MAIN FACTORS AFFECTING CLIMATE CHANGE, ACIDIFICATION AND EUTROPHICATION IN MSW MANAGEMENT SYSTEMS

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Key Words: MSW management, waste-to-energy, landfill, mechanical treatment, residual waste.

The continuous increasing of solid waste generation worldwide calls for management strategies to support environmental sustainability. Life Cycle Assessment (LCA) is a decision-support tool for quantifying environmental impacts of systems (product systems). Among the most important and discussed output-based impact categories of waste management, there are: global warming potential (GWP), acidification potential (AP) and eutrophication potential (EP). The aim of this work is to identify which are the most important factors in the Municipal Solid Waste (MSW) management affecting to GWP, AP and EP and what kind of conditions in the operating environment are essentials to these factors.

After a review of available literature on this topic (more than thirthy rarther recent papers were analyzed in details even if the reference list is not reported here for length constraints), the work was concentrated at evaluating two rather different study cases: i) the territory belonging to the province of Siena in the south of Tuscany region (Italy) and ii) the territory of South Karelia, the region in the southern Finland on the border with Russia. The total amount of MSW generated in the province of Siena in 2013 was 163 823 t, of which 94 963 t are residual waste, which is processed in a mechanical and biological treatment (MBT) plant. Dry fraction from MBT is sent for waste-to-energy (WtE), while humid fraction is landfilled after aerobic biological stabilization. Source separated wastes (about 45%) are refined locally by mechanical treatment and sent away for material recovery, in particular the organic fraction is processed locally for compost production. Concerning South Karelia region, the total amount of MSW generated in 2013 was 75 280 t, of which 22 500 t are residual waste. Separate collection is reserved for recoverable materials (cardboard, glass, metal, and paper) as well as for biodegradable waste. Residual urban waste is partly disposed to landfill and partly burned into WtE plant. Landfilling has been the only way to treat the residual MSW in the South Karelia region up to 2012, when it was decided to route part of them to a WtE plant. In the end of 2013 about one third of total residual waste was burned into the plant, producing district heating and electricity for the grid. Since 2015, all the residual waste has been directed to the WtE plant.

The results obtained in the case study analysis are partially consistent with the literature review. For instance, it was observed that collection and transportation contribution to the total balance is likely to be negligible, as also recognized by different authors. However, as others LCA practitioners point out, it is important to evaluate its contribution mainly when recycling treatment is operated, in order to assess the real benefits of recycling, especially for AP and EP related emissions. As expected, direct emissions from the WtE and from the landfill generate the largest contribution in the whole waste management system, concerning GWP, AP and EP. The same conclusion can be made when considering the energy recovery from WtE and from landfill gas combustion. It was observed that assumptions about waste composition have a considerable influence on the final LCA results. Even assumptions regarding displaced energy can largely affect the LCA final results, such as in both the case studies (i.e. displaced energy mix and energy recovery efficiencies), and this outcome is consistent with the reviewed literature. In particular the real replaced fuel by heat recovery has an important weight on the final results. Additionally, the recovery or disposal of the rejects from MBT plant plays an important role: in this regard, heat recovery can be crucial for improving the environmental performance significantly with respect to landfilling. However, it should be kept in mind that the great variance between different waste management systems prevents a meaningful generalization of the LCA results, which always need context-specific assessments.