

英文Abstract

Future Projections on Mercury Control Technologies and Health Risk from Exposure to Mercury

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This study evaluated mercury control/management technologies, which are countermeasures necessary for assessing the effectiveness of the Minamata Convention, considering future changes in social trends. We predicted human exposure to mercury from the mercury concentration in marine products calculated using the global scenario analysis model (SII-6-2) and global environmental dynamic model (SII-6-3).

Measures, technologies, emission factors, etc. required for future projections of mercury emissions at major sources were investigated by surveying industry groups and companies and examining the most recent databases, papers, etc. The results were evaluated and assigned to the SII-6-2 group. As future mercury emission control technologies, we examined mercury behavior in CO₂ capture devices and activated carbon-based high-performance adsorbents. Since mercury waste management is essential for achieving a final mercury sink, we conducted simulated landfill experiments using lab-scale lysimeters and accelerated leaching tests to establish long-term management methods for waste consisting of mercury. Based on the lab-scale lysimeters, the possibility of mercury leaching from solidified mercury waste was low, even if all the solidified mercury waste was landfilled with mixed waste or incineration residue. The accelerated leaching tests showed that mercury wastes solidified with modified sulfur or epoxy resin were more stable than those with low alkali cement, but alkali, oxidizers, and Na₂S had significant effects on mercury leaching. Reinforcing the solidified material with an epoxy coating was identified as an effective additional measure for solidified mercury waste. In addition, results from the lab-scale lysimeters validated the model of mercury behavior in landfills. Model simulations also reflected the inevitably large uncertainty in the local environmental risk of landfilling solidified mercury waste.

We also investigated the health risks of mercury exposure. The health outcomes selected were “Effects of prenatal exposure on neurodevelopment in children: IQ reduction” and “Cardiac deaths”. “Health risk from the consumption of seafood via markets” was selected as an exposure scenario. Model calculations showed that implementing emission reduction measures would result in a significant difference in health risk by 2050. Compared to no action, the maximum reduction scenario should prevent economic losses of 27 trillion yen/year. However, there is a time lag before the impact of countermeasures becomes apparent, indicating the importance of implementing countermeasures early.