CHAPTER V

CONCLUSIONS

From the results of this study on the treatment of low-level radioactive cesium-137 and technetium-99 liquid wastes, the sorption efficiency of cesium-137 and technetium-99 for inorganic ion-exchangers such as Titanium dioxide, Zeolite, Bentonite, Kaolinite, Sand, Sandy soil, HAP and Antimony pentoxide have been determined under a variety of experimental conditions. The optimum conditions for the sorption of cesium-137 can be determined from the data shown in Table 5.1, below.

Table 5.1 The Optimum Range of Conditions for the Sorption of Cesium-137 on Various Ion-exchange Materials.

Inorganic Exchangers	pH	Contact Time (min.)	Temperature (°C)	Exchanger* Weight(g)	% Sorption Efficiency
Titanium dioxide	3 - 9	10-20	25 - 50	3	55-70
Zeolite	1 -13	5-10	25 - 50	0.3	90-99
Bentonite	1 -13	10-20	25 - 50	1	65-80
Kaolinite	3 -11	5-10	25 - 50	0.3	90-98
Sand	3 -11	10-20	25 - 50	1	80-86
Sandy soil	3 -11	10-20	25 - 50	1	75-85
HAP	1 - 7	20-30	25 - 50	1	80-85
Antimony pentoxide	1 - 9	10-20	25 - 50	1	85-98

Note : (*) The volume of solution is 30 ml.

The data on the sorption efficiency of technetium-99 by inorganic ion-exchangers shows that Antimony pentoxide was the only exchanger with high sorption efficiency (about 80-90 %). The optimum conditions for this system can be described as follows:

The optimum pH was in the range of 1-9, the optimum contact time was about 5 days and the optimum ratio was 3 g.of exchanger to 30 ml of stock solution.

During the immobilization study of exchangers by cementation, it was found that titanium dioxide, zeolite, bentonite, kaolinite and sand can be incorporated with cement to produce suitable waste forms. The physical stability of the cemented wastes were tested in regard to homogeneity, percent weight loss and density after the curing time. It was found that the homogeneity of all types of waste forms was satisfactory, with the exception of the Bentonite sample which had a high degree of porosity, caused by its tendency to swell in the presence of water.

A comparison of the compressive strength values for waste forms containing the various exchangers showed them to be in this decreasing order;

sand > titanium dioxide > zeolite > kaolinite > bentonite.

According to these results, sand appears to be the most suitable inorganic exchanger for the treatment of cesium-137 liquid waste not only because of its high sorption efficiency but also its high compressive strength, low cost and availability.

Antimony pentoxide was found to be the only suitable exchanger for the treatment of technetium-99 liquid waste. However, further work is required to find a substitute for this material because of its high cost.

The results of the leaching tests indicate that the leach rate of cesium-137 in the kaolinite waste form was in the range of 10^{-3} $g/cm^2.day$.

The prediction of leachability of cesium-137 for 200 days at 25 °C and 50 °C was found to be 0.4542 g/cm^2 and 0.7176 g/cm^2, respectively.