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Instructions for Pre-treatment of Mineral Wool Wastes

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Modification Control

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DELIVERABLE 1.2 INSTRUCTIONS FOR PRE-TREATMENT OF MINERAL WOOL WASTES

Mineral wool products are sold in various forms depending on the application requirements. Consequently, mineral wool wastes vary greatly in their properties. For the milling and pre-treatment of mineral wool waste bulk density, possible coating materials and material size are the most critical as they directly affect their handling and processing.

Table 1 shows the mineral wool waste types collected in WOOL2LOOP-project from demolition sites and mineral wool production plants around European Union. Mineral wool waste samples had high variation in their type and some samples contained coating materials which may complicate the comminution process.

Table 1. Mineral wool waste sample types collected in WOOL2LOOP from various locations.

Sample number	Sample type
1	Glass blowing wool
2	Stone blowing wool
3	Mix of glass wool and stone wool lumps
4	Stone wool panels
5	Stone wool ceiling panel
6	Stone wool with aluminium foil
7	Stone wool panels
8	Stone wool ceiling panel with coating
9	Glass wool with aluminium foil
10	Dense stone wool panel
11	Glass wool panel
12	Glass wool
13	Ultimate wool lumps
14	Ultimate wool, no-organic resin
15	Glass wool, probably mix of phenolic and green binder
16	Glass wool, probably mix of phenolic and green binder
17	Mix of stone and glass wool
18	Mixed glass wool waste
19	Mixed stone wool waste
20	Mixed glass wool waste
21	Glass wool, green binder
22	Glass wool without binder
23	Glass wool with phenolic resin
24	Phenolic glass wool
25	Green binder glass wool

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Based on results obtained in WOOL2LOOP ball mill is a feasible milling method for mineral wool waste in order to achieve sufficiently small particle size. However, it is possible to feed only blowing wool type material (lump size <5cm in diameter) into ball mill as-received. Larger mineral wool waste samples such as panels have to be first shred into smaller size. Despite the variation in the density and coating of mineral wool samples the shredding process with Rapid 200 granulator-type shred resulted in similar material size and type which could be fed into ball mill. Based on the results there is no significant difference in the ball milling result between different mineral wool types. Additionally, dry vs. wet ball milling was studied. There was no significant difference in the material fineness in dry vs. wet milling process. In addition to ball mill, a hydraulic press was used to mill mineral wool samples. It was concluded that there was no significant difference in the final material fineness between mineral wool samples after pressing.

Also commercially manufactured mills specifically meant for mineral wool waste milling already exist in the market which could be used in combination with WOOL2LOOP technology. Commercial mills are mainly based on screw compression. Some mills require mineral wool waste pre-treatment (panels cannot be fed) prior to actual milling for homogenising the material and to avoid problems with material feeding. Main risk in mineral wool waste milling is the presence of larger pieces of wood, stones or steel within mineral wool waste that would break the mill if waste separation is not properly done. Based on the results, there is variation in the fineness of the milled mineral wool waste with different commercial mills. Also, the throughput varies from 0.2 t/hour to 15 t/h with different mills, thus the suitability of each mill for should be carefully evaluated before purchasing.

Based on the literature, the energy consumption of cement clinker milling is 11 – 35 kWh/t depending on the clinker mill type. Based on our estimations the milling of mineral wool waste has similar energy consumption range.

Other critical aspect of mineral wool wastes is their organic resin content and resin type. Based on the literature, possible resin types in mineral wools include, but are not limited to: phenol-formaldehyde-urea resins, phenol-formaldehyde resols, phenol resins, melamine-urea-formaldehyde, polyesters, polyamides, furan-based resins, and polysiloxane-polyol hybrid organo-inorganic binder. Other often used organic binder components are de-dusting oils, emulsifiers, dyes, silanes, ammonium sulfate, ammonium hydroxide, extenders, water, and so-called scavengers (such as ammonia, melamine, dicyanideamide and urea) which are used to minimize free formaldehyde during mineral wool production. The exhaustive listing gives indication of the challenge to analyse, pre-treat and control these components.

Five different solvent mixtures for organic resin removal from mineral wools were studied. A decrease in organic resin content after the treatments was detected, but the removal efficiency was less than 50 %. Phenol-formaldehyde resins, which are the most common organic resin type in mineral wools, are known to be one of the most stable resins, and consequently it is challenging to remove it by solvent treatment without affecting the mineral wool fibers extensively. Further experiments are conducted including thermal treatments.

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