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CLIMATE PROTECTION POTENTIAL OF WASTE MANAGEMENT IN BOSNIA AND HERZEGOVINA

Abstract: *In order to comply with the EU landfill directive (Bosnia and Herzegovina is a potential candidate for a membership in the European Union) and to reduce greenhouse gas emissions as well as to save important resources, mechanical biological treatment of municipal solid waste is a promising waste treatment option compared to open dumping and in particular large size landfilling. Mechanical biological waste treatment shows high potential to reduce direct GHG emissions throughavoiding methane generation in landfills. Besides, indirect GHG can be reduced by replacing primary products or fossil energy by recycling products and renewable energy, which are less greenhouse gas emission intensive.*

Key words: municipal solid waste management, greenhouse gas emissions, mechanical-biological treatment, landfill gas, material recovery.

INTRODUCTION

Currently, about 95% of the municipal solid waste (MSW) generated in Bosnia and Herzegovina (B&H) is landfilled [1]. There are information about two sanitary landfills, namely the landfill site of ‘Smiljevici’ and the one of ‘Uborak’. According to estimations, there are 75 official municipal landfills and about 3,000 wild dumps that cover the major part of MSW disposal in B&H, notably in the rural areas [2]. Disposal of biodegradable materials, such as food waste and paper waste, which are part of MSW, result in landfill gas (LFG) emissions. LFG mainly consists of methane, which is a high potential greenhouse gas (GHG). Without installation of advanced LFG catchment systems, LFG is emitted to the atmosphere, where it contributes to climate change.

In order to protect the environment, particularly soil and groundwater, projects are planned and partly initiated to switch from unmanaged dump sites to large size sanitary landfills [1,2]. Large size landfills enhance anaerobic conditions inside the landfill body, which in turn increases the methane generation rate. Therefore, large size landfills without advanced LFG catchment systems are more climate harming than open dumps.

This is one reason, why the EU Landfill Directive demands a reduction of organic materials being disposed inland fills. B&H is a potential candidate for a membership in the European Union [3], so in future it might be relevant to comply with EU legislation.

In the following, the potential GHG emissions from disposal of MSW by open dumping and large size landfilling are compared. Furthermore, an alternative MSW (pre-) treatment option, applying separation at source and mechanical biological treatment (MBT), is presented and evaluated according to its increase or decrease in GHG emissions.

METHODS

The potential GHG emissions resulting from open dumping, which is currently the predominant practice of MSW disposal in B&H (scenario 1) and large size landfilling, which is part of the future policy of MSW disposal in B&H (scenario 2) are evaluated on the national level for B&H.

Information about the generated quantities of waste and the composition of MSW in B&H are required when determining the methane generation and emission potential from any type of landfill.

According to data from the European Environmental Agency [4], in total, 1.5 million tons of MSW are generated in B&H annually (state 2009) with a trend of increasing MSW generation. The only information about MSW composition in B&H discovered during literature research was published within a Bosna Sema Educational Institutions Sarajevo College ISWEEEP Project [5]. This MSW composition, which is shown in Figure 1, is used for modeling the potential mass flow of and GHG emissions from MSW in B&H comparing different waste management approaches.

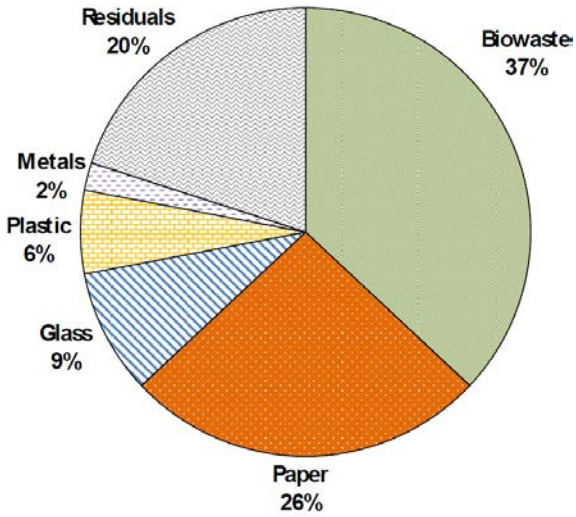

Figure 1. *Exemplary MSW composition for B&H, which has been applied in the presented work*

In order to determine the GHG emissions that potentially result from scenario 1 and scenario 2, the 'Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site' [6], which is approved by the United Nations Framework Convention on Climate Change (UNFCCC) has been applied. In order to demonstrate the highest LFG emission potential, LFG catchment has not been taken into account for scenario 2.

