CHAPTER IV

RESULTS

4.1 Experiments on Sorption Characteristics

4.1.1 Investigation of the Effect of pH and Contact Time

4.1.1.1 Sorption of ^{137}Cs on Inorganic Ion-exchangers

The results of sorption of ^{137}Cs by Titanium dioxide, Zeolite, Bentonite, Kaolinite, Sand, Sandy Soil, Hydrated Antimony Pentoxide (HAP) and Antimony Pentoxide are shown in Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8 respectively as well as in Tables A.1, A.2, A.3, A.4, A.5, A.6, A.7 and A.8 respectively (Appendix A).

A comparison of percentages of sorption on all inorganic ion-exchangers at pH = 7 is shown in Figure 4.9 or Table A.9 (Appendix A).

The percentage sorption efficiency of cesium-137 was found to be in the range of 80-99 , The results also show that zeolite and kaolinite have high sorption efficiencies.

4.1.1.2 Sorption of ^{99}Tc on Inorganic Ion-exchangers

The results on the sorption of ^{99}Tc by Titanium dioxide, Zeolite, Bentonite, Kaolinite, Sand, Sandy Soil, Hydrated Antimony Pentoxide (HAP) and Antimony Pentoxide appear in Tables A.11 through A.18 respectively. Figures 4.11, 4.12, 4.13 and 4.14 show the sorption of ^{99}Tc on Titanium-dioxide, Zeolite, Kaolinite and Antimony pentoxide, respectively.

The comparison of percentages of sorption on all inorganic ion-exchangers at pH 7 is shown in Figure 4.15 and Table A.19(Appendix A). From the data, it was determined that Antimony pentoxide is the only satisfactory exchanger for TcO_4^-, at pH 1-9 and 5 day optimum time.

4.1.2 Investigation of the Effect of Temperature

4.1.2.1 Sorption of ^{137}Cs on Inorganic Ion-exchangers

The percentages of sorption of ^{137}Cs by all inorganic ion-exchanger were plotted against the temperature as shown in Figure 4.10 as well Table A.10 (Appendix A).

It was found that the optimum temperature was in the range of 25-50°C.

4.1.2.2 Sorption of ^{99}Tc on Inorganic Ion-exchangers

The percentages of sorption of ^{99}Tc by all inorganic ion-exchanger were plotted against the temperature as show in Figure 4.16 as well as in Table A.16 (Appendix A).

It was found that the optimum temperature was 25°C.

4.1.3. Determination of the Optimum Weight Ratio

The optimum weight ratio of exchanger to solution for ^{137}Cs and ^{99}Tc are shown in Tables A.21 and A.22 (Appendix A).

It was found that the optimum weight of kaolinite and zeolite are 0.3 g. for ^{137}Cs. For ^{99}Tc, the optimum weight of Antimony pentoxide is 3 g.

4.2 Cementation Process Experiment

4.2.1 Density Measurements for Ion-exchangers and Portland Cement

The density of Kaolinite, Bentonite, Sand, Zeolite and Portland Cement are shown in Table A.23 (Appendix A).

4.2.2 Calculation of Weight of Materials Ratio for Cementation

The various ratios of Titanium dioxide, Zeolite, Bentonite, Kaolinite and Sand to cement are shown in Tables A.24, A.25, A.26, A.27 and A.28 respectively(Appendix A).

4.2.3 Basic Properties of Cemented-Wastes Test

4.2.3.1 Physical and Mechanical Properties Test

a) Homogeneity

A comparison of the homogeneity of the waste forms, performed visually are shown in Table A.29(Appendix A).

All of the waste forms were found to be satisfactory with the exception of Bentonite.

b) Density and Percentage of Weight-loss

The density of various types of specimens and their weight-loss after curing are shown in Table A.30 of Appendix A.

c) Compressive Strength

The compressive strength of cemented waste forms containing Titanium dioxide, Zeolite, Bentonite, Kaolinite and Sand, in various ratios, are shown in Tables A.31, A.32, A.33, A.34 and A.35 (Appendix A) respectively. A comparison of the Compressive Strength of the various waste forms is shown in Figure 4.17

A comparison of the optimum exchanger:cement ratio is shown in Figure 4.18 as well as in Table A.36 (Appendix A).

4.2.3.2 Leaching Test

The initail activity data for each specimens is shown in Table 4.37 while the leach rates of the samples at various temperatures are shown in Table A.38 (Appendix A).

The incremental fraction leached is shown in Figure 4.19 and the cumulative fraction leached is shown in Figure 4.20.

A prediction of leachability of Cesium-137 for 200 days at 25°C, and at 50°C is shown in Figures 4.21 and 4.22 respectively.

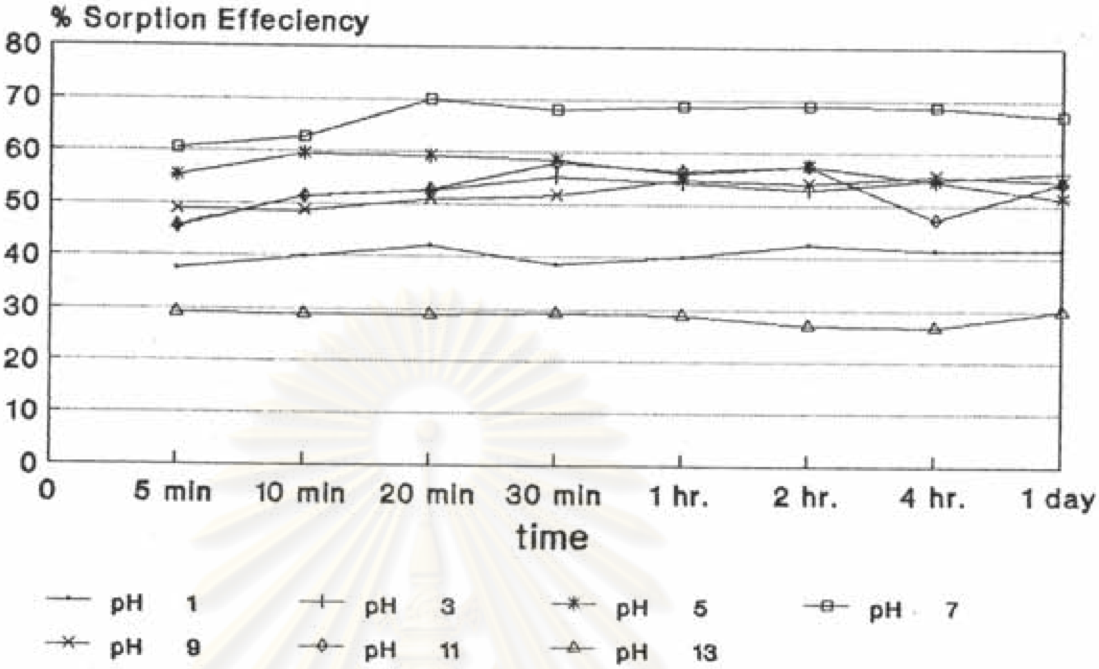

Figure 4.1 % Sorption Efficiency of ^{137}Cs on Titanium Dioxide as Effected by pH and Contact Time.

