norms evaluating compostability and biodegradability. It also clearly defines the difference between compostability and biodegradability, two terms that are frequently mistakenly used. According to the European Standard EN13432, a compostable material must be:

Biodegradable

- **Biodegradability** is determined by measuring the actual metabolic conversion of the compostable material into CO₂ by antimicrobial activity. This property is determined quantitatively by using the standard test method EN14046 (or ISO 14855). The acceptance level is 90% which must be reached in 6 months
- LENZING™ Viscose and LENZING™ Lyocell were tested during 45 days and 55 days, respectively, at a low temperature of 28° C (ambient temperature) to simulate home composting conditions. It is considered that if a material is biodegradable at low temperature it would certainly be at any higher temperature, as the microbial activity increases with temperature. LENZING™ Viscose and LENZING™ Lyocell biodegraded rapidly in less than 2 months at low temperature as shown in figure 1 and figure 2.

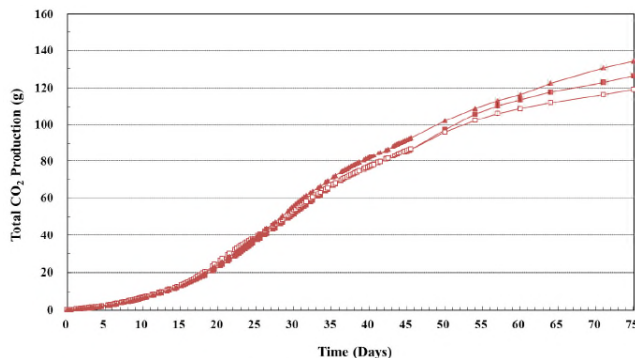


Fig. 1 The biodegradation of LENZING™ Viscose at 28° C started after a lag phase of 9 days and proceeded at good rate. At the end of the test, after 45 days, a plateau in biodegradation at the level of 93.1%+/- 1.9% was measured, or on a relative basis, compared to the suitable reference substrate cellulose, a biodegradation of 100.5% was calculated.

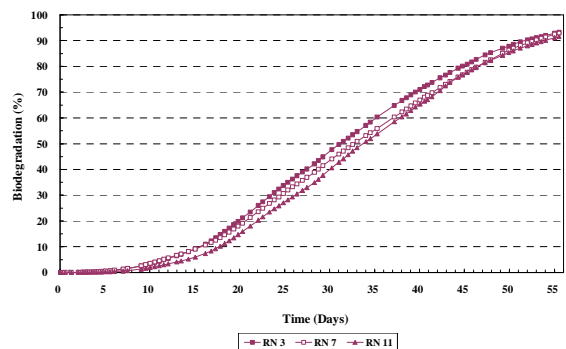


Fig. 2 The biodegradation of LENZING™ Lyocell at 28° C started after a lag phase of 9 days and proceeded at slower rate than LENZING™ Viscose. After 55 days a plateau in biodegradation at a level of 92.6%+0.9% was observed or 96.7% on a relative basis, compared to the reference substrate cellulose

Disintegratable

- **Disintegration** is the fragmentation of a compostable material into smaller pieces and thus the loss of visibility in the final compost. This is measured with the composting test EN14045.
- The test material is degraded together with organic waste for 3 months. After this time the compost is sieved with a 2 mm sieve. The residues of test material with dimensions greater than 2 mm are considered as not having disintegrated. This fraction must be less than 10% of the initial mass. LENZING™ Viscose and LENZING™ Lyocell disintegrated swiftly at ambient temperature as shown in figure 3 and 4:

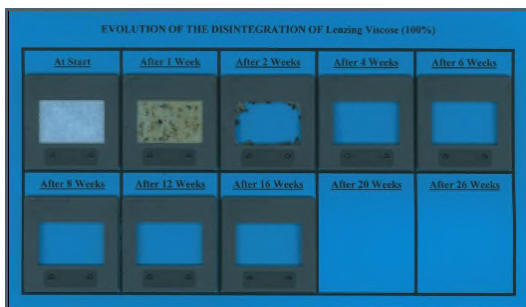


Fig. 3 A very swift disintegration was observed at ambient temperature for test material LENZING™ Viscose (273 μm – 55 g/m²). After 6 weeks the test could be stopped, as the material was completely disintegrated.

