1. Introduction | Purpose of the experiment

Organic (plant fibres) and inorganic (plastics) materials are subject to different rates of decomposition due to their nature. Whether and how quickly materials decompose also depends on the conditions that nature provides. Factors such as ambient temperature, soil moisture, nutrient content, soil properties and biological activity, for example, are crucial to the duration of the decomposition process. Climatic factors such as temperature and humidity are crucial. Decomposition is more pronounced in tropical regions with high temperatures and humidity than in cold or dry areas. The pore and grain size distribution of the soil influences the availability of water and oxygen, which in turn determines the activity of the decomposing microorganisms.

The purpose of this experiment is to observe the process and duration of the decomposition of three elastic bands, consisting of different material compositions, in a simulated natural and healthy garden compost environment. The progress of decomposition is recorded in detail for the elastic made of organic cotton and natural rubber.

It is assumed that the untreated cotton will decompose very quickly. Due to the positive properties of natural rubber, even though the vulcanised* rubber used here, a comparatively rapid decomposition process can be assumed.

**During vulcanisation, the natural rubber is mixed with sulphur and fillers such as mineral carbon black and kaolin and processed into thin, highly elastic threads using extruders. The actual vulcanisation process takes place by heating to temperatures between 100 and 180 ^{0}C, giving the product greater resistance to ageing than cold vulcanisation. Other characteristics of vulcanised rubber are high elasticity, high mechanical resistance and high tear resistance.*

2. Test parameters

Testing location	Alpenwurm.at, Am Bahnhof 5/5B, 2281 Raasdorf, Austria
Standard	Use of a proprietary standard to determine biodegradability under natural conditions (burial in healthy, active soil)
Test area	75 x 43 x 30 cm
Inspection rhythm	Monthly 1 x
Test set-up	A real setting of a natural and healthy compost heap is recreated on an area of L 75x W 43x D 30 cm. The test setup consists of a mixture of moistened hay, rotting material, cellulose pulp, coconut fibres, ground primary rock, compost worms and worm food. The sample is buried in the middle.
Number of worms on test area	approx. 3,000 worms (3 kgs)
Worm species	Eisenia Hortensis, Eisenia Foetida, Eisenia Andrei
Soil moisture content	60 – 70 %
Humidity	50 – 70 %
pH factor	approx. 7 (neutral)
Test objects Pieces of 12 cm each sewn onto stainless steel with the respective yarns (CO, PA6.6, CLY)	 f.l.t.r. CO/NR (Organic Cotton/Natural Rubber), PA6.6 (Polyamid 6.6), CLY/Roica (Lyocell/Roica V550)
material composition	79 % CO | 21 % NR The percentages of the components of the other test elasticss are not relevant for this protocol.
Feeding frequency	Once a week; approx. 400 g of powder made from various grains and rock dust, which is sprinkled on top and eaten by the worms within three days. The substrate (components of soil) is permanently rooted through and eaten;

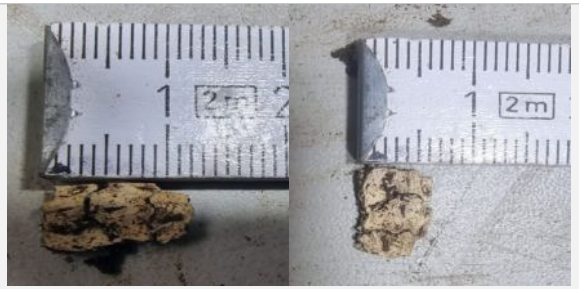
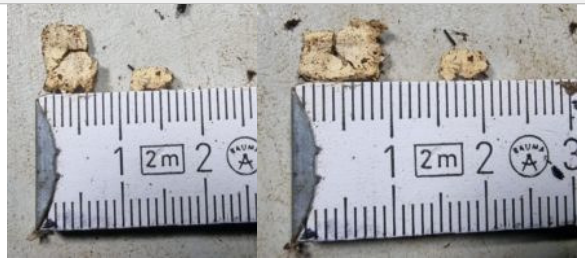
3. Description of the procedure

Inspection date	Photo	Remark
Start: **12.03.2023**		Experiment is being set up. The sample is buried to a depth of about 5 cm. 400 g of dry food is sprinkled on top Room temperature: 18.1 degrees.
24.03.2023	Video only	First inspection after 12 days. Feeding took place a week earlier. Room temperature at daytime: 15-18 ^{0}C Room temperature at night: 18 ^{0}C constant Humidity: approx. 70% Sample removed and observed: There appear to be slight changes in PA 6.6 and CLY. CO shows no signs. Expert assessment: 'It probably speaks for the quality of the natural rubber that it still looks so good despite the difficult conditions.'
11.04.2023		Second inspection after a total of 30 days. Soil heavily eroded, needs feeding; Everything intact, everything still in place. PA 6.6 apparently changed. From left to right: CLY / ROICA, PA 6.6 / Helanca, CO / NR