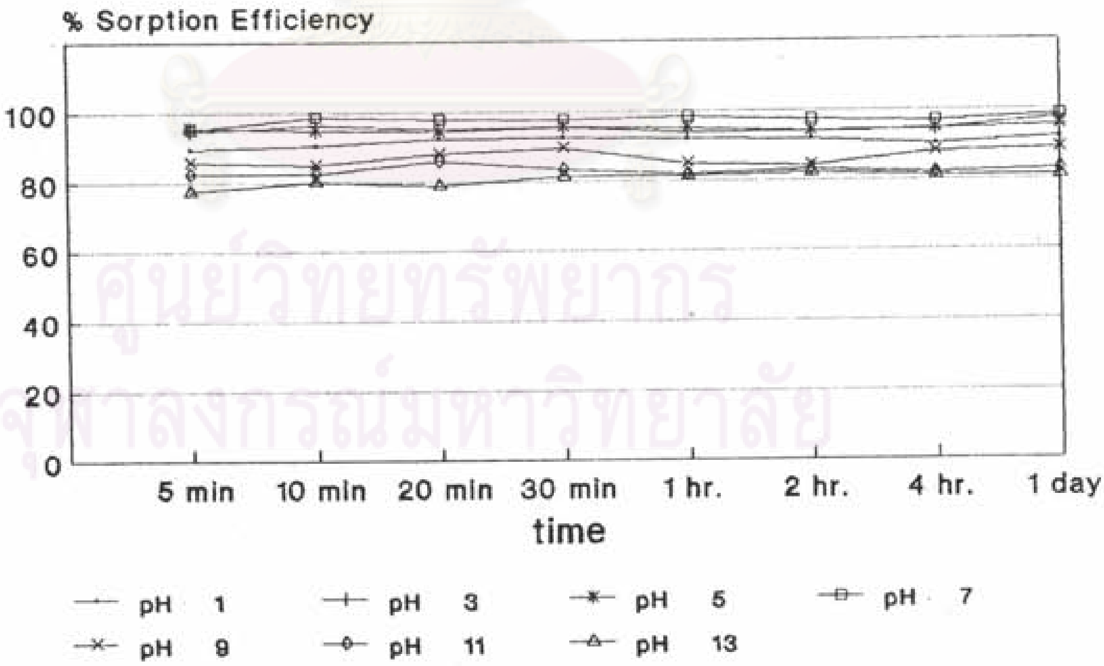

Figure 4.2 % Sorption Efficiency of ^{137}Cs on Zeolite as Effected by pH and Contact Time.

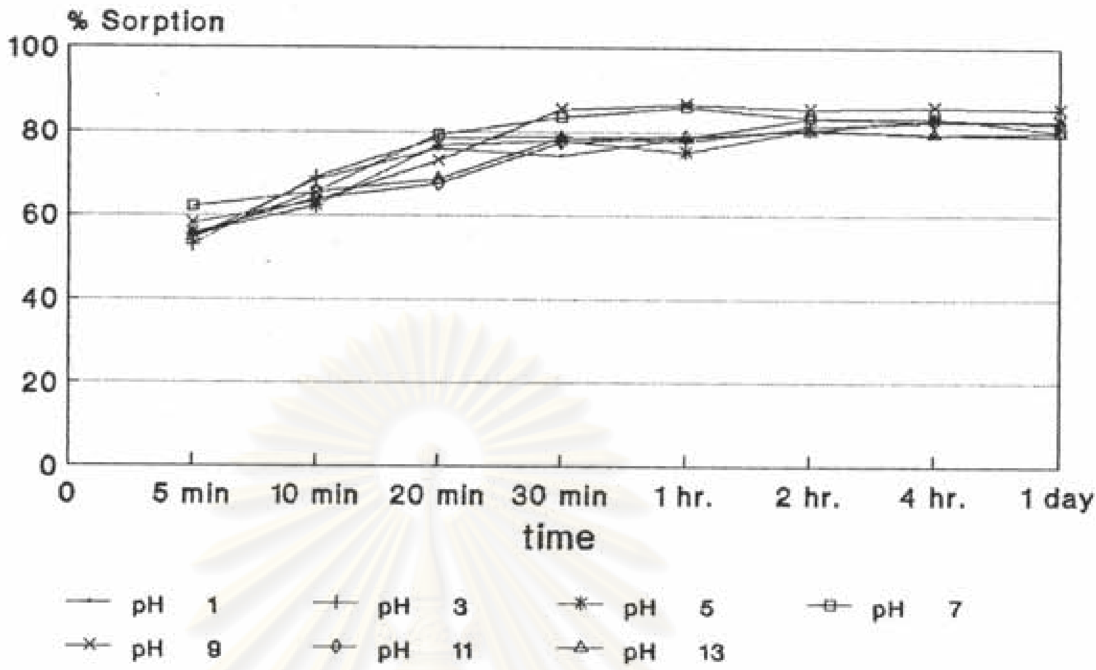

Figure 4.3 % Sorption Efficiency of ^{137}Cs on Bentonite as Effected by pH and Contact Time.

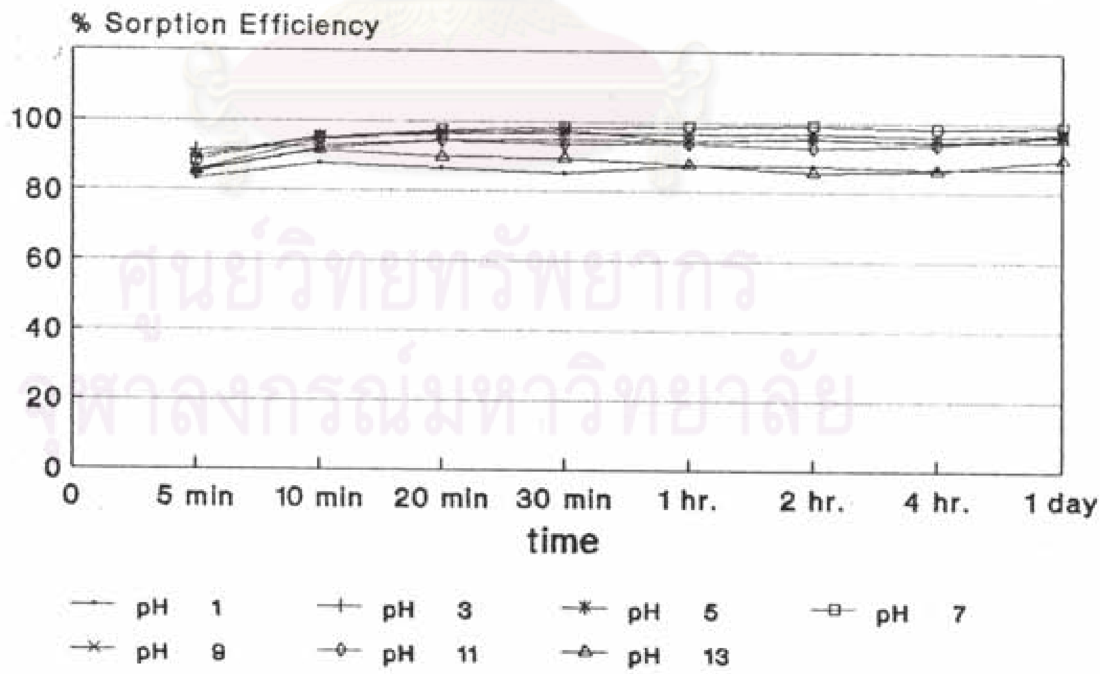

Figure 4.4 % Sorption Efficiency of ^{137}Cs on Kaolinite as Effected by pH and Contact Time.