The UNFCCC tool applies a methane correction factor (MCF) to consider the conditions of landfilling in terms of the methane emission potential. The lowest MCF suggested by the IPCC 2006 Guidelines for National Greenhouse Inventories amounts to 0.4 and is to be applied for "unmanaged-shallow solid waste disposal sites. This comprises all SWDS (solid waste disposal sites) not meeting the criteria of managed SWDS and which have depths of less than 5 meters." ([6], page4).In this study, this type of waste disposal has been chosen for scenario 1. The GHG emissions from anaerobic managed solid waste disposal sites, which "must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste" ([6], page 4) are to be calculated applying an MCF of 1.0. This MCF has been chosen for scenario 2 within this study.

Apart from the waste composition and the way of disposal, the tool also takes into account climatic conditions. In this study, B&H is considered a dry country, whose average temperature is below 20°C (boreal and temperate; mean annual precipitation < potential evapotranspiration).The calculation of potential GHG emissions from disposal was carried out for a short term time horizon of 10 years only. According to the applied tool, less than 50% of degradation has taken place after 10 years of disposal, so that the long term GHG emissions from landfilling are more than twice as high as the one considered in this study.

In order to comply with the EU Landfill Directive, the redirection of organic substances from being landfilled is relevant. Figure 2 shows a MSW management system, which avoids the major part of organic substances in MSW from being landfilled (scenario 3).

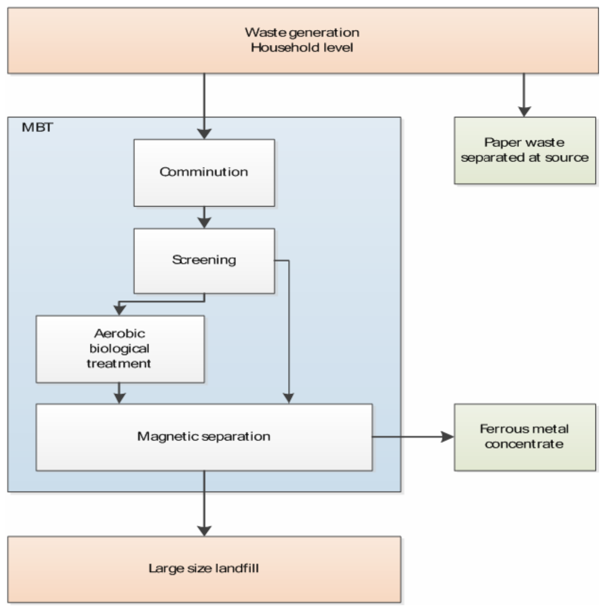

Figure 2. *Flow chart of the waste management system, investigated in scenario 3, which includes separation of paper waste at source, MBT and ferrous metals recovery from MSW*

