

## Summary

The environmental compatibility of reactive flameproof coatings was investigated by a combination of leaching tests and subsequent Eco toxicological testing. Three representative flameproof coating systems were chosen, which are directly exposed to outside weathering in their range of application. Such flameproof coating systems comprise a base body of steel a priming-coat, an adhesion-promoting agent, the reactive flameproof component and a top coat.

The test specimens were tested using two leaching procedures: DIN EN 16105 (tank test applying intermittent contact with water in 9 immersion cycles whereby each cycle consists of 1 h submerging, 4 h drying, and again 1h submerging of the sample at an liquid-to-surface area (L/A) ratio of 25 L/m<sup>2</sup>) as well as CEN/TS 16637-2 (Horizontal dynamic surface leaching test DSLT comprising 8 fractions at an L/A ratio of 25 L/m<sup>2</sup>). The eluates of the DSL test were then studied considering their Eco toxicological effects using algal toxicity test (DIN EN ISO 8692), acute Daphnia toxicity test (DIN EN ISO 6341), fish egg test (DIN EN ISO 15088), luminescent bacteria test (DIN EN ISO 11348-2) and umu-genotoxicity-test (ISO 13829) as well as manometric respirometry test according to OECD 301F at TOC (Total Organic Carbon) contents above 10 mg/L in the eluate.

A mixture of the first two eluate fractions of the DSL test as well as a fraction representing a longer immersion time (fraction 7) were analysed in the Eco toxicological tests. Additionally, blank test control eluates covering the whole procedure were also tested.

In the DSL T eluates low concentrations of the cations analyzed were found except for zinc (Zn) and barium (Ba). In the GC-MS screening in particular, phenol, 1-methoxypropylacetate and benzaldehyde were detected. The TOC content of the first two eluate fractions (at a total test duration of 24 h) was significantly lower compared to the TOC content in the seventh fraction (at a total test duration of 36 days) probably due to maceration of the coating and the longer contact time by a factor of 20. The Eco toxicological effects in the seventh eluate fraction increased significantly and reached values up to LID L = 256 for the luminescent bacteria test whereas only values up to LID L =24 were determined for the combined first two fractions. Effects in the daphnia toxicity test were only observed in the seventh fraction for one of the three investigated systems of flameproof coatings (LID D = 8). No effects were found using the fish egg test and no genotoxicity was observed for all investigated eluates. The eluates of the seventh fractions showed a significant biodegradability of organic ingredients of 69 to 88%.

In the tank test using intermittent contact with water only low concentrations of cations and anions were analyzed in the eluates. The cumulative release calculated ranges between 10 to 54 mg/m<sup>2</sup> for phosphate, 0.3 to 3 mg/m<sup>2</sup> for Zn and 0.2 to 0.7 mg/m<sup>2</sup> for Ba respectively. Unlike observed with the DSLT, the TOC values of the

eluates were much lower (maximum 5 mg/L) and decreased with increasing test duration.

Recommendations for a suitable approach in testing of reactive flameproof coatings were derived from the results.