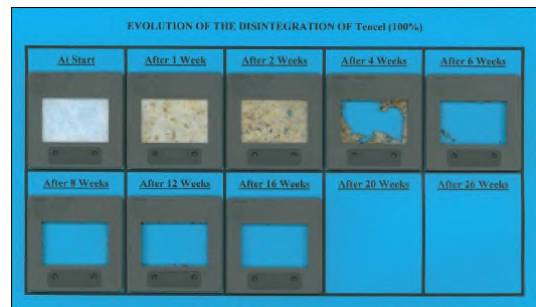


Fig. 4 The disintegration of LENZING™ Lyocell at ambient temperature (384 μm -62 g/m²) proceeded very well. After 16 weeks these were completely disintegrated.

Compost Quality (material characteristics and compost analyses)

- A **compostable** material must demonstrate the absence of negative effects on the composting process and on the compost quality. Therefore the norm sets limits for volatile matter, heavy metals (Cu, Zn, Ni, Cd, Pb, Hg, Cr, Mo, Se, As) and fluorine as shown in table 1. This table also shows the limits according the US standard ASTM D6400 as a comparison. All tested LENZING™ fibers were far below the limits.

Metal	Limit values		
	Europe EN 13432 (2000)	USA* ASTM D 6400-12	Canada BNQ P 9011-911-5
Zn	<150	<1400	<463
Cu	<50	<750	<189
Ni	<25	<210	<45
Cd	<0.5	<19.5	<5
Pb	<50	<150	<125
Hg	<0.5	<8.5	<1
Cr	<50	-	<265
Mo	<1	-	<5
Se	<0.75	<50	<4
As	<5	<20.5	<19
F	<100	-	-
Co	-	-	<38

Table 1 Acceptance limits of heavy metals and fluorine according to international standards [ppm]

- A plant growth test is carried out on compost samples where the degradation of the test material has taken place. There must be no difference from control compost.
- Barley and cress plant growth tests were performed on LENZING™ Viscose and LENZING™ Lyocell compost. Compost was obtained from the pilot-scale composting of the fibers. No residuals were left such as metabolites, undegraded components and inorganic components that exert a negative effect on the germination and growth of barley and cress plants.

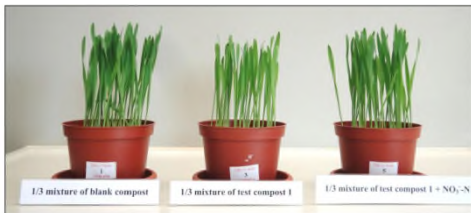


Fig. 5 Detailed barley plant growth after an incubation period of 7 days (from left to right): 1/3 mixture of blank compost, 1/3 mixture of test compost 1 and 1/3 of test compost 1 with nitrate addition

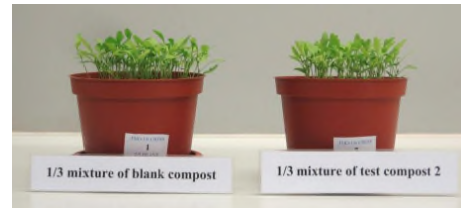


Fig. 6 Detailed cress plant growth after an incubation period of 13 days (from left to right): 1/3 mixture of blank compost, 1/3 mixture of test compost 1.

Standard nonwoven and standard textile fiber types of LENZING™ Viscose (raw white and Color), LENZING™ Modal (raw white and Color), and LENZING™ Lyocell fulfil the requirements of compostability according to EN 13432 and were thus certified with the TÜV Austria logos “OK COMPOST”, “OK COMPOST HOME” and “OK BIODEGRADABLE SOIL”.

