Landfill emission quantification

Improvement in measurement and modelling approaches to asses (long-term) emissions and stabilization

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Introduction Main focus of this project is assessment of landfill stabilization and long-term emissions through monitoring of leachate/gas concentrations. For accurate assessment, current measurement and modelling methods need to be improved. Main issue in data-analysis of measured emissions is the inability of methods to capture emission dynamics accurately. The proposed measurement method will improve this and therefore lead to better estimations of stabilization and emissions. Furthermore, for prediction of long-term emissions there is another problem. Currently predictions are highly uncertain. This is because they are made by extrapolation of empirical and not process-based relations. These predictions can therefore not be used for landfill aftercare assessment. A new modelling approach is proposed that reduces uncertainty by including the distribution and characteristics of processes responsible for emissions. Information on these processes, since landfill are considered black-boxes, can only be extracted from emission and waste sample datasets. Detailed and accurate measurement datasets are therefore also for modelling very important. Ideas for improvements in measurement and modelling methods are described in more detail and displayed in Figure 1 and 2, respectively.

Improved measurement method:

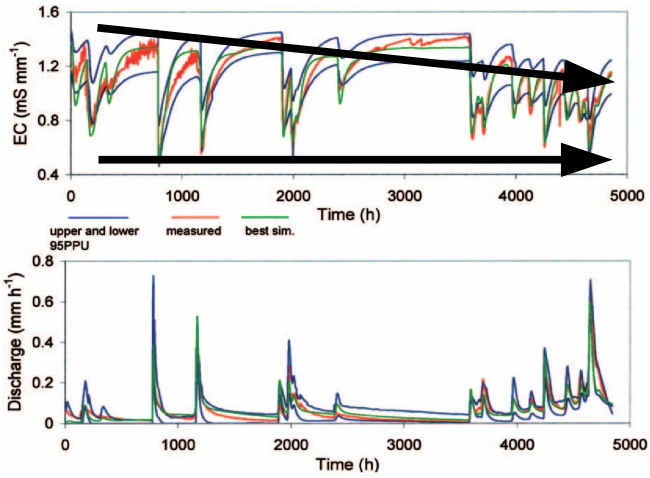

Figure 1: Measured electric conductivity (EC) in time (top) and measured discharge rate in time (bottom). A correlation can be detected between maximum discharge rates and minimum EC. Also a decreasing trend in maximum EC in time can be observed. EC is correlated to the concentrations of charged species in the discharge. (Abbaspour et al 2004).

Due to variation in environmental conditions, like rainfall events, leachate concentrations are very dynamic on a short-time scale. Measured concentrations in leachate oscillate between maximum and minimum concentrations. Electrical conductivity (EC) is correlated to the total concentration of charged species in discharge/leachate. With EC measurements, the oscillations and trends in maximum and minimum concentrations can be observed. EC measurements are displayed in Figure 1 (trends are indicated by arrows). For accurate data-analysis of stabilization and emissions it is important to obtain a good estimation of the trends of these two types of concentrations for all compounds. To obtain these, high frequent sampling or on-line monitoring will be necessary but is currently not possible or too costly.

The following improvements are proposed to solve this problem. Firstly high-frequent sampling of many compounds is replaced by flux-averaged measurements with Sorbicells. Secondly, to increase accuracy, the Sorbicell measurements are corrected for environmental dynamics by on-line monitoring of several key parameter like EC, pH and DOC.

Improved modelling method:

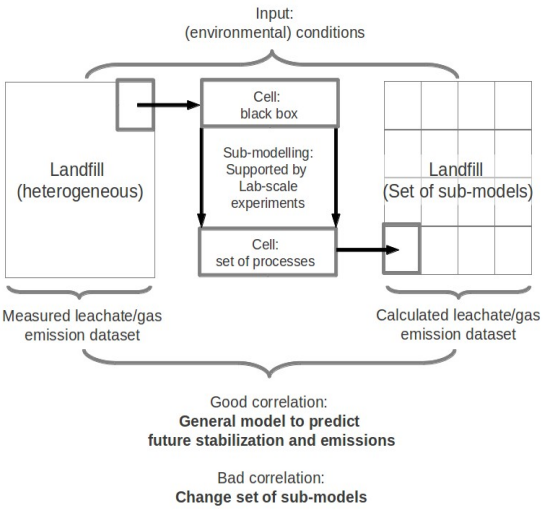

Figure 2: Representation of a heterogeneous landfill by a set of cells (sub-models). Good correlation of the calculated and measured leachate/gas emissions indicates a good description of the dominant processes in the landfill.

Currently landfills are considered black-boxes. Therefore only empirical relations, relating input and output conditions exists. Key research question is how to extract information (opening the black box) from emission and waste sample datasets to model the distribution and characteristics of these processes. With this model, based on distribution and characteristics of process, more accurate long term emissions predictions can be made.

The following modelling approach is proposed to realize this and a schematic representation is displayed in Figure 2. In order to model heterogeneity in processes, the landfill model is divided in many cells/sub-models. These sub-models are representative for possible landfill states and their controlling parameters will be estimated from corresponding datasets (experiments/LeachXS). Once a set of all possible states for a landfill is assembled and calibrated the stochastic distribution of these states must be estimated. This estimation will be based upon an optimization, minimizing the error between the calculated and measured emission dataset. When the correlation between these sets is good, the model can be considered as an accurate representation of the landfill.

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