WASTE MINIMIZATION AND WASTEWATER TREATMENT IN AN ELECTROPLATING INDUSTRY

A Dissertation submitted in partial fulfillment of the requirement for the Master of Science Degree in Environmental Management

BY

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DECLARATION

"This dissertation has not been previously presented in whole or part to any university or institute for a higher degree"

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K. G. S. Jayawardana

To the best of my knowledge the above particulars are correct

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04/03/2002

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SUMMARY

Electroplating has been introduced to Sri Lanka more than a hundred years ago and there are more than 80 electroplating units in Sri Lanka, including household units. However, it has been found that the electroplating technology in Sri Lanka is lagging behind the world level and several problems of electroplating facilities with regard to plating technology and wastewater treatment had been identified.

The objective of this study was to investigate the possibilities of waste minimization and optimization of wastewater treatment in the electroplating industry using readily available resources and technologies in the country, focusing on the nickel and chromium-plating process and treatment of wastewater generated in that process.

Methodology of this study consisted of making observations of the existing process estimating water and energy consumption, analysis of process solutions and treated wastewater, studying process parameters used in the production process and wastewater treatment, and carrying out a designed experiment to study optimum pH for heavy metal precipitation.

It was found that quality control of the product is poor and the industry lacks technical know-how to carry out the electroplating process and wastewater treatment efficiently. However, the industry has already implemented a few quality control and waste minimization activities such as quality control of intermediate product within the process, two stage rinsing, and dragout recovery.

Possibilities to reduce electricity and water consumption without affecting the quality of the product through introduction of temperature control units for heaters, removal of unnecessary unit operations employed in the production process etc. and the necessity of proper stripping of rejects before recycling them into the production process in order to avoid unnecessary contaminations of bath solutions were identified. With regard to the wastewater treatment, it was found that the optimum pH for hydroxide precipitation of nickel and chromium in a mixture is pH 8.0.

It is recommended to introduce drain boards, stripping for rejects, temperature feed back control system for heaters and improved process control in nickel-plating activity immediately and , to study the possibility of working longer hours a day than the normal 8hr shift, which would increase the savings on electricity used for bath heating. It is also recommended to omit unnecessary unit operations and to change over to Cr^{3+} chromium plating solution instead of Cr^{6+} solutions, while proper quality control procedures such as corrosion resistance test & Adhesion tests are carried out to increase the value of the product and reduce wastage.

Measures recommended to improve the wastewater treatment system include carrying out chromium reduction at pH 3 for a minimum period of 30 minutes, strict control of Cr^{6+} discharge into the Heavy Metal Precipitation Tank, carrying out nickel and chromium precipitation at a pH value between 8 – 8.5 and filtering supernatant of the sedimentation tank to avoid escape of suspended material with the supernatant.