


基于梯形模糊数的地表灰尘重金属污染健康风险评估模型

Fuzzy assessment model for the health risk of heavy metals in urban dusts based on trapezoidal fuzzy numbers

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中文摘要:

将梯形模糊数引入环境健康风险评估领域,构建了城市地表灰尘重金属污染健康风险评估模糊模型,提出了健康风险等级判别方法和具有模糊化特征的风险等级判别标准.同时,选取重金属Zn、Pb、Cu、Cd和Cr为评价因子,将基于梯形模糊数的健康风险评估模型和风险等级识别方法应用于合肥市城区地表灰尘重金属污染的健康风险评估中.结果表明,地表灰尘中Cd和Cr的致癌风险均很低,期望值分别为 1.49×10^{-9} 和 2.75×10^{-7} ,低于美国环保署(US EPA)推荐值 10^{-6} ;Cd和Cr致癌总风险对I级风险的隶属度为0.927,因此属于极低风险水平.儿童的地表灰尘重金属非致癌总风险期望值为1.888,超过了安全阈值1.0,而成人的非致癌总风险期望值仅为0.278;儿童和成人健康风险的主要暴露途径都是手-口直接摄入.

英文摘要:

By denoting exposure factors as trapezoidal fuzzy numbers, fuzzy assessment models were developed to calculate exposure dose and characterize the health risk of heavy metals in urban dusts. In addition, a new classification model and assessment criteria with seven grades for cancer risk are put forward. As a case study, the models established above were employed for human health risk assessment of Zn, Pb, Cu, Cd and Cr in urban dusts from the city of Hefei. The results showed that the expected values of cancer risk for the carcinogenic metals Cd and Cr were 1.49×10^{-9} and 2.75×10^{-7} , respectively, lower than the soil management standard of the US EPA (i.e. 1.0×10^{-6}). The Grade I total cancer risk for Cd and Cr reached 0.927, suggesting that the annual cancer risks were extremely low and could be neglected. The expected value of total non-cancer hazard of the five heavy metals for children reached 1.888 and exceeded the safety threshold value (i.e. 1.0). But for adults, the expected value was just 0.278 and far below the threshold value of 1.0. In Hefei, the highest levels of risk for all the elements included in the study seem to be associated with the route of ingestion of dust particles.

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