The MSW is directed to an MBT plant prior to landfilling. Reliable, well-proven MBT processes, whose aerobic biological stage is fed with the fine fraction (<60mm) of MSW, show a mass loss of the organic content of roughly 60% [7]. The organic content of the fine fraction mainly consists of bio-waste. Paper waste shows a higher average particle size and the major part of paper waste remains in the coarse fraction of MSW, which is not directed to the biological treatment. In order to avoid paper waste from being landfilled, it has been assumed to be separated at household level by at least 60% and to be directed to a paper recycling facility. This way of treatment does not only avoid LFG emissions from degradation of paper waste but also saves GHG emissions and resources by replacing primary paper with recycling paper. The GHG emission savings are assumed to amount to 3 tons of CO_2 equivalent per ton of recycled paper. Apart from biological treatment, MBT plants often include ferrous metal separation, since magnetic separation technology is comparably easy to handle and typically amortizes quickly. Within scenario 3, ferrous metals are assumed to be recovered up to90% and directed to a ferrous metal recycling facility to reduce GHG emissions and primary resources. The GHG emission reduction per ton of recycled ferrous metal is assumed with 1.2 tons CO2-equivalent. The solid output of MBT is assumed to be sent to a large size landfill without landfill gas recovery as described in scenario 2. The landfill gas emission rate due to degradation of food waste however is reduced by 50% since the food waste is partly mineralized and the major fraction of easily degradable substances is already converted due to previous biological treatment.

RESULTS

Figure 3 shows the mass flow of MSW in B&H when implementing the scenarios described in chapter 2.

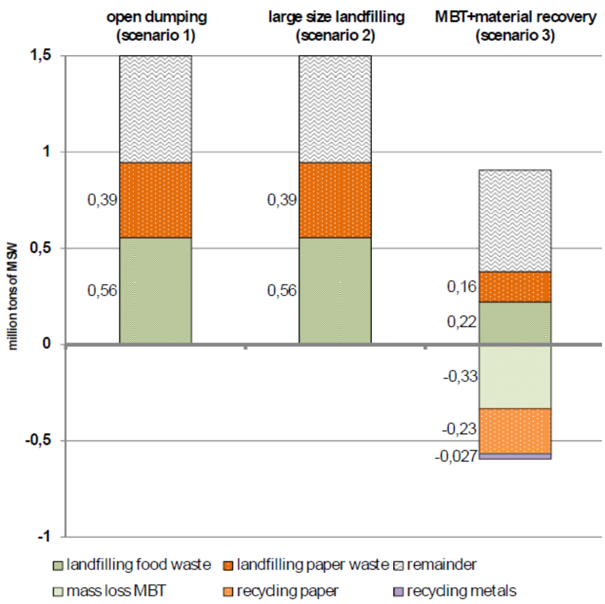

Figure 3. *Mass flow of different scenarios – positive flows are directed to landfill, negative flows are avoided from being landfilled*

The mass flow of MSW in scenario 1 and scenario 2 is equal, since all waste is sent to landfill disposal sites. The fraction of food waste and paper waste in MSW is indicated so that the influence of MBT and material recovery on the amount of organic MSW going to landfills outlined. In scenario 3, the amount of organic substances going to landfill is reduced by 60% compared to scenario 1 and scenario 2. The total amount of MSW going to landfill is reduced by 40%.

Figure 4 shows the potential GHG emissions resulting from the investigated waste management scenarios, all expressed in CO2-equivalents.

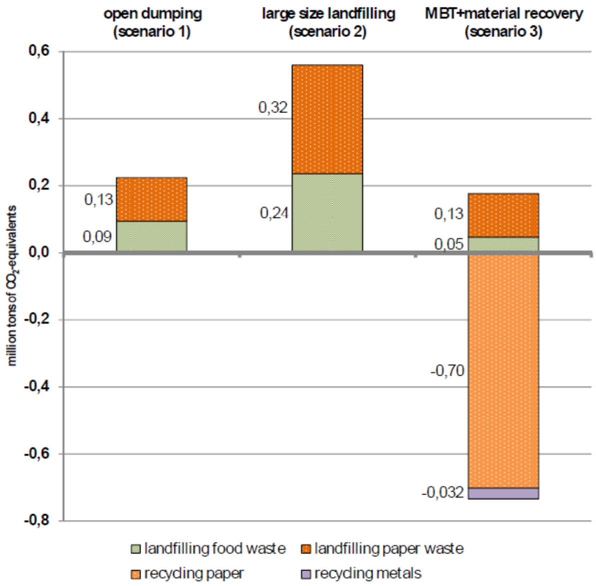

Figure 4. *Mass flow of GHG emissions – positive flows are GHG emissions, negative flows are GHG savings*

