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New insights into the High Temperature Stability of stone wool fibres

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Abstract: Stone wool (SW) is widely used for thermal insulation and well known for its fire resistance. The fire resistance, or high temperature stability (HTS) describes the ability of SW to maintain its geometrical integrity at elevated temperatures ($\approx 1000^\circ\text{C}$). HTS is important for slowing down the spread of construction fires. Pre-oxidizing SW at temperatures around the glass transition temperatures (T_g) has beneficial effects on the HTS [1-2] through the formation of a nanocrystalline surface layer consisting of MgO. Using a newly developed method for quantifying HTS [3], our research provides interesting new information about the details of the HTS improvement through pre-oxidation. We used hot stage microscopy to quantify the HTS of SW pre-oxidized at various temperatures for 15 min, and various durations at T_g (677°C).

Our work reveals that pre-oxidation of SW does not lead to a continuous improvement in HTS. Pre-oxidation of SW initially leads to an improvement in HTS (i.e., an increase in A_2/A_0 in Fig. 1) followed by a decrease as shown by the dependence of HTS with increasing temperature of pre-oxidation (Fig. 1a) and duration (Fig. 1b). We link the initial increase in HTS to the formation of the nanocrystalline surface layer, and the following decrease to a mechanical break-down of the nanocrystalline layer. This hitherto unknown aspect of HTS is important in relation to fire-protection as it can lead to various HTS of SW, depending on the development of a fire. Heating rate and maximum temperature of the fire can affect the HTS through the described effect of breakdown of the nanocrystalline surface layer.

Key words: Stone wool; high temperature stability; nanocrystals

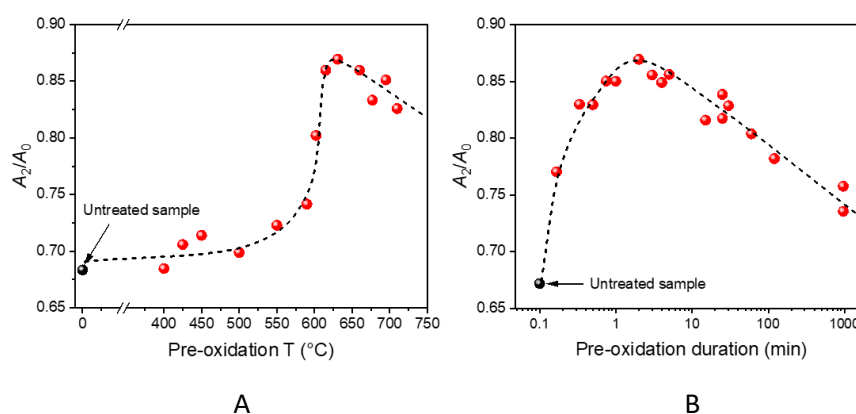


Fig. 1 (a) The dependence of A_2/A_0 (which is a measure of high-temperature stability) on the pre-oxidation temperature for 15 min and (b) the pre-oxidation duration at T_g (677°C) for SW

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