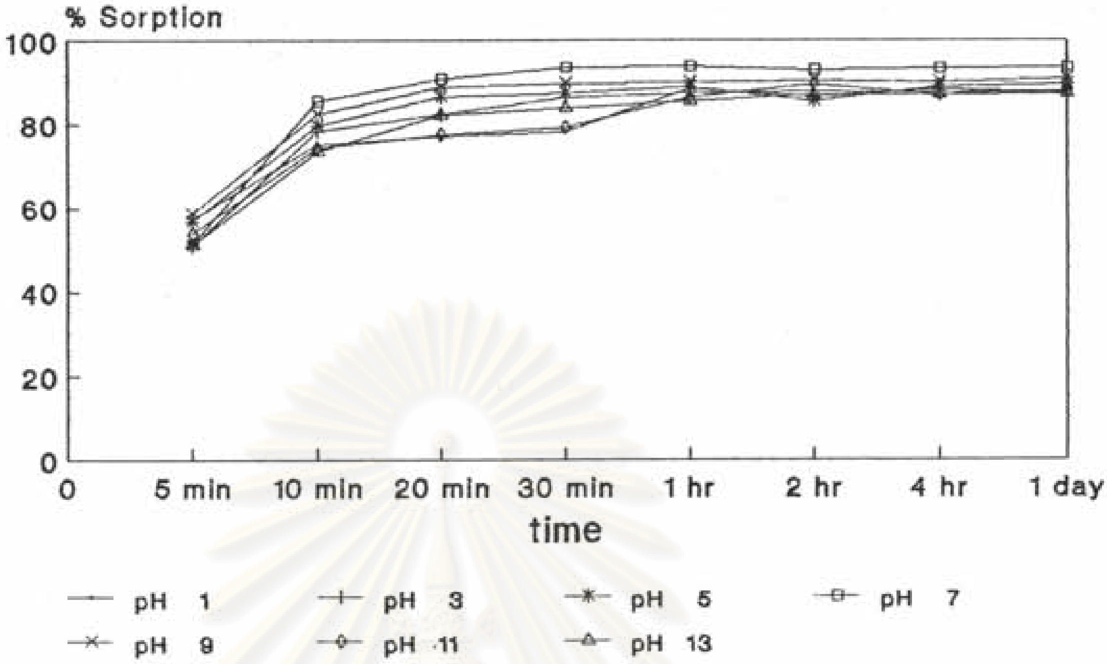

Figure 4.5 % Sorption Efficiency of ^{137}Cs on Sand as Effected by pH and Contact Time.

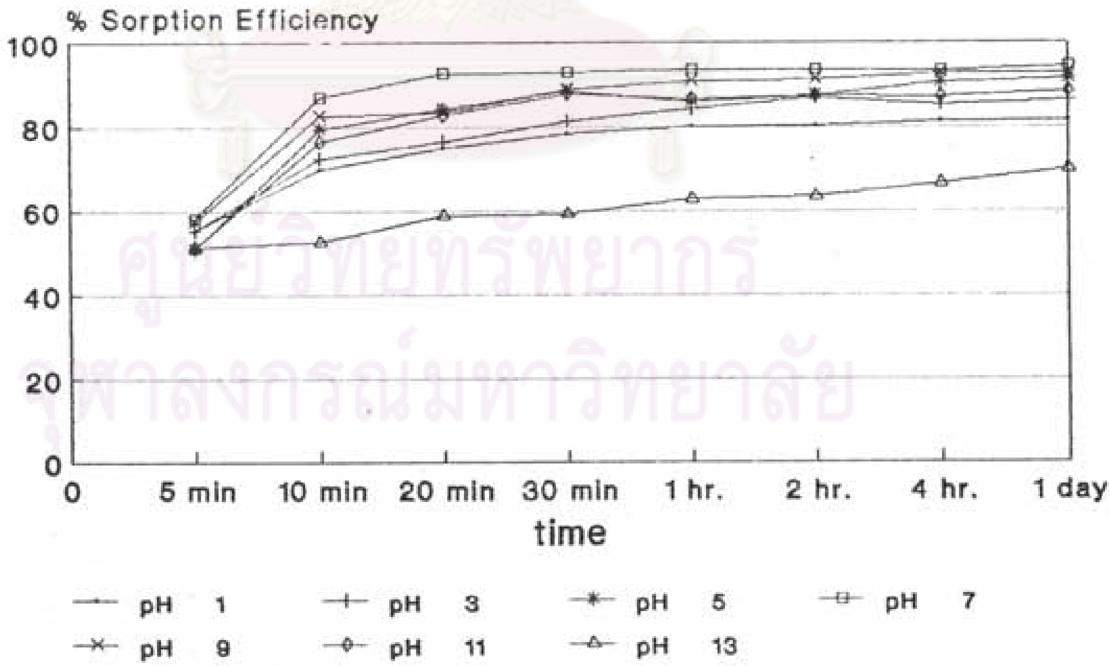

Figure 4.6 % Sorption Efficiency of ^{137}Cs on Sandy Soil as Effected by pH and Contact Time.

