Environmental Impact Analysis of Mercury Release in Malaysia

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INTRODUCTION

Mercury is a global pollutant that can cause serious impacts on human health and the environment. Mercury can get into the environment in several different ways. Some mercury releases to environment due to natural sources, human activities and re-emit from the previously deposited in nature. Besides, it is well known that Asia not only represents the region with the largest mercury emissions, but also the region with the fastest growth rate of emissions. Malaysia is included in the areas of potentially significant mercury pollution. High concentrations of mercury have been reported in the areas of West Port, Malacca Straits, Prai, and Johor due to industrial activities (Praveena et al., 2013). Therefore, it is necessary to clarify the release sources for the appropriate management of mercury in Malaysia.

MATERIALS AND METHODS

The study is aimed at identifying and quantifying the mercury released to the environment. The data obtained through detailed inventory data is then calculated to determine the environmental impact. According to Habuer. et. al. 2021, The potential mercury distribution into various media can be calculated as follows:

$$TR_{Hg\rightarrow i} = \sum_{i=(1)}^{(6)} \sum_{c=1}^{41} (ARD_c * IF_c * DF_{c,i}) \qquad (1)$$

where $TR_{Hg\rightarrow i}$ is the potential mercury releases into different media in year 2019. i represents different environmental media and intermediate pathways, including (1) Air, (2) Water, (3) Land, (4) Product, (5) General waste and (6) Specific treatment. ARD is activity rate data. C represents different source categories. The input factor (IF) is the mercury concentration in the material or in the unit weight of the product (Habuer. et. al. 2021). Distribution factor (DF) is how the estimated mercury input from an activity/source is distributed to different environmental media and intermediate pathways (Civancik and Yetis, 2018). The IFs and DFs in the UNEP Toolkit (UNEP Chemicals, 2019) have been used for this estimation. ARD were obtained from various statistical yearbooks and databases. The Recipe 2016 method from the SimaPro software was used. However, for this study, the mercury release to air, water, and land only was included for environmental impact analysis. The intermediate pathways were neglected. Assumed that not the final output to the environment.

RESULTS AND DISCUSSION

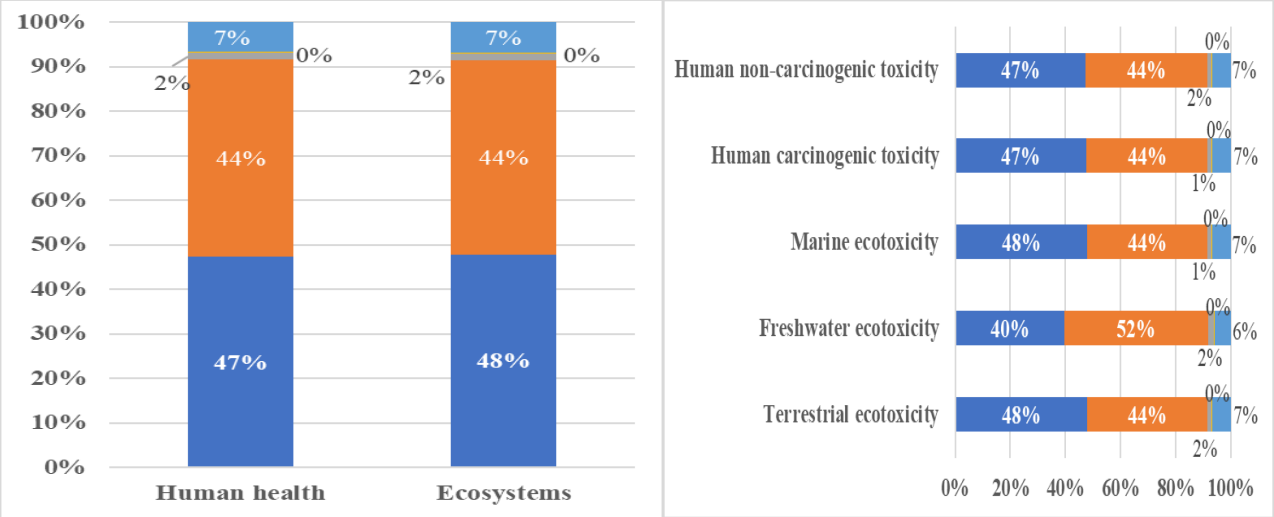
Total mercury releases in Malaysia, 2019

The sources of mercury releases can be identified into five categories: combustion, mineral production, secondary metal production, waste treatment, and others. Others include crematoria and cemeteries. The total

input of mercury is estimated to be 20.9 tons in 2019. The amount of mercury releases into air is estimated to be 11 tons which is the largest fate, accounted for 85% of total quantified releases. The amount of mercury releases into water and land are estimated to be 0.047 tons and 0.545 tons respectively.

Environmental impact of mercury releases in Malaysia, 2019

Figure 1 shows the environmental impact of mercury releases. The main contributor was the combustion category that contributed 47% of the damage to human health (human non-carcinogenic toxicity and human carcinogenic toxicity), and 48% to the damage to ecosystem diversity. The damages to terrestrial ecotoxicity, marine ecotoxicity and freshwater ecotoxicity, were mainly attributed to the categories of combustion and mineral production.



a) Method: Recipe Endpoint b) Method: Recipe Midpoint

Combustion Mineral Production Others Secondary Metal Production Waste treatment

Figure 1 Environmental impact of mercury in a) Recipe endpoint, b) Recipe midpoint

CONCLUSION

This study aimed to identify and quantify the mercury released and its environmental impact in Malaysia. The main contributors were combustion, mineral production, waste treatment, others (crematoria and cemeteries), and secondary metal production in Malaysia in 2019. Mercury release caused impacts to human health, toxicity of human non-carcinogenic and human carcinogenic, and impacts to the ecosystem diversity including ecotoxicity of marine, freshwater, and terrestrial. In this sense, Malaysia should implement strategic mercury management policies for avoiding pollution.

REFERENCES

Civancik, D., Yetis, U., Substance flow analysis of mercury in Turkey for policy decision support. Environmental Science Pollution Research 25 (4), 2996e3008, 2018.

Praveena, S.M., de Burbure, C. et al., Mini review of mercury contamination in environment and human with an emphasis on Malaysia: status and needs. Reviews on Environmental Health 28 (4), 195e202, 2013.

UNEP (United Nations Environment Programme) Chemicals, Toolkit for Identification and Quantification of Mercury Releases, Reference Report and Revised Inventory level 2 Report, 2019

Habuer, Fujiwara, T., Takaoka, M. Anthropogenic Mercury Release Flow in China. Chemical Engineering Transaction 83. 2021.in press.