Evaluation of microbial populations in biological treatment of landfill leachate at low temperature and in methane oxidation structure

Pelkonen Markku

Helsinki University of Technology, Laboratory of Environmental Engineering
PO BOX 6100, FIN-02015 HUT (Espoo), Finland. Markku.Pelkonen@hut.fi
Phone +358-9-451 3847, fax +358-9-451 3856

In the management of landfill emissions biological processes have in many cases an important role. This concerns for example landfill leachate management as well as methane emissions. To evaluate and upgrade the performance of those processes more detailed information about the microbial phenomena and the selection of microbes are of importance. In this study results are shown from a full scale leachate treatment plant operating at low temperature as well as methane oxidation during cold and warm season.

The full scale leachate treatment plant, which has been in operation over two years, operates at temperature around 15-20 °C during the warm season and at around 5-7 °C during the cold season. In case of snow melting periods the temperature can decrease to 4 °C, but the drop of temperature can be controlled in some degree with the operational parameters. Data, which has been collected from the whole operation period, shows that a complete and stable nitrification can be maintained in those very demanding conditions (temperature 4 °C, much higher salt and ammonia concentrations compared to municipal wastewaters). This led to effort to find out, which bacteria are selected to the process and capable of this performance.

The previous results (Pelkonen et al. 2000) showed a reasonable nitrification rate indicated as ammonium reduction or nitrate production as a sum reaction at low temperature. In practice the oxidation is a two step reaction consisting of ammonium oxidation to nitrite and then to nitrate. A more detailed characterization of the biomass showed in batch tests, which was performed at low temperature, that the nitrite oxidation rate was much higher than the ammonium oxidation, which was the rate limiting step. These two (ammonium and nitrite oxidizing) populations were analyzed with fluorescent in situ hybridization oligonucleotide probes (FISH). The results show that from the nitrite oxidizing community *Nitrospira sp.* was widely present being the dominating organism. This result is in agreement with recent information of nitrite oxidizers (Daims et al. 2000). It is good to know that the picture of ammonia and nitrite oxidizers in real processes has been changed recently due to the new techniques (such as FISH) available, which makes it possible to analyze the environmental samples in a more representative way. From the ammonia oxidizing bacteria the halophilic members of *Nitrosomonas* could be detected. However, it is more obvious that the diversity of ammonia oxidizing bacteria is larger than that of nitrite oxidizers and requires more effort to get a complete picture of this group. The presence of new species, not earlier described from a treatment process, cannot be omitted.
This example shows the application of biological process in conditions, which can be considered as very demanding, and bacteria capable of the performance are of interest. That is one way to expand the application ranges of biological processes. Another example is made

with methane oxidizers (MOB) at low and intermediate temperatures by using group specific identification of the MOB with FISH in a biologically active methane oxidation structure.

References:

Daims H, Nielsen PH, Juretschko S, Wagner M (2000) Novel *Nitrospira*-like bacteria as dominant nitrite-oxidizers in biofilms from wastewater treatment plants: diversity and *in situ* physiology. Water Science & Tech. Vol 41 No 4-5, pp. 85-90.

Pelkonen M, Kotro M, Wang Z (2000) Full scale performance of biological leachate treatment at low temperature. 1st intercont. landfill research symposium, Luleå 10-13.12.2000.