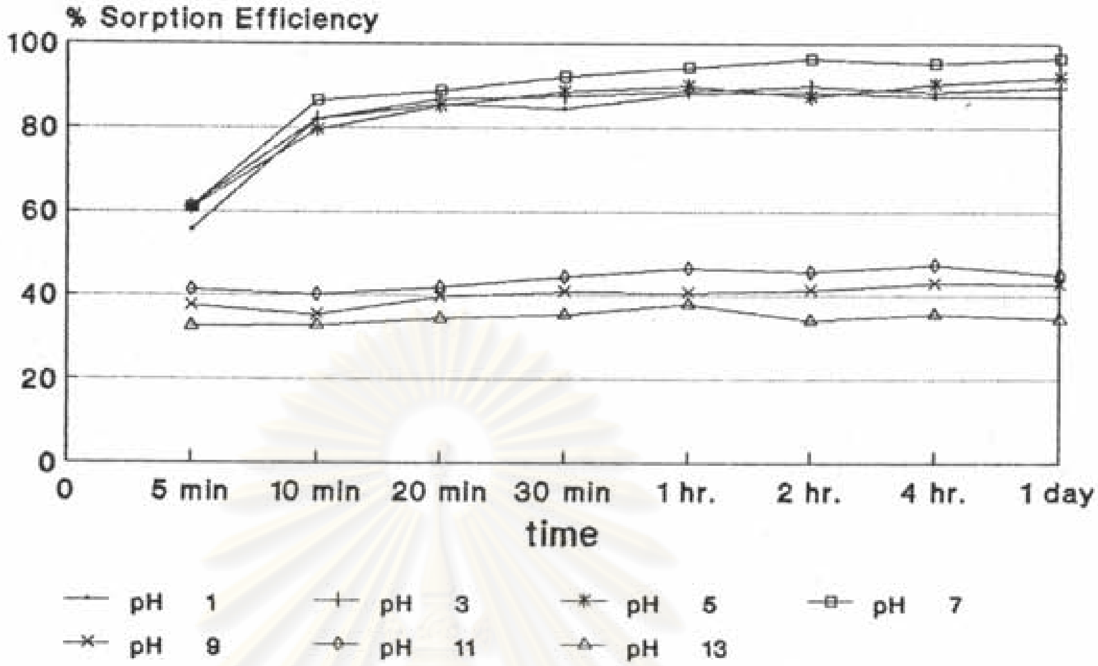

Figure 4.7 % Sorption Efficiency of ^{137}Cs on HAP as Effected by pH and Contact Time.

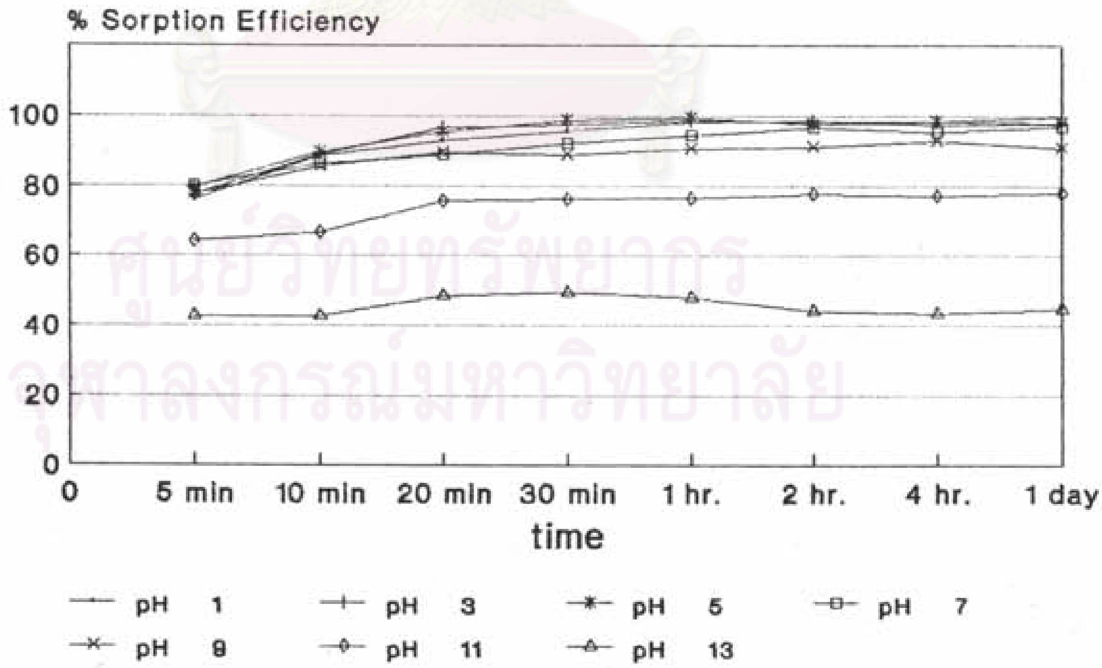

Figure 4.8 % Sorption Efficiency of ^{137}Cs on Antimony Pentoxide as Effected by pH and Contact Time.

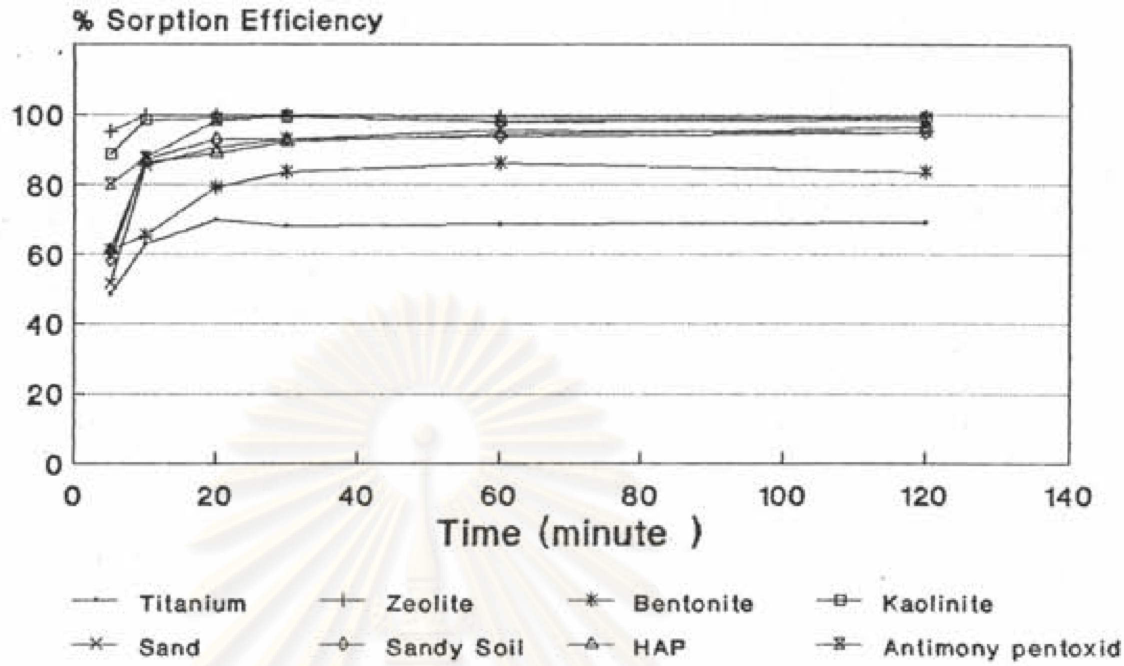

Figure 4.9 A Comparison of the Sorption Efficiency of ^{137}Cs by Various Exchangers (pH 7, 25°C, Various Contact Time)

