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Dissolution of stone wool materials coated with organic binder in a synthetic lung fluid

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Stone wool composed of man-made vitreous fibers (MMVF) and organic binder is widely used in many construction applications, such as materials for heat insulation and protection against spread of fire. One of the important requirements to the stone wool products is safety to the humans during production, installation and usage, in cases when fibers can be inhaled.

In this work, we investigated the dissolution behavior of the stone wool fibers coated with different amount (0 to 6 wt. %) of organic binder (phenol-urea-formaldehyde) using the typical industrial coating procedure. The amount of deposited coating was monitored with thermogravimetric techniques and dissolution was studied in a synthetic lung fluid (modified Gamble's solution) both in batch and under continuous flow conditions. Scanning electron microscopy showed homogeneous dissolution of the uncoated fibers, while fibers with organic coating preferentially dissolve in the uncoated areas resulting in surface cavity formation. However, the results of ICP-OES analysis of the reacted solutions and X-ray photoelectron spectroscopy analysis of the fiber surfaces showed that dissolution in the synthetic lung fluid was close to being congruent for all investigated materials and that the organic binder does not influence the dissolution rate of the stone wool materials.