04.05.2023		3rd inspection after 53 days: the worms have grown, parameters such as humidity etc. have remained the same, room temperature 20 °C CO / NR Detached from the steel wire; shows signs of decomposition at various points. The rubber is still very elastic and does not yet appear to be showing signs of fatigue. The strap is divided: the more decomposed piece is sent back to CHARLE for examination. The second piece goes back into the box until it is decomposed.
04.05.2023		CLY / ROICA Removed from the steel wire. Barely stretches at all, breaks under low load. Shows first signs of decomposition. Also being sent back for inspection. **The test will not be continued as the main focus is on the signs of decomposition of CO/NR.**
04.05.2023		**PA 6.6 / Helanca** Still on the steel, showing no signs of decomposition. Will also be returned for inspection. **The experiment will not be continued, as the main focus is on the signs of decomposition of CO/NR.**
02.06.2023		29 days later (total of 82 days) - CO is completely decomposed - NR is no longer elastic, has shrunk into a mass - Room temperature 20 °C - Humidity constant

26.06.2023		26 days later (a total of 108 days) - NR 15 mm long - NR 7 mm wide - apparently shrunk (no comparative values available for the size of - - the piece from 02.06.23 - temperature and humidity constant - worms grown Test continued!
24.07.2023		28 days later (total of 136 days) - NR 15 mm long - NR 7 mm wide - Specimen has become thinner - Temperature 22–25 °C - Humidity constant - Worms have grown and reproduced
29.08.2023	Video only	34 days later (total of 170 days) - NR 15 mm long - NR 7 mm wide - Specimen has become even thinner but has not lost its size - Temperature 22–25 °C - Humidity constant - Worms have grown and produced offspring

22.09.2023	  	24 days later (194 days in total) - NR 12 mm long - NR 6 mm wide - Specimen has become wafer-thin and has lost size - Temperature 21–24 °C - Humidity constant - Worms have grown and produced offspring
06.10.2023	 	18 days later (208 days in total) - NR 11 mm long - NR 6 mm wide - Specimen even thinner and smaller - Temperature 20–21 °C - Humidity constant Crate now too full (video only) and needs to be rearranged (video only)

03.11.2023		28 days later (total of 236 days) - NR 11 mm long - NR 6 mm wide - Specimen is threatening to break apart - It has become more brittle and appears wider due to cracks that have formed - Temperature 16–20 °C - Humidity constant The test continues!
08.12.2023		35 days later (271 days in total) - broken down into two parts, very thin - 1st part: NR 8 mm long, NR 6 mm wide - 2nd part: NR 4 mm long, NR approx. 2 mm wide) - Temperature: 15–17 °C - Humidity: approx. 70% Test to be continued!
12.01.2024		35 days later (total of 306 days) - thinner - 1st part: NR 8 mm long, NR 5 mm wide - 2nd part: NR 4 mm long, NR approx. 2 mm wide) - Temperature 15–17 °C - Humidity approx. 70% The experiment continues!
16.02.2024		35 days later (a total of 341 days) - thinner and very unstable - 1st part: NR 8 mm long, NR 5 mm wide - 2nd part: NR 4 mm long, NR approx. 2 mm wide) - Temperature 15–17 °C - Humidity approx. 70% The experiment continues!

17.03.2024	 	30 days later (a total of 371 days) - thinner - due to the enlargement of the cracks (- 1st part: NR 9 mm long, NR 6 mm wide - 2nd part: NR 3 mm long, NR approx. 2 mm wide) - Temperature 15–17 °C - Humidity approx. 70% - Test finished!

4. Comment

One of the most important components of the business model of CHARLE premium haberdashery is the compostability of the materials used. For this reason, only biologically recyclable materials are processed to manufacture the narrow fabrics.
Natural rubber is an important component in the production of elastic bands as an alternative to synthetic elastomers. This is because synthetic rubber is difficult to break down in nature and leaves behind microplastics, which are released, for example, during washing. Microplastics pose a significant environmental pollution problem because they remain in the oceans and in drinking water and thus enter the human body through food intake.

It is estimated that synthetic elastics account for over 90% of the global market. For naturally degradable elastics, the share is less than 10%, although this area is slowly growing as awareness of sustainability increases. CHARLE premium haberdashery is a pioneer and leader in the development and production of circular narrow fabrics.

In the present experiment, the cotton degraded within 82 days through microorganisms and worms. The natural rubber (9 threads of 6 cm each) mostly decomposed after 371 days. The residual pieces measuring 9 x 6 mm and 3 x 2 mm are very thin, porous and brittle.

The experiment was terminated due to a lack of time. However, a continuation of the experiment is not necessary due to the positive and meaningful results.

Michael Lutz from Alpenwurm.at assumes that the worms would have long since eaten the residual pieces in milled form. He considers the experiment a success. It provides a meaningful basis for demonstrating the biodegradability of the elastic test specimen, which consists of 79 % cotton and 21 % natural rubber.

Raasdorf, den 18.03.2024 Michael Lutz Mandy Geddert