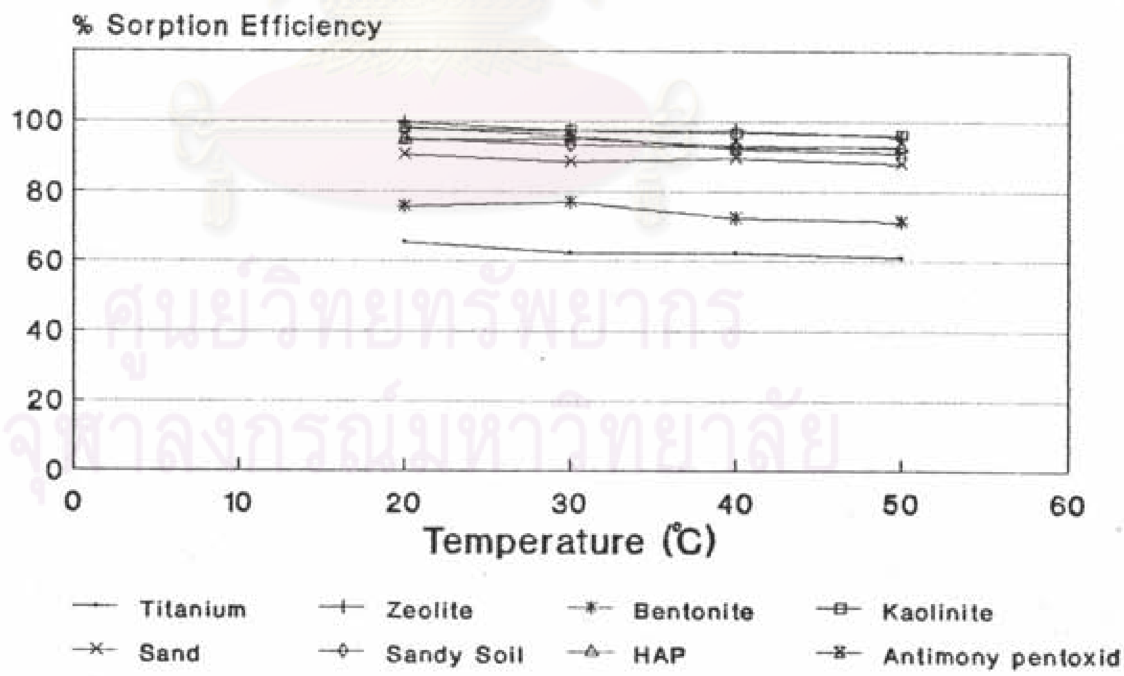

Figure 4.10 A Comparison of the Sorption Efficiency of ^{137}Cs at Various Temperatures (pH 7, 1hr.Contact Time)

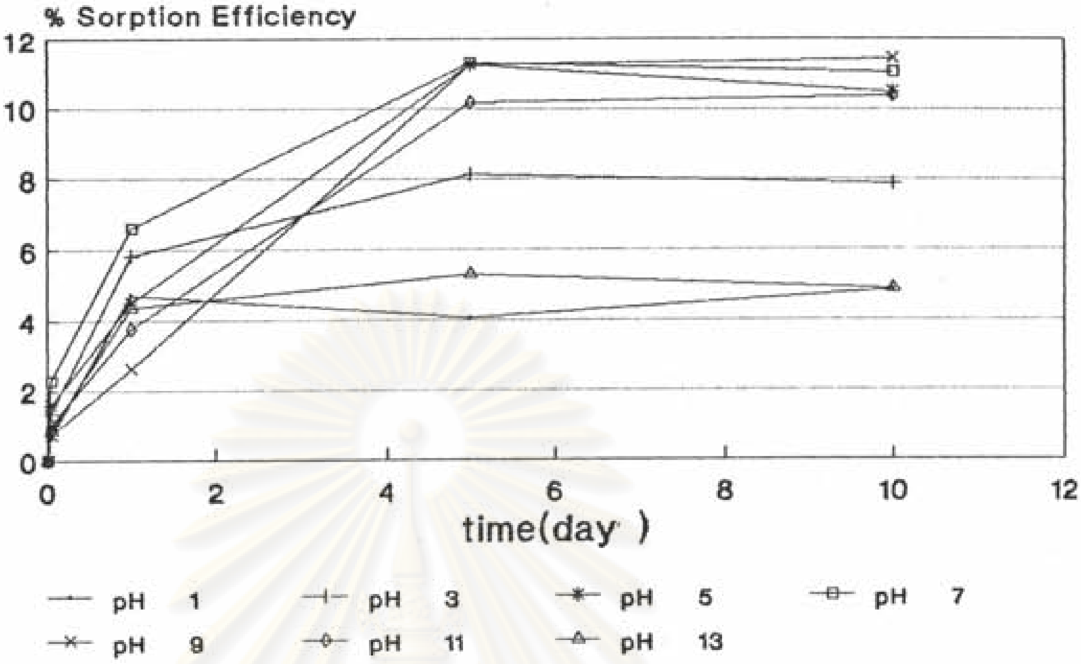

Figure 4.11 % Sorption Efficiency of ^{99}Tc on Titanium Dioxide as Effected by pH and Contact Time.

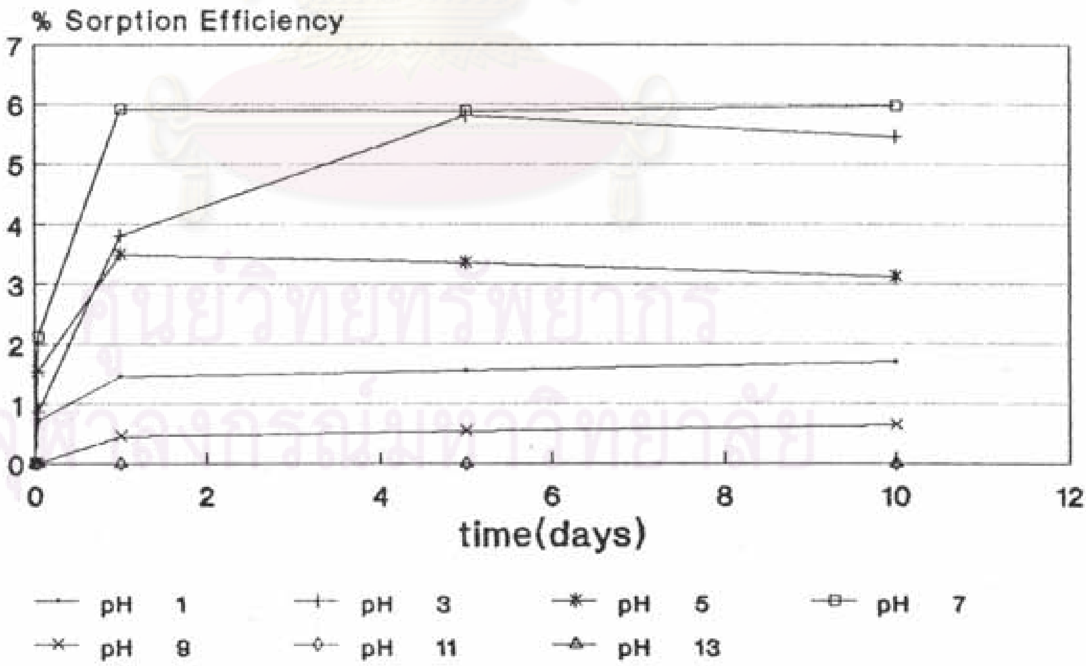

Figure 4.12 % Sorption Efficiency of ^{99}Tc on Zeolite as Effected by pH and Contact Time.

