Short and long-term settlement properties of MBT waste

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After mechanical and biological treatment (MBT), municipal solid waste (MSW) has altered compression properties with respect to the input waste material. In mechanical and biological treatment plant which utilizes biodrying, municipal solid waste is separated in several waste streams (i.e. plastics, metals, RDF), while certain amount of remained waste (so-called methanogenic fraction) has to be landfilled into the bioreactor landfill cell.

Bioreactor landfills recycle leachate back into the landfill body in order to enhance decomposition of the biodegradable solid waste and producing methane for energy recovery purposes. From a civil engineering point of view, bioreactor landfills can be observed as artificial embankments and slopes with the main building block being mechanical-biological treated waste. While described methodology is beneficial to the environment it can also cause significant difficulties in the operating conditions of the landfill. Namely, due to an increased moisture content and unit weight, decreased effective stresses and rapid biodegradation a significant amount of settlement within the landfill body can be anticipated. Therefore, the examination and determination of the compression properties of biodryed methanogenic fraction are of substantial importance to a quality landfill design process. In this paper, the focus is on determining the compressibility behavior of biodryed methanogenic fraction with maximum particle size of 25 mm.

According to Powrie *et al.* (2019) settlement of partly of fully saturated waste is consisted from three distinctive components: immediate compression - mainly related to the compression or expulsion of gas and/or the compression of very soft particles; primary compression – predominantly governed by the discharge of the excessive liquid; secondary compression – caused by rheological creep and biodegradation. Therefore, four different test conditions were investigated: compression behaviour of dry material, compression behaviour of fully wetted material, compression behaviour of the initially dry material up to a certain stress level, and then followed by wetting and continued loading; long-term compression caused by the biodegradation processes (Figure 1). The long-term compression test lasts for more than 11 months and it is still in progress while during the test environmental parameters and generation of landfill gases were also monitored (Figure 2).

Based on the measured data compression properties under dry and wet condition of the tested material is obtained. In addition, change in compression properties caused by wetting procedure (leachate recirculation), as well as the long-term compression properties were also established.

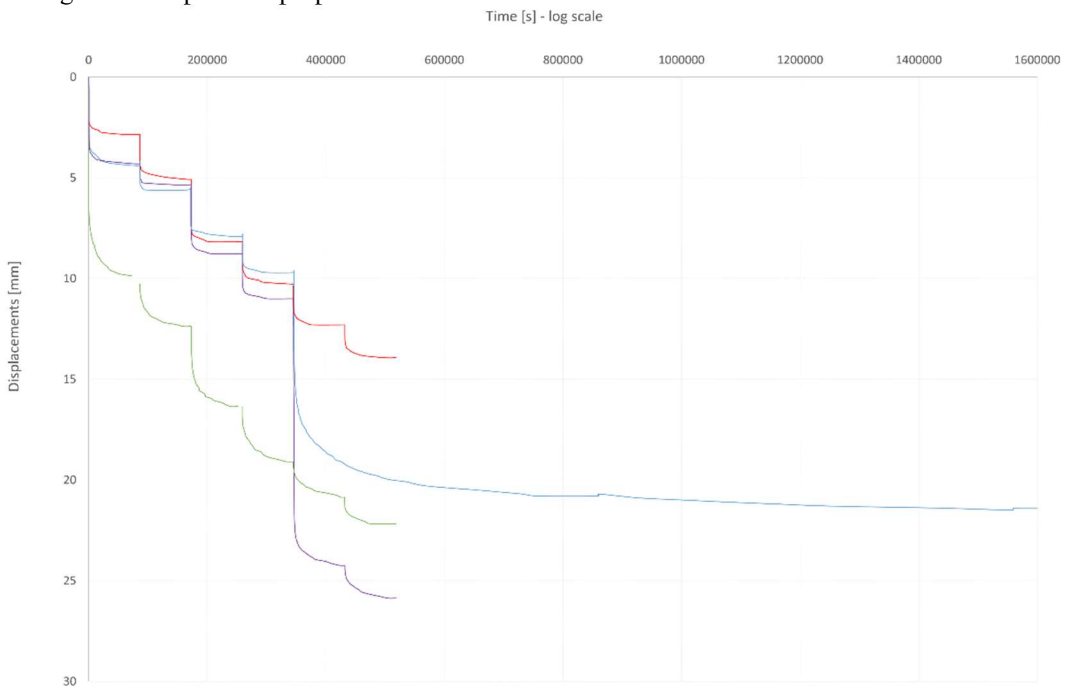

Figure 1. Displacement – time curves for dry (red), wet (green), dry-wet (purple) and long-term (blue) samples. *Note: presented Figure does not include initial settlements of samples caused by the top platen.*

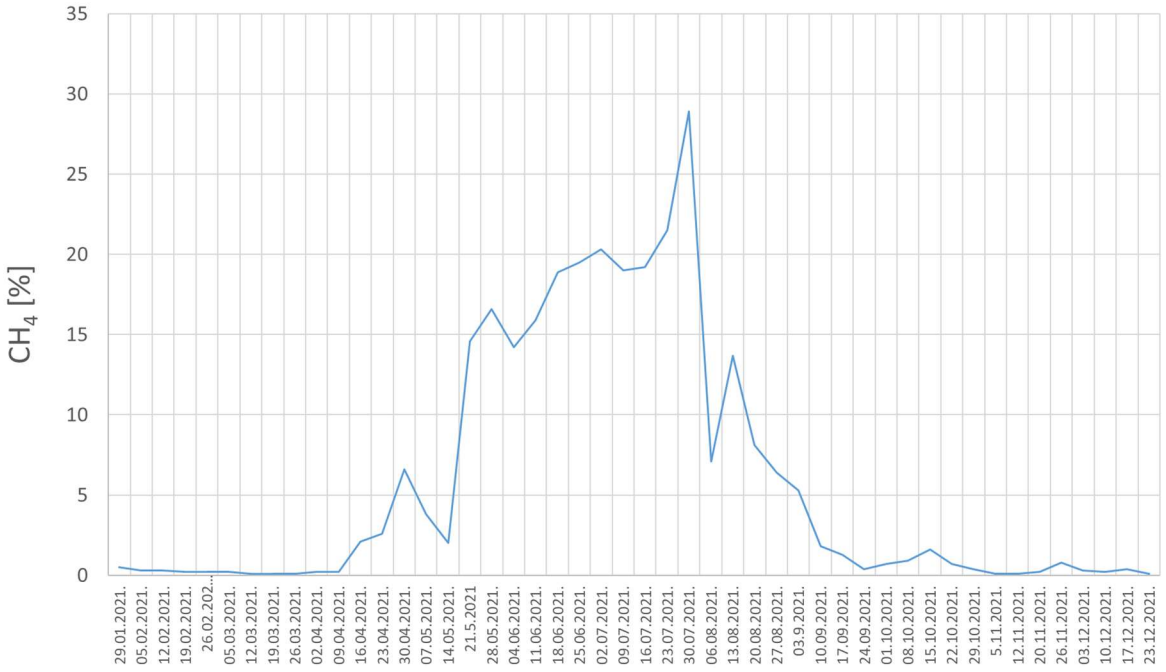

Figure 2. Methane generation during the long-term compression experiment

Key words: MBT, MSW, immediate settlement, secondary compression, bioreactor landfill

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References
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