TREATMENT OF INDUSTRIAL WASTEWATER CONTAINING HEAVY METALS BY ELECTRODIALYSIS

MASTER OF SCIENCE

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DECLARATION

I hereby declare that the work included in the thesis in part or whole has not been submitted in any form for any other academic qualification of any institution.

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ABSTRACT

Ratmalana-Moratuwa industrial area has been subject to heavy pollution from various industries for more than a decade. This area is believed to have been polluted with heavy metals that have some drastic adverse impacts on human beings and surrounding eco-systems. Since there has not been a comprehensive study done to get an insight into the degree of contamination so far, an attempt was made in understanding the existing scenario in terms of predominant heavy metals.

In Ratmalana-Moratuwa industrial area, 79 groundwater wells were selected with biased sampling for heavy metal analysis. All wells were sampled for Fe, Mn, Ag, Ni, Al, Cr, Cu, Pb, Cd, Zn and Co. The analysis was carried out with the technique of Atomic Absorption Spectrophotometry and the results from well waters revealed that Fe, Mn, Ag, Ni, and Al levels were greater than those stipulated for drinking water by World Health Organization. Hence all most all wells were found to be abandoned merely due to the taste and colour problems.

Most of the industries tend to discharge untreated or partially treated effluent into the nearby drains and hence there is a likelihood of groundwater being affected. 36 industrial effluents were sampled for heavy metal analysis and the results from industrial effluents revealed that Pb, Cr, Cu concentrations were high compared to Sri Lankan Standards for discharge of effluents into inland surface waters. Similarly the concentrations of Fe, Al, Mn, Ag and Co were found to be comparatively high but no enforceable standard levels are available in Sri Lanka.

There is a greater need for cleaner technologies for the treatment of heavy metal contaminated wastewaters. Electrodialysis is one such technique that has many advantages such as avoidance of hazardous sludge production, less area requirement, application of low voltage and operation under ambient pressure. Although few studies have been conducted for heavy metal concentration by electrodialysis, in this study a laboratory fabricated four-membrane, five-compartment, electrodialysis cell was used with commercially available cationic and anionic selective membranes to investigate the effect of current density and permselectivity on selected heavy metal concentration. Initially a NaCl solution was desalinized to confirm the permselectivity and separation efficiency for Na ion. Subsequently experiments were carried out to concentrate heavy metals, from selected ionic solutions containing Al and Ni ions. Although there was no optimization of conditions for desalination, the initial concentration of the feed water decreased by 69% with an applied current density of 10 mA/cm^2. For stable operation and a higher current efficiency, a lower current density of 10 mA/cm^2 should be employed for the reactor configuration used to minimize effects such as co-ion transport, anode dissolution and heat loss. The permselectivity of the membrane contribute strongly to the degree of separation of heavy metals. The use of different permselective membranes together with complexation techniques need to be further investigated to improve separation efficiencies for heavy metals.

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