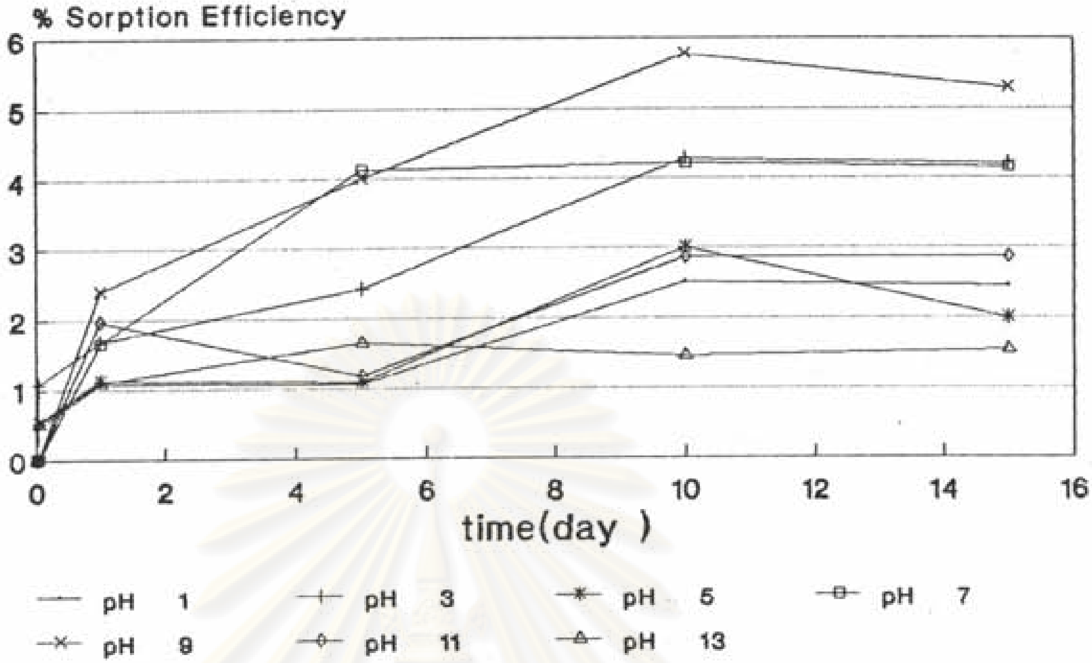

Figure 4.13 % Sorption Efficiency of ^{99}Tc on Kaolinite as Effected by pH and Contact Time.

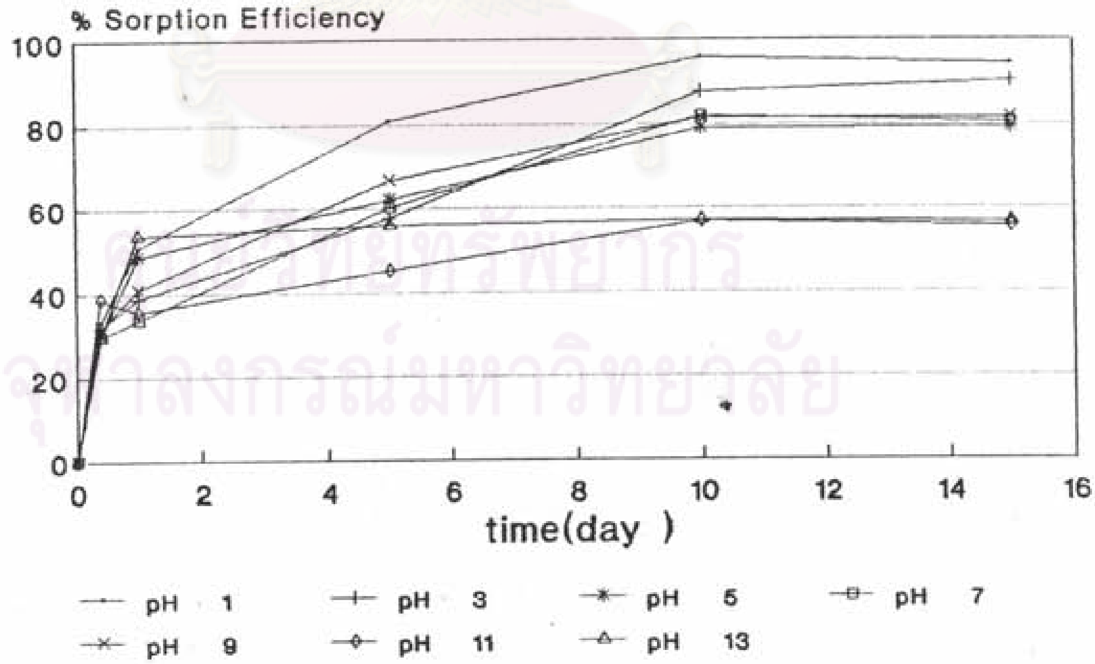

Figure 4.14 % Sorption Efficiency of ^{99}Tc on Antimony Pentoxide as Effected by pH and Contact Time.

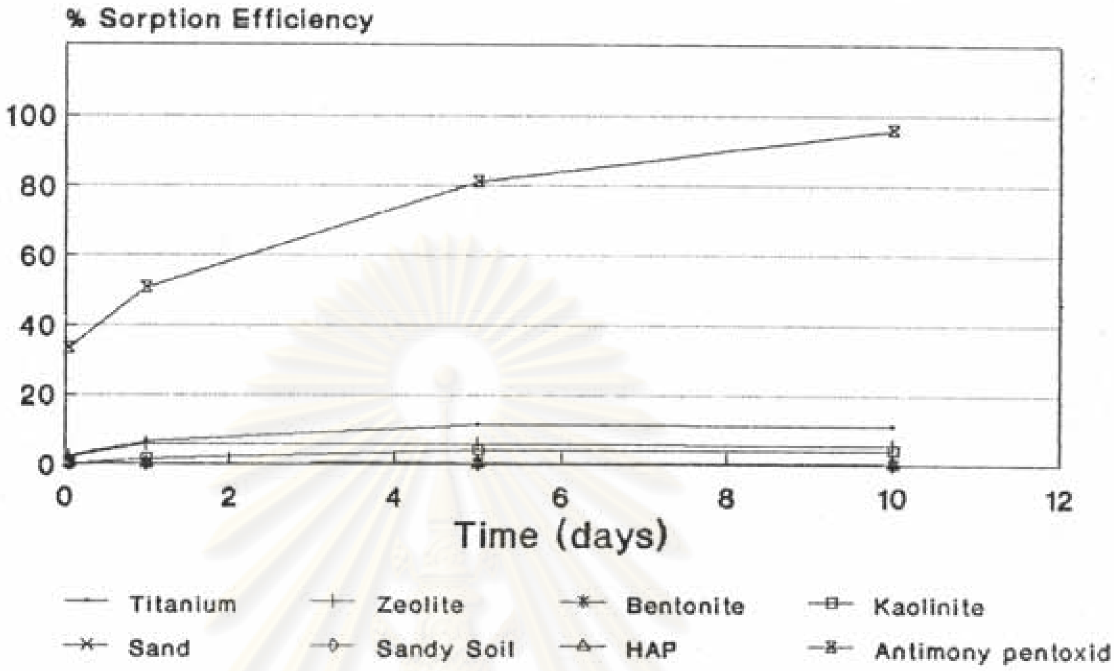

Figure 4.15 A Comparison of the Sorption Efficiency of ^{99}Tc on Various Exchangers at Various Times, Optimum pH 7,25°C.

