Title: Characterisation of landfill leachate from municipal solid waste of Astana city.

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Abstract

In 1998, the government of Kazakhstan has decided to move the capital city of the country from Almaty to Astana (previously named as Akmola) which is located in the northern part of the country. Since that time, the population of city has tripled and currently reached 1 mln in 2016. Rapid increase of the Astana city has put a significant pressure on the city municipalities to deal with the amount of municipal solid waste (MSW), MWS management and infrastructure at the disposal polygons. According to the data of municipality, the current area of the Astana polygon has been operating since 2006 and has already exceeded its capacity. By the end of 2016, the polygon has accepted over 4 mln. tons of MSW while its projected capacity is 3.2 mln tons. An identical new polygon is going to start accept MSW roughly from March 2017, while current one will start re-cultivation process in the first half of 2017 (Ekopoligon-Astana).

Landfilling of MSW is still remains the dominant municipal solid waste management practice in Kazakhstan. As a result, MSW land filling generates a huge amount the landfill gas and leachate that brings a serious environmental concern to the air and groundwater pollution (Kjeldsen et al., 2002). Landfill leachate is the product water that has produced through waste deposits and undergone aerobic and anaerobic microbial decomposition (Brennan et al., 2017). Typically landfill leachate contains several groups of pollutants such as organic matter, nutrients, and inorganic pollutants (Kjeldsen et al., 2002). Latest pollutants typically contain heavy metals, toxic organic micro pollutants. At present, there is a limited data in the literature on leachate analysis from MSW landfills of Kazakhstan polygons. Therefore, this study is focused on the chemical characterisation of the landfill leachate from MSW of Astana city. We plan to characterise leachate and apply adsorption techniques for removal of heavy metals. Activated carbon and zeolite particles will be employed to investigate its effect on the reduction of metal concentration, which will be estimated by AAS. A complementary experiment will be conducted to examine conductivity and pH in the samples which will be measured at predetermined time intervals and concentrations.

In addition to the leachate characterisation, the data from landfill gas measurement campaigns will also be provided that has been conducted in July and August 2016. Our measurements of landfill gas composition have showed over 50% of methane and around 35% for carbon dioxide. For these tests, a portable gas analyser was used that has been calibrated for each gas compounds. In addition, biogas sample will be tested by stationary gas chromatography.

References

Bienvenu K. Mavakala, Severine Le Faucheur, Crispin K. Mulaji, Amandine Laffite, Naresh Devarajan, Emmanuel M. Biey, gregory Giuliani, Jean-Paul Oramonga, Prosper Kabatsuila, Pius T. Mpiana, John Pote. "Leachates draining from controlled municipal solid waste landfill: Detailed geochemical characterization and toxicity tests." Waste Management (2016): 238-248.

Ekopoligon-Astana report 2017. (The data obtained by personal communication).

P. Kjeldsen, M.A. Barlaz, A.P. Rooker, A. Baun, A. Ledin, T.H. Christensen, Present and long-term composition of MSW landfill leachate: a review, Crit. Rev.Environ. Sci. Technol. 32 (2002) 297–336.