SUMMARY

Surface water are exposed to pollution from the large quantities effluent that industry daily discharge into the rivers, sewage works, etc. with ions of non-ferrous toxic metals such as nickel, cadmium, zinc, lead, chromium and cupper. Several techniques are available for the removal such ions from waste water, including precipitation and separation on organic resins which are widely used in the industry. In recent years, other processes have been developed with offer certain advantages, among them, the use double salts of polybasic acids with tetravalent metals. The advantages of these metals are due to their high radiation and thermal stabilities.

This work had been done in an attempt to synthesize organic resin such as poly(acrylamide-acrylic acid) with impregnation by inorganic ion exchange metal such as silicon titanate that can be of help in the industrial waste pollution problem. This work is concerned with the preparation of poly(acrylamide-acrylic acid)-silicon titanate. Characterization of the synthesized metals using X-ray diffraction, X-ray fluorescence and infrared spectroscopy was concerned. Capacity, equilibrium measurements and selectivity patterns for Cu^{2+}, Ni^{2+}, Zn^{2+} and Cd^{2+} ions were determined on P(AM-AA)-SiTi. Besides it involves a study of the

removal of these toxic elements from waste water of solutions using column beds of P(AM-AA)-SiTi.

The work carried out in this thesis is summarized into three main parts, namely; the introduction, the experimental and the results and discussion.

First part

The first part is the introduction which includes the type of pollution, toxicity and chemistry of some heavy metals, different tools used for the treatment of waste water using inorganic and organic materials. Literature survey was carried out to cover almost the last three decades related to the proposed subject.

Second part

The second part is the experimental which includes the chemicals used as well as the instrumentation, the analytical techniques and procedures used in this thesis were also described.

Third part

The third part deals with the results and discussion. The interpretation of data indicated that:-

1- The results of partition showed that poly(acrylamide-acrylic acid) had amorphous structure and the crystallinity increased by impregnation of silicon titanate in-situ poly(acrylamide-acylic

acid). The synthesized poly(acrylamide-acrylic acid)-silicon titanate has semicrystalline structure.

2- The preliminary studied of the sorption indicated that the equilibrium was attend for Cu^{2+}, Cd^{2+}, Ni^{2+} and Zn^{2+} ions on P(AM-AA)-SiTi with in 3 hrs.

3- The solubility of P(AM-AA) and P(AM-AA)-SiTi in different data showed that, the prepared resins are very stable in water and sparingly soluble in nitric and hydrochloric acids up to 5 M. Also the data indicated that the chemical stability of resin increased by in-situ precipitate of silicon titanate with the resin.

4- Effect of pH of the medium on the dissociation of inorganic species from resin indicated that the dissociation percent of silicon and titanate from P(AM-AA)-SiTi resin are very low and below detection limit up to 3-4 pH.

5- Apparent capacity of P(AM-AA)-SiTi for Cu^{2+}, Cd^{2+}, $Ni^{2+}$and Zn^{2+} ions at natural pH was measured and indicated the high selectivity of P(AM-AA)-SiTi for Cd^{2+} ions and the order selectivity

$$\mathbf{Cd^{2+} > Ni^{2+} > Cu^{2+} > Zn^{2+}.}$$

6- Effect of pH on the apparent capacity of P(AM-AA)-SiTi for Zn^{2+}, Cu^{2+}, Cd^{2+} and Ni^{2+} ions showed that, the capacity increased with increasing pH of the medium up to 2.91, 4.64, 3.51 and 2.52 for

Ni^{2+}, Cu^{2+}, Cd^{2+} and Zn^{2+} ions, respectively. About these pH values the capacity decreased.

7- The results of the effect of batch factor indicated that the of maximum weight from P(AM-AA)-SiTi sufficient for the quantitative removal of Zn^{2+}, Cd^{2+}, Cu^{2+} and Ni^{2+} ions is 100 mg.

8- The application of the Freundlich and Langmuir equations to the sorption of Cu^{2+}, Cd^{2+}, Ni^{2+} and Zn^{2+} ions on P(AM-AA)-SiTi indicated that all these elements obey Freundlich isotherm and it was physically adsorbed on P(AM-AA)-SiTi resin.

9- The influence of various quantities of NaCl, $NaNO_3$ and Na_2SO_4 as interfering ions in the feed solution on the retention percent of Cu^{2+}, Cd^{2+}, Ni^{2+} and Zn^{2+} ions were determined. The data obtained showed that the retention of the about metal ions were decreased with increasing NaCl, $NaNO_3$ and Na_2SO_4 concentrations in the fed solution, especially in the case of Na_2SO_4 salt were the retention percent was decreased and effected by a factor 13, 63.85, 59.2 and 61.62 % for Cu^{2+}, Ni^{2+}, Cd^{2+} and Zn^{2+} ions, respectively.

Presence of organic agents in the feed waste solution such as EDTA and sodium hydrogen tartarate also decreases the retention percent of Cu^{2+}, Ni^{2+}, Cd^{2+} and Zn^{2+} to agent extent compared with the other salts (NaCl, $NaNO_3$ and Na_2SO_4).

10- The retention of Cu^{2+}, Cd^{2+}, Ni^{2+} and Zn^{2+} ions on P(AM- AA)-SiTi column beds were calculated. The data show that the breakthrough capacity (BCT) for Cd^{2+}, Cu^{2+}, Ni^{2+} and Zn^{2+} ions were found to be 11, 9.6, 5.5 and 3 mg/g, respectively. Also application studies were extended to the removal of some heavy metal ions from industrial toxic waste solution.