Public health impact from waste-to-energy plants

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Summary

The concern on municipal solid waste management has significantly increased, along with the enormous increase in industrialization and quantity of waste production. In this context, particular aspects related to the different alternatives in the waste treatments are necessarily more and more to be studied. The present doctoral thesis focuses the attention on the waste incineration and the health risk assessment from this kind of plants. Original aspects with regard to the human health risk methodology and also the importance of new pollutants that must be taken into account, hence has been focused in the current research. The research was divided in two parts: the first one was orientated on state-of-the-art of waste incineration plants and the human health risk methodology and new considerations related to the methodology were made; in the second part an application of the present research for a waste incineration plant was exemplified.

Therefore, the current work proposes a tool for the health risk assessment concerning micro-pollutants, and also some indicators for macro pollutants impact assessment. For the first part of the research, a review of the existent approach for the health risk assessment was necessary to be realized. About the micro pollutants, it was started with the United States Environmental Protection Agency (US EPA, 1998) approach and then the updated methodology of the Office of Environmental Health Hazard Assessment (OEHHA, 2003). An interesting aspect after the approach definition is the choice of the pollutants from the waste incineration. Also, the air limit concentration levels for the regulated emissions were evaluated with the aim of establishing if the risk resulted from the regulated concentrations is an acceptable one.

Respect to the methodology used until now, a particular attention was paid for the diet exposure pathway; this is because, in case of the dioxin it was demonstrated that the food is the major route for human exposure to dioxin and dioxin-like compounds. Moreover, interesting results came out with regard to Cr through inhalation exposure and emissions from waste incineration plants. It was noted that with regard to the heavy metals risk assessment, together with Cd that already was considered for HRA, also Cr must be taken into account. Additional, a limit from Cr emission from waste-to-energy plants was proposed.

Consequently, it resulted that two important aspects must be carefully evaluated first that a waste incineration plant is designed: the territory prescription and the population presences in the interested area. In case that impacted area is located in an unfavorable area from the point of view of the pollutants dispersion and additionally is dedicated to the agriculture, the dioxin removal must become a priority; otherwise, if the interested area is an urban one, heavy metals emission decrease (in particular Cr and Cd) becomes a necessity.

For health risk assessment software was developed with the aim to facilitate the work considering existent database for the human health risk assessment. In this way, it is possible that different simulations are done and negative consequences are avoided.

Moreover, it resulted that dioxin deposition from waste incineration plant is negligible respect to the case when compost from sewage sludge is used. Additionally, it was demonstrated that the use of compost from sewage sludge makes possible the overall of the dioxin deposition resulted from the tolerable daily intake suggested by WHO. Suggestions on the dioxin content in compost used in agriculture were made; moreover, it was indicated that the dioxin content in compost used in agriculture sector must to consider an annual compost quantity applied for the different categories of compost.

With regard to both primary and secondary particles, it was demonstrated that a modern incinerator has a negligible role in the overall balance of particulate matter. Besides, it was noted the NOx removal importance with reference to NOx role in secondary particulate matter formation. However, in case of placing an incinerator of high capacity in unfavorable areas, it is important to maximize the efficiency of NO_x removal adopting multiple approaches as flue gas recirculation, SNCR, SCR. That is useful for avoiding problems of air quality in case of peak events.

Moreover, the human health risk quantification has been carried out for the macro pollutants through different indicators. In this way, it is possible to assess the human health risk from a waste incineration plant but also to establish criteria for the minimization of human health risk from the waste incineration plants. It was obtained as an instrument which can be applied not just for a particular case (just for a type of waste incineration plant, or for a particular meteorology or geographical conditions), but for different situations and special conditions. This kind of objective was essential considering that the developed approach needed to be applied in two different realities: the Italian and Romania.