The comparison to Figure 3 shows that the mass flow of scenario 1 and scenario 2 in terms of GHG emissions is not equal. Switching from open dumping to large size disposal without LFG catchment leads to GHG emissions increased by 150%. However, when applying MBT and separating paper waste at household level as shown in scenario 3, MSW management shows the potential to serve as a net carbon sink by avoiding GHG emissions from LFG production as well as saving GHG emissions through recycling. Compared to scenario 1 the GHG emission reduction potential, of scenario 3, amounts up to 350%.

CONCLUSIONS

Investigating the potential impact of different waste management systems in B&H, it has been found that the type of landfilling does not influence the mass flow of MSW, however, the GHG emissions from landfilling may clearly increase, when switching from open dumping to large size landfilling without implementing LFG catchment. Separate collection of paper waste and MBT including ferrous metal recovery, in contrast, allow high GHG emission reductions so that MSW management has the potential to serve as a net carbon sink. At the same time, lifetime of landfill disposal sites and resource efficiency are increased.

REFERENCE

[1] European Environment Agency, URL: http://www.eea.europa.eu/soer/countries/ba/soertopic_view?topic=waste, accessed 04/2012

[2] Rohrhofer, K., Budisa, I., Berger, S.-B.: Waste Management in SE-Countries – Case Histories in BiH 2006, Praxistagung Deponie 2006

[3] European Comission, URL: http://ec.europa.eu/enlargement/potential-candidate-countries/bosnia_and_ herzegovina/ eu_bosnia_and_herzegovina_relations_en.htm, accessed 04/2012

[4] European Environment Agency, URL: http://www.eea.europa.eu/data-and-maps/figures/municipal-waste-generation-per-capita-in-western-europe-eu-15-new-member-states-eu-12-eu-countries-eu-27-and-total-in-europe-eu-27-turkey-croatia-norway-iceland-switzerland-4, accessed 04/2012

[5] Sulejmanovic, A., Masic, A.: BOSNA SEMA EDUCATIONAL INSTITUTIONS SARAJEVO COLLEGE ISWEEEP PROJECT, Project's name: Using transparent wastes as 'Transparent thermal insulators' 2007, URL: http://bosepo.ba/BOSNIA_PROJECT_1.pdf, accessed 04/2012

[6] United Nations Framework Convention on Climate Change: Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site, Version 04, URL: http://cdm.unfccc.int/ methodologies/ PAmethodologies/tools/am-tool-04-v4.pdf, accessed 04/2012

[7] Ketelsen, K:, Kanning, K.: Umrüstung der MBA zur Biogasgewinnung, Bio- und Sekundärrohstoffverwertung V, ISBN: 3928673564, Pages 619-648, 2010

POTENCIJAL UPRAVLJANJA OTPADOM U BOSNI I HERCEGOVINI ZA SPREČAVANJE KLIMATSKIH PROMENA

Adele Clausen, Thomas Pretz

Rezime: *U cilju usaglašavanja sa Evropskom direktivom o otpadu (Bosna i Hercegovina je potencijalni kandidat za članstvo u Evropskoj Uniji) i smanjenja emisije gasova staklene bašte, mehaničko-biološki tretman čvrstog komunalnog otpada je alternativa divljim i velikim gradskim deponijama. Mehaničko-biološki tretman otpada predstavlja veliki potencijal za smanjenje emisija gasova staklene bašte sprečavanjem pojave metana na deponijama. Pored toga, smanjenje emisija gasova staklene bašte se može postići smanjenjem upotrebe fosilnih energenata ili upotrebom recikliranih proizvoda i obnovljivih izvora energije, koji izazivaji manji efekat staklene bašte.*

Ključne reči: upravljanje čvrstim komunalnim otpadom, emisija gasova staklene bašte, mehaničko-biološki tretman, deponijski gas, upotreba sekundarnih materijala.