

**SCIENTIFIC AND TECHNICAL CO-OPERATION**

**between**

**Graz University of Technology (Austria)  
and**

**University of Zagreb (Croatia)**

October 2018.

The partners discussed additional details about experimental programme which needs to be carried out in order to improve the prediction power of the hypoplastic constitutive model for MBT waste material.

Furthermore, the partners also discussed on possibilities for mutual projects proposals along with additional partners from Széchenyi István University, Győr, Hungary who was also attended the meeting. The representatives of the Hungarian side was Assoc. Prof. Majid Movahedi Rad and Gábor Hajdú, MSc.

On 15<sup>th</sup> October Assoc. Prof. Majid Movahedi Rad held a presentation under the title “Numerical modeling of grain crushing with DEM”.

On 17<sup>th</sup> October Assoc. Prof. Igor Petrovic held a presentation under the title “Biodrying and Bioreactor landfills”. Within the presentation it was elaborated the main differences between untreated and treated waste material (Figure 1), as well as the importance of knowing the mechanical parameters of the biodried waste material in order for proper design of bioreactor sanitary landfill (leachate recirculation, stability of drainage gas wells...).

On 19<sup>th</sup> October Prof. Erich Bauer and Mohammadkeya Khosravi, PhD held an introduction lecture about hypoplasticity.

The portion of biodried waste which is remained after subsequent mechanical treatment (so called „fine fraction“), suitable for landfilling at bioreactor landfill, is presented on Figure 1. It can be noticed that this material has relatively small particle size (max is about 25 mm) and therefore low hydraulic conductivity. According to the best knowledge of project partner for the specified material there is no any published data about mechanical and hydraulic properties.



Figure 1.

The following topics has been discussed:

a) Experimental programme

- creep behavior of biodried waste material – the influence of loading speed on the change of void ratio
- collapsible behavior – the influence of change of moisture content of the change of void ratio under constant load

- the importance of the tested sample. Prior testing the following sample properties has to be established:
  - main constituents
  - granulometric curve (for each constituent and for the mixture)
  - dry density (for each constituent and for the mixture)
  - solid particle density (for each constituent and for the mixture)
  - moisture tendency
- to examine the possibility to create artificial samples consisted from 3 to 4 main constituents of the actual waste sample
- to examine the influence on grain crushing for samples with different ratios of stiff and soft particles – possibility for cooperation with partners from Hungary
- to examine the fresh waste material with suppressed biodegradation in order to catch pure mechanical behaviour of waste. The sample degradation can be suppressed with addition of the necessary amount of acetic and propionic acids. Then, to examine the waste material under various degradation stages. The degradation process can be accelerated with inoculation of sample with appropriate microorganisms and nutrients.
- the question of measurement of the radial deformation during triaxial tests in order to establish the volume change of partially saturated samples
- the question of how to control and keep constant the moisture of air in the case that additional air is going to be introduced to the waste sample

b) Project calls from various sources on which we can apply

- calls from Croatian Science Foundation
- calls from Unity through knowledge fund (UKF) – for this kind of cooperation we need to seek for a partner which have Croatian citizenship and currently work abroad. Therefore, Renato Sarc, PhD from Montanuniversität Leoben is going to be invited to the next meeting
- KIC Raw Materials calls – University of Zagreb and TU Graz already participate in this community. Each year KIC announces calls for proposals. It should be investigated whether there is a possibility to apply to some of their calls. Partners from Széchenyi István University can participate through University of Miskolc.
- calls from Hungarian national funds
- Horizon 2020 calls

c) Literature review – to search for recently published papers related to the mechanical behaviour of waste material. Some of them are:

- Constant load and constant volume response of municipal solid waste in simple shear December 2016, Waste Management 63, DOI: 10.1016/j.wasman.2016.09.029
- Evolution of saturated hydraulic conductivity with compression and degradation for municipal solid waste, April 2017, Waste Management 65, DOI: 10.1016/j.wasman.2017.04.015
- Response of Municipal Solid Waste to Mechanical Compression, December 2016, Journal of Geotechnical and Geoenvironmental Engineering 143(3), DOI: 10.1061/(ASCE)GT.1943-5606.0001608

- Influence of the fibre component of soft plastic on shear strength parameters of pre-treated municipal solid waste, January 2014, A.V.A. Borgatto, Claudio Mahler, Kai Münnich, A.D. Webler
- Coupled experimental assessment of physico-biochemical characteristics of municipal solid waste undergoing enhanced biodegradation, January 2018, Géotechnique, DOI: 10.1680/jgeot.16.p.253
- Experimental Assessment and Modelling of Coupled Biochemical-Physical-Mechanical Biodegradation Process of a Municipal Solid Waste Sample from Michigan, Conference Paper, Sep 2017, Sampurna Datta, Dimitrios Zekkos, Xunchang Fei, John McDougall
- Large-Scale Experimental Assessment of the Effect of Degradation on Shear Strength of Municipal Solid Waste from a Texas Landfill, Chapter, Jun 2017, Sampurna Datta, Xunchang Fei, Dimitrios Zekkos
- The Influence of Waste Composition on the Physico-Biochemical-Hydraulic Characteristics of the Degradation Process of Municipal Solid Waste, Conference Paper, Aug 2016, Xunchang Fei, Dimitrios Zekkos
- Special Thematic Issue: Sanitary Landfilling, Edited by Alberto Pivato, Volume 63, Pages 1-432 (May 2017)
- Waste Composition-Dependent “HBM” Model Parameters Based on Degradation Experiments, November 2018, Journal of Environmental Geotechnics, DOI: 10.1680/jenge.18.00014, Sampurna Datta, Dimitrios Zekkos, Xunchang Fei, John McDougall