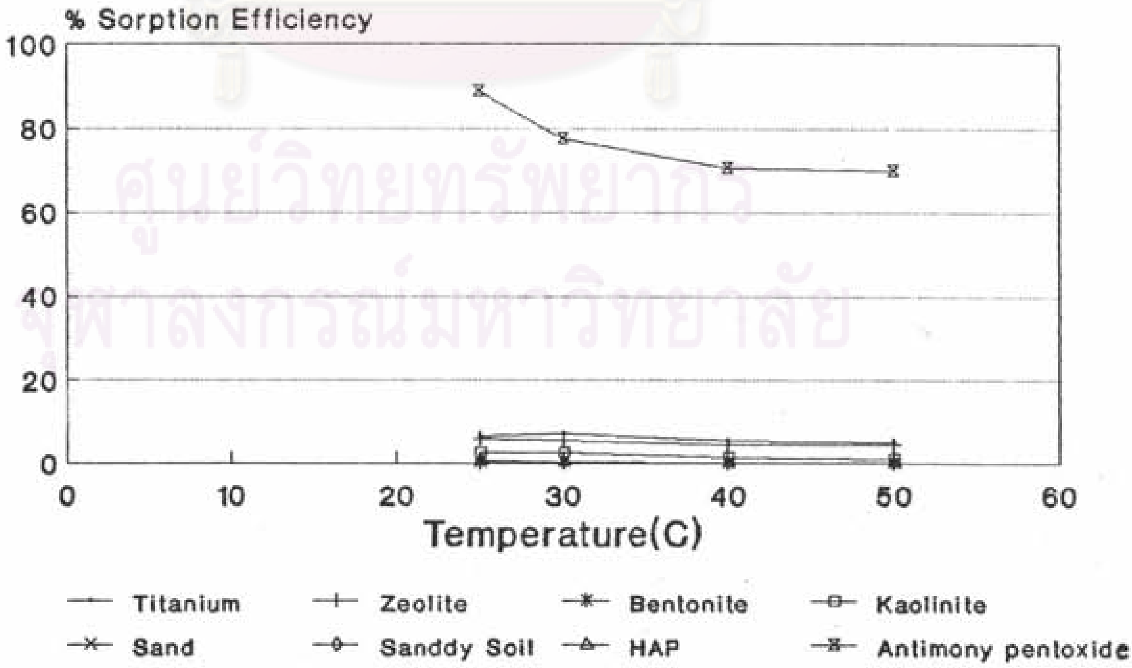

Figure 4.16 A Comparison of the Sorption Efficiency of ^{99}Tc at Various Temperatures, pH 7 and 1 day Contact Time.

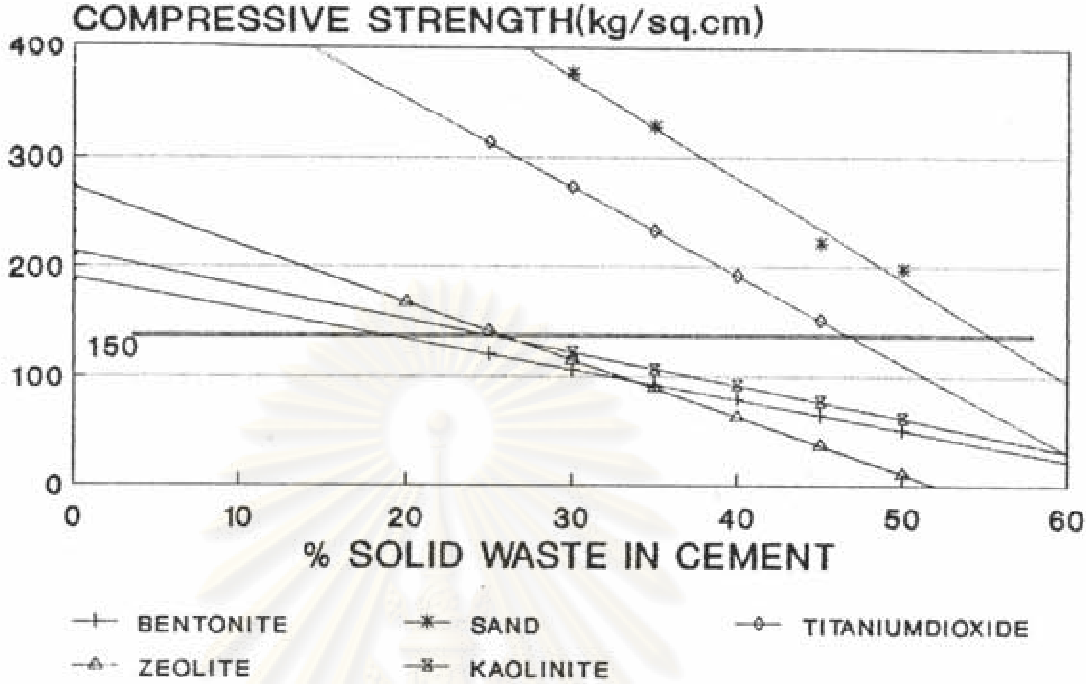

Figure 4.17 A Comparison of the Compressive Strength of Various Cemented Waste Forms.

