KALMAR ECO-TECH'03
Bioremediation and Leachate Treatment
KALMAR, SWEDEN, November 25-27, 2003

TREATMENT OF LEACHATES IN REGARD TO HEAVY METALS BY THE AID OF SULPHATE-REDUCING BACTERIA

***Möller Anna*[1]**
***Grahn Anna*[2]**
***Welander Ulrika*[1]**
Lund University, Sweden
[2]Renova AB, Sweden

1 SUMMARY OF THE STUDY

The most common way of removing heavy metals from wastewater is by increasing the pH so that they precipitates as oxides or hydroxides. Metalsulphides are however often more difficult to dissolve than the corresponding hydroxides or oxides under oxidizing as well as reducing conditions [1]. Furthermore, their precipitation at lower pH values makes use of a larger pH range possible. Sulphide produced by sulphate-reducing bacteria yield metal precipitates with better sedimentation characteristics than that produced chemically probably depending on to that microbes in the effluent can act as nuclei for precipitation [2].

Most of the earlier studies using sulphate-reducing bacteria for treatment of wastewater have been performed on water containing higher concentrations of heavy metals than leachates coming from most municipal landfills (e.g. water from mines). A portion of the metals is furthermore bound to small colloidal particles or in water soluble chelates in the leachate, which means that this kind of wastewater has a complex composition [3,4].

Four leachates from two different Swedish landfills were treated in regard to removal of eight heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn). A bio-bed process inoculated with sulphate-reducing bacteria was utilized for the treatment. Batch as well as continuous experiments was performed. Different pH-values (3,7 and 9), metal:sulphide ratios and precipitation times were tested in the batch experiments. The precipitation of Cd and Cu were shown to be dependent on the sulphide: metal ratio in a batch experiment involving one of the leachates. The removal increased with an increase in sulphide: metal up to 45:1. The batch experiments showed the precipitation to be a relatively fast process. No significant differences in results were found between experiments terminated after a day and those terminated after a week. The removal of Cd, Cu and Zn were however found to be dependent on the precipitation time in a continuous experiment with one of the leachates. Cd and Cu were shown to be the metals most efficiently removed during the continuous experiments while Cr was most difficult to precipitate. Cu was removed most efficiently at pH 3, whereas in most cases As, Cd, Cr and Zn were removed most

efficiently at pH 9. No tendency for the precipitation of Hg, Ni and Pb to depend on the pH was found.

The bio-bed process was shown to be a promising alternative for treatment of leachates in regard to removal of the metals studied. The fact that one of the two leachates for which the best results were obtained came from a landfill for hazardous waste is of a special interest. Further studies are needed on more leachates e.g. from hazardous waste landfill sites, in order to explore the general applicability of the results. Studies in which the metal content in different colloidal fractions are measured before and after treatment are important for developing a better understanding of the process. Pilot-scale studies would also be of an interest in order to evaluate the process under realistic conditions e.g. variation in temperature and chemical composition of the leachate.

2 ACKNOWLEDGEMENT

The Swedish Association of Waste Management is gratefully acknowledged for financing of the research.

3 REFERENCES

[1] Hammack R.W., Edenborn H.M., 1992, The removal of nickel from mine waters using bacterial sulfate reduction. *Appl.Microbiol.Biotechnol.*, 37, 674-678. DOI: https://doi.org/10.1007/BF00240748

[2] Kolmert Å., 1999, Sulfate-reducing bacteria in bioremedition processes. *Licentiate thesis*, Department of Biotechnology, Lund University, Lund, Sweden.

[3] Christensen T.H., Kjeldsen P., Bjerg P.L., Jensen D.L., Christensen J.B., Baun A., Albrechtsen H-J., Heron G., 2001, Biogeochemistry of landfill leachate plumes. *Appl. Geochem.*, 16, 659-718. DOI: https://doi.org/10.1016/S0883-2927(00)00082-2

[4] Gounaris V., Anderson P.R., Holsen T.H., 1993, Characteristics and environmental significance of colloids in landfill leachate. *Environ.Sci.Technol.*, 27, 1381-1387. DOI: https://10.1021/es00044a013

A paper describing the study in detail is accepted for publication in *Environmental Technology*. It will be published in January or February 2004 according to the plans.