In situ Aeration of the Old Kuhstedt Landfill, Germany

- Results of the Full Scale Operation and Comparison with the Lab Scale Investigations -

M. RITZKOWSKI*, K.-U. HEYER** and R. STEGMANN*

* Dep. of Waste Management, TU Hamburg-Harburg, Harburger Schlossstr. 36, D - 21079 Hamburg [m.ritzkowski@tu-harburg.de; Phone: +49/40/42878-2053; Fax: -2375; http://www.tu-harburg.de/aws/]

** Consultants for Waste Management, Prof. R. Stegmann and Partner; Nartenstr. 4a, D - 21079 Hamburg [heyer@ifas-hamburg.de]

Introduction

The results of investigations from laboratory scale tests and many old landfills in Germany show that significant emissions occur over long periods of time after closure. The significant emissions via the gas phase will last at least 3 decades after the closure of the landfill while leachate emissions are predicted for many decades or even centuries. By respecting the sourrounding environment of the old landfills and the type and quality of protection barriers (f.e. liners), which are missing in most cases for the old landfills, the emissions from these landfills may result in a significant negative impact on the environment. The aerobic in situ stabilisation by means of low pressure aeration (AERO*flott*, Stegmann et al., 2000*)* attempts to reduce the inventory of organic matter inside the landfill body in order to modify and to stabilise it in a way that the emission potential will be significantly and sustainably reduced. This aim can be achieved by installing of the aerobic degradation processes in the landfill which are faster and more extensive than anaerobic degradation. This results in a reduction f.e. in hydrocarbons as well as nitrogen in the leachate phase. In principle the same processes are installed in the old landfills that are used for the biological pre-treatment of residual waste. This process is used in Germany and many other European countries with increasing tendency. Further more the accelerated aerobic in situ stabilisation has a significant cost saving potential due to a reduction of the aftercare period. Additionally the cost intensive surface liner system as it is prescribed by the German Technical Guidance Municipal Solid Waste might be modified into an alternative surface cover system after the aeration measure has been terminated (Heyer et al., 2001).

Investigations in Landfill Simulation Reactors (LSR)

Since 1999 a R&D project, financed by the German Ministry of Research and Technology (BMBF) and the Landkreis Rotenburg (Wümme), is carried out. Within this project the Technical University of Hamburg-Harburg, Department of Waste Management in cooperation with the Consultants for Waste Management, Hamburg are investigating the fundamentals of landfill aeration and the operation of the in situ stabilisation in full scale. In order to demonstrate the effects of the aeration on the emission behaviour of the landfilled waste and more over to reach important indications for a successful operation of the installed aeration equipment extensive laboratory investigations in Landfill Simulation Reactors (LSR) on waste samples taken from the old Kuhstedt Landfill are practised. The intermediate results of these long term investigations show that due to the aeration biodegradable organic components are converted faster, nitrogen concentrations in the leachate

can be reduced significantly but on the other hand the buffer capacity is reduced and sulfate concentrations increase temporarily. Apart from the effects on the leachate quality the carbon conversion into CO_2 and its discharge via the gas phase during the aeration is increased in a considerable way (Ritzkowski et al., 2001).

Set up and results of the full scale application

The full scale realisation of the aeration measures at the old Kuhstedt landfill consist of a system of 25 gas wells. Each well can either be used for aeration or for extraction of the exhaust air which is treated afterwards by non-catalytic oxidation or activated carbon. After the planning and preparation phase the equipment for the aeration measures has been installed in summer and early autumn 2000. Since October 2000 gas was extracted out of the landfill body and in April 2001 the active aeration measure started. The first results from the monitoring of the gas phase, leachate and groundwater composition, temperatures and settlements of the landfill body show that the positives effects, indicated by the lab scale investigations, can principally be achieved in full scale. This particularly includes the changing of the milieu conditions from anaerobic to aerobic (indicated by changing pH- and Eh-values), the reduction of the ammonia concentration in the upper aquifer (measured in some monitoring wells in the down-stream area of the old landfill), in accelerated carbon discharge (in comparison with the former anaerobic conditions) and a significantly temperature and settlement increase (following a clear correlation between oxygen supply and the amount of biological degradable organic substance) in the landfill body (Ritzkowski et al., 2002).

Outlook and research questions

It is planned to continue the aeration for approx. 12 months in order to achieve a widely and homogenous degradation of the organic substances inside the landfill. Subsequently solid samples will be taken and analysed to determine the realised degree of biological stabilisation of the waste samples. This will include measurements of the respiration activity and gas formation potential as well as in parallel long term investigations in LSR. The landfill body itself should be kept in aerobic conditions by certain measures, f.e. passive aeration after the active aeration period has been terminated.

References

Heyer, K.-U., Hupe, K., Ritzkowski, M., Stegmann, R., 2001. Technical Implemetation and Operation of the Low Pressure Aeration of Landfills. In: Sardinia 01, Eighth International Waste Management and Landfill Symposium, Conferrence Proceedings, Vol IV, pp 521-530

Ritzkowski, M., Heyer, K.-U., Stegmann, R., 2001. Aerobic in situ stabilization of old landfills with the old landfill Kuhstedt (Germany) serving as an example. In: Sardinia 01, Eighth International Waste Management and Landfill Symposium, Conferrence Proceedings, Vol IV, pp 577-586

Ritzkowski, M., Heyer, K.-U., Stegmann, R., 2002. Aerobe in situ Stabilisierung der Altdeponie Kuhstedt - Laboruntersuchungen und Praxisbezug - In: Deponietechnik 2000, 3. Hamburger Abfallwirtschaftstage 14.-15. Februar 2002, Hamburger Berichte, Band 18, Hrsg.: R. Stegmann, G. Rettenberger, H.-J. Ehrig, W. Bidlingmaier, Verlag Abfall aktuell, Stuttgart, pp 173-197

Stegmann, R., Hupe, K., Heyer, K.-U., 2000. Verfahren zur abgestuften beschleunigten in situ-Stabilisierung von Deponien und Altablagerungen. Patent Nr. 10005243. Deutsches Patent- und Markenamt, München