

Evaluation of a mechanistic model (SprayExpo) for predicting aerosol exposure during spray application

Martin Tischer, Ulrich Poppek, Unit Exposure scenarios, Federal Institute for Occupational safety and Health (BAuA), Dortmund, Germany,
Tischer.Martin@baua.bund.de / Poppek.Ulrich@baua.bund.de / +49 231 9071 2345.

Commissioned by the Federal Institute for Occupational Safety and Health (BAuA) the Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM) has developed a mechanistic model (SprayExpo) for predicting aerosol exposure during spray application of non-evaporating biocidal substances. The model calculates the airborne concentrations in various health relevant particle size fractions. It takes into account turbulent diffusion, droplet evaporation, gravitational settling and includes an improved droplet impaction module for calculating the overspray during spraying onto a surface. Furthermore, it is no longer necessary to directly enter primary droplet distributions. Instead, for common spraying techniques these are stored in a database from which they can be retrieved by specifying the spraying technique and simple process parameters such as the spraying pressure.

The sensitivity analysis revealed that besides the substance release rate, the droplet spectrum is the process parameter that has a decisive impact on the exposure level. In contrast, the vapor pressure of the solvent only plays a secondary role for the exposure concentration of the active ingredient within the relevant range of values.

The evaluation of SprayExpo includes the comparison with the already existing models "ConsExpo" and "BG-Spray" as well as the comparison with measurement data. To this end exposure concentrations were determined at workplaces in the area of antifouling treatment (shipyard) and in several scenarios in stored product protection by personal sampling and subsequent chemical analysis. For both room spraying and spraying onto walls, comparisons between the model and experiments revealed that spray applications can generally be reproduced with an uncertainty of factor 4 or lower. With regard to dermal exposure, the model can only take into account the sedimentation flow of the airborne droplets, but not accidentally occurring splashes. Therefore, the dermal exposure at the workplace is underestimated by SprayExpo in the majority of cases. However, the dermal exposure is represented quite well in the case of room spraying.

In general, the comparison of modelled predictions with measured values at real workplaces demonstrates that SprayExpo is appropriate for assessing exposure during indoor spraying processes. It has to be acknowledged, however, that the model has to be used with the necessary expertise.