

Title *

Composition, Respirable Fraction and Dissolution Rate of 24 Stone Wool MMVF with their Binder

Abstract *

Background: Man-made vitreous fibres (MMVF) are produced on a large scale for thermal insulation purposes. After extensive studies of fibre effects in the 1980ies and 1990ies, the composition of MMVF was modified to reduce the fibrotic and cancerogenic potential via reduced biopersistence. However, occupational risks by handling, applying, disposing modern MMVF may be underestimated as the conventional regulatory classification - combining composition, in-vivo clearance and effects- seems to be based entirely on MMVF after removal of the binder.

Results: Here we report the oxide composition of 23 modern MMVF from Germany, Finland, UK, Denmark, Russia, China (five different producers) and one pre-1995 MMVF. We find that most of the investigated modern MMVF can be classified as „High-alumina, low-silica wool“, but several were on or beyond the borderline to „pre-1995 Rock (Stone) wool“. We then used well-established flow-through dissolution testing at pH 4.5 and pH 7.4, with and without binder, at various flow rates, to screen the biosolubility of 14 MMVF over 32 days. At the flow rate and acidic pH of reports that found 47 ng/cm²/h dissolution rate for reference biopersistent MMVF21 (without binder), we find rates from 17 to 90 ng/cm²/h for modern MMVF as customary in trade (with binder). Removing the binder accelerates the dissolution significantly, but not to the level of reference biosoluble MMVF34. We finally simulated handling or disposing of MMVF and measured size fractions in the aerosol. The respirable fraction of modern MMVF is low, but not less than pre-1995 MMVF.

Conclusions: The average composition of modern stone wool MMVF is different from historic biopersistent MMVF, but to a lesser extent than expected. The dissolution rates measured by abiotic methods indicate that the binder has a significant influence on dissolution via gel formation. Considering the content of respirable fibres, these findings imply that the risk assessment of modern stone wool may need to be revisited based on in-vivo studies of MMVF as marketed (with binder).

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