Release assessment methodology for safe sustainable and recyclable by-design practices for plastics: the epoxy-resin composite case study

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Supporting Information 1. Hard abrasion following outdoor aging

Inductively Coupled Plasma- Mass Spectrometry

An ICP-MS analysis has been conducted using the triple quadrupole ICP-QQQ (Agilent 8900) after a total digestion of each investigated sample. An acid digestion is carried out with 4 ml of concentrated ultrapure nitric acid (HNO_3 70 %) and 1 mL of concentrated ultrapure hydrochloric acid (HCl 37 %) in an analytical microwave at 280 °C and each sample was weighted before the digestion. The digestion residue obtained is then diluted appropriately to analyse Sulphur (S). This element was selected as it is contained in the AFD hardener and its quantity varied among different samples. Quantification is performed by interpolation on a calibration line prepared from commercial standards of the elements of interest. The test is performed in duplicate and results expressed as mean ±st.dev. of the independent measurements.

The following samples were processed using the above-mentioned protocol:

- Clean sanding paper as a blank.
- Sanding paper after abrasion (left and right wheel paper separately).
- Composite samples 1 x 1 cm size before weathering.

Scanning Electron Microscopy

Scanning Electron Microscopy analysis using JEOL J-7100FE, operating at 20 keV with a secondary electron detector. Prior to the SEM observation, the specimens were coated with carbon to increase their conductivity. The SEM has been used to study the powder generated during the abrasion collected with few drops of milliQ water and deposited on SEM stubs to determine particle morphology and size distribution of the material released.

The thickness of each sample in three different points was measured before and after abrasion (after removing the powder obtained from the abrasion) using the micrometre Mitutoyo model S1012XB (Figure 51). Results are reported in millimetres with 2 decimals as mean and standard deviation between the two replicates of each material. An analytical balance (Denver Instrument, APX-200) has been used to weight samples and wheels with the sanding paper before and after performing abrasion. Results are reported in grams with 4 decimals for the mean and standard deviation of the two replicates of each material.

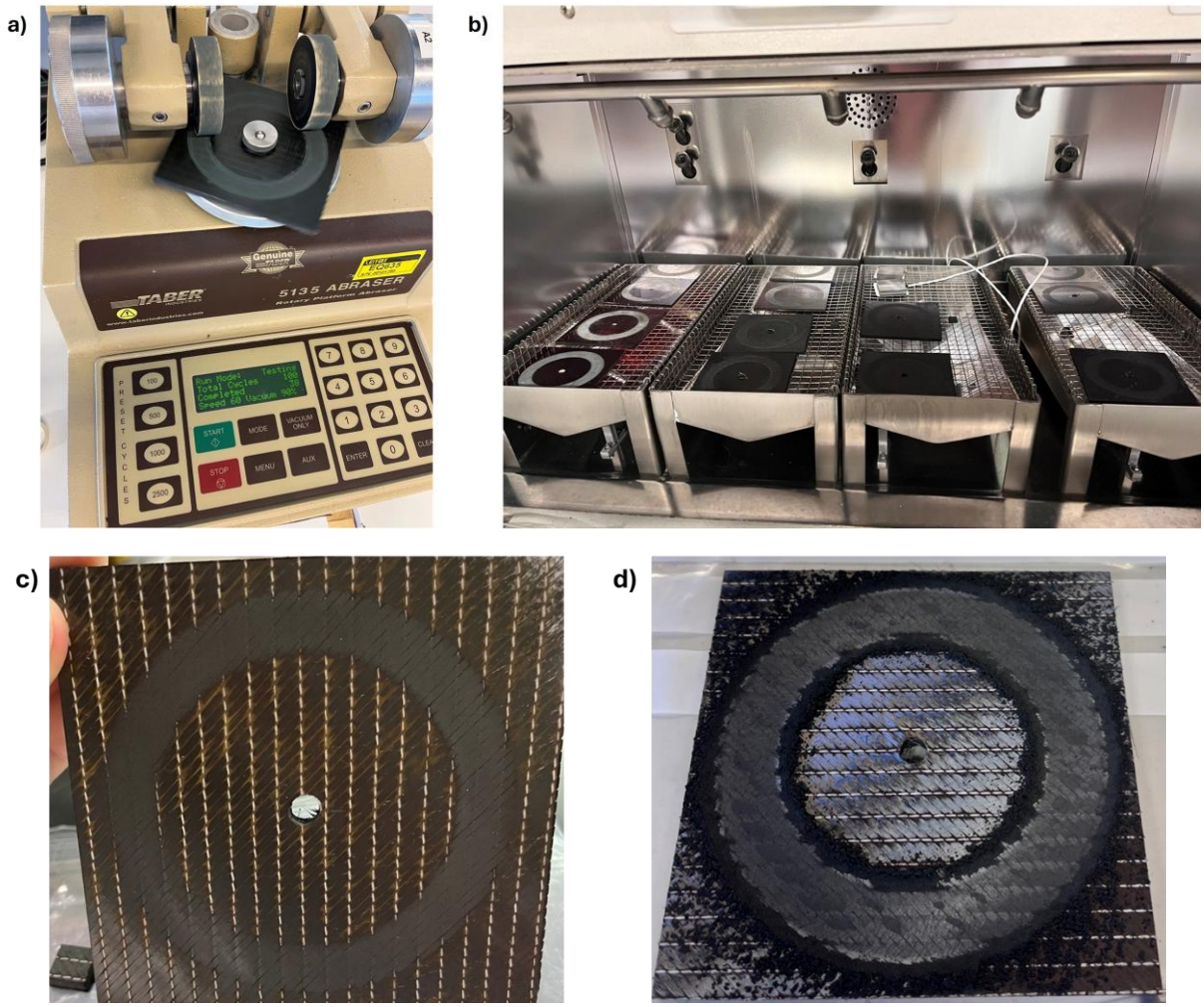

Figure SI1. Hard abrasion and weathering respectively using the a) Taber abrader and the b) SUNTEST XXL+ climatic chamber, c) the effect of 750h of weathering in the samples.

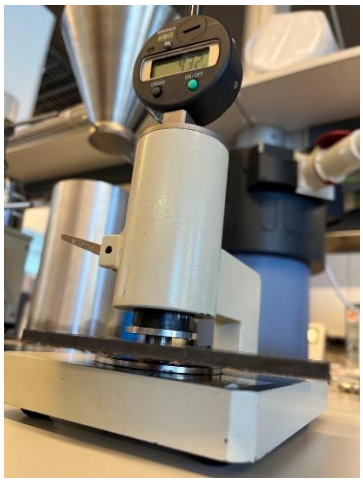

Figure 51. Equipment used to measure the thickness of the composite samples.