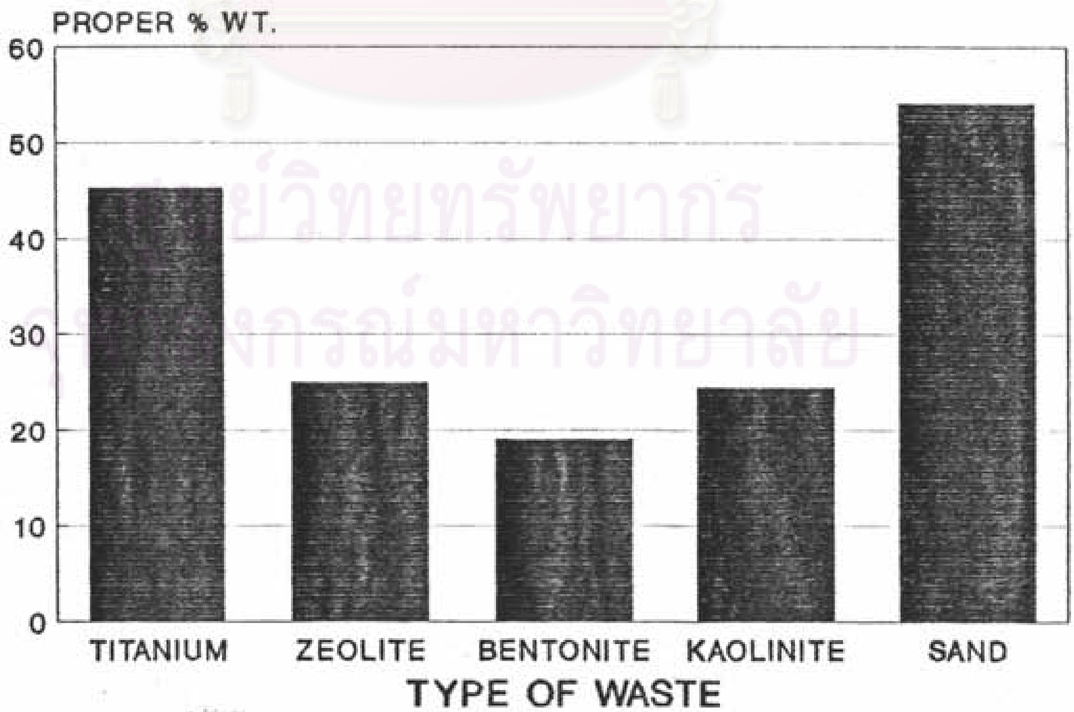

Figure 4.18 A Comparison of the Optimum Exchanger/Cement Ratio of Various Waste Forms.

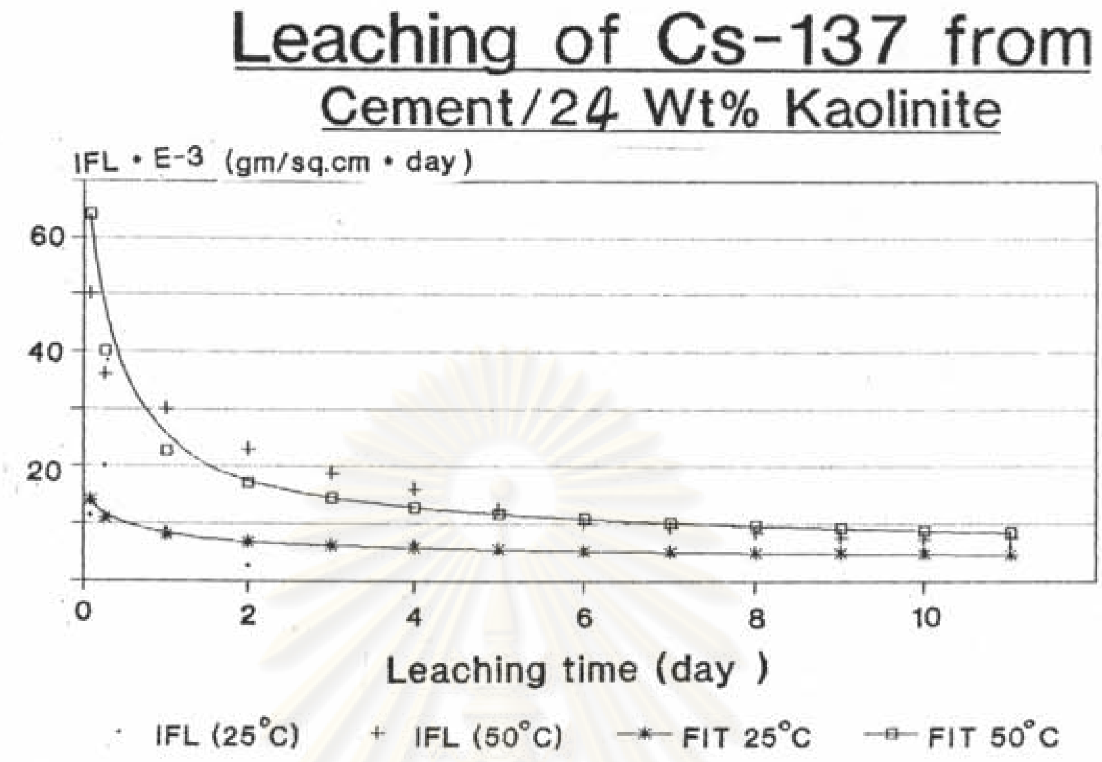

Figure 4.19 ^{137}Cs Leachability for Kaolinite/Cement Waste Forms by Incremental Fraction Leached.

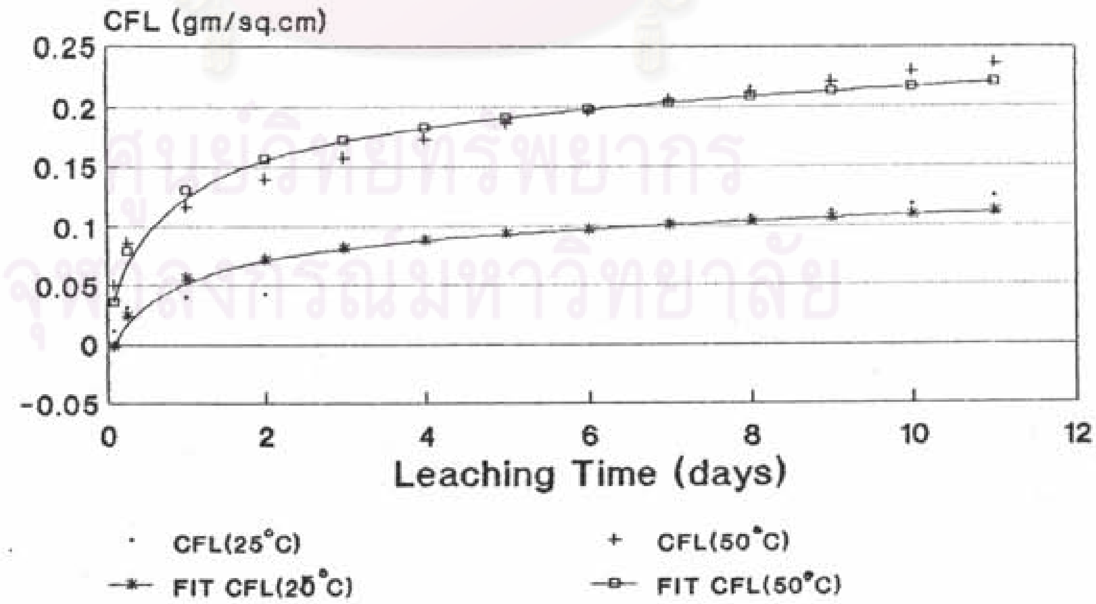

Figure 4.20 ^{137}Cs Leachability for Kaolinite/Cement Waste Forms by Cumulative Fraction Leached.

