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Estimating Nickel exposure in respirable dust from Nickel in inhalable dust

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At different workplaces, the dust exposure and associated metal constituents, e. g. nickel, can be immense, and can cause occupational diseases. They range from allergic reactions to different forms of cancer. From early years of exposure measurement, only data of nickel in one dust fraction (mainly inhalable instead of respirable and inhalable) were measured. For retrospective evaluations of exposure levels or of occupational diseases, this is problematic. For this purpose, it is desirable to convert nickel concentrations from inhalable to respirable dust. Therefore, a total of 234 202 respirable fraction measurements, 123 118 inhalable fraction measurements and 32 882 nickel measurements in total were extracted from the exposure database MEGA. After several parameters and restrictions (e.g. same industrial sector, working activity and sampling duration or type of sampling) were considered, 551 parallel measurements of nickel concentrations in inhalable (c_(I(Ni))) and respirable dust (c_(R(Ni))) fractions from 2011 to 2020 could be determined and investigated by linear regression analysis. Inhalable dust is the most important predictor variable, showing an adj. R^2 of 0.767. To refine the conversion of nickel concentrations, the total dataset was divided into working activity groups 'high temperature processing', 'filling/transport/storage', and 'machining/abrasive techniques'. From these groups, more task-specific subgroups were formed: 'welding (grinding time fraction [GTF] < 5 %)', 'welding (GTF > 5 %)', 'high temperature cutting' and 'grinding'. The nickel concentrations were transformed using the natural logarithm. For each group an individual conversion function with its relating confidence interval could be calculated. All conversion functions (except for 'welding GTF < 5 %') are power functions with adj. R^2 between 0.628 and 0.924: c_(R(Ni))=□c_(I(Ni))□^k*e^(C_0), where k and C0 are regression coefficients. Thus, there is no linear correlation between c_(R(Ni)) and c_(I(Ni)), no single conversion factor and the conversion must always refer to the individual workplace.

Biography

Cornelia Wippich graduated in 2016 with a master's degree in analytical chemistry and quality assurance at the University of Applied Sciences Bonn-Rhein-Sieg, Germany. As a part of her doctoral thesis, she conducted research on the conversion of inhalable and respirable dust and metal dust constituents in different industry sectors. Since 2019 Ms. Wippich is working as a scientific employee in the section metal analysis at the Institute for Occupational Safety and Health of the German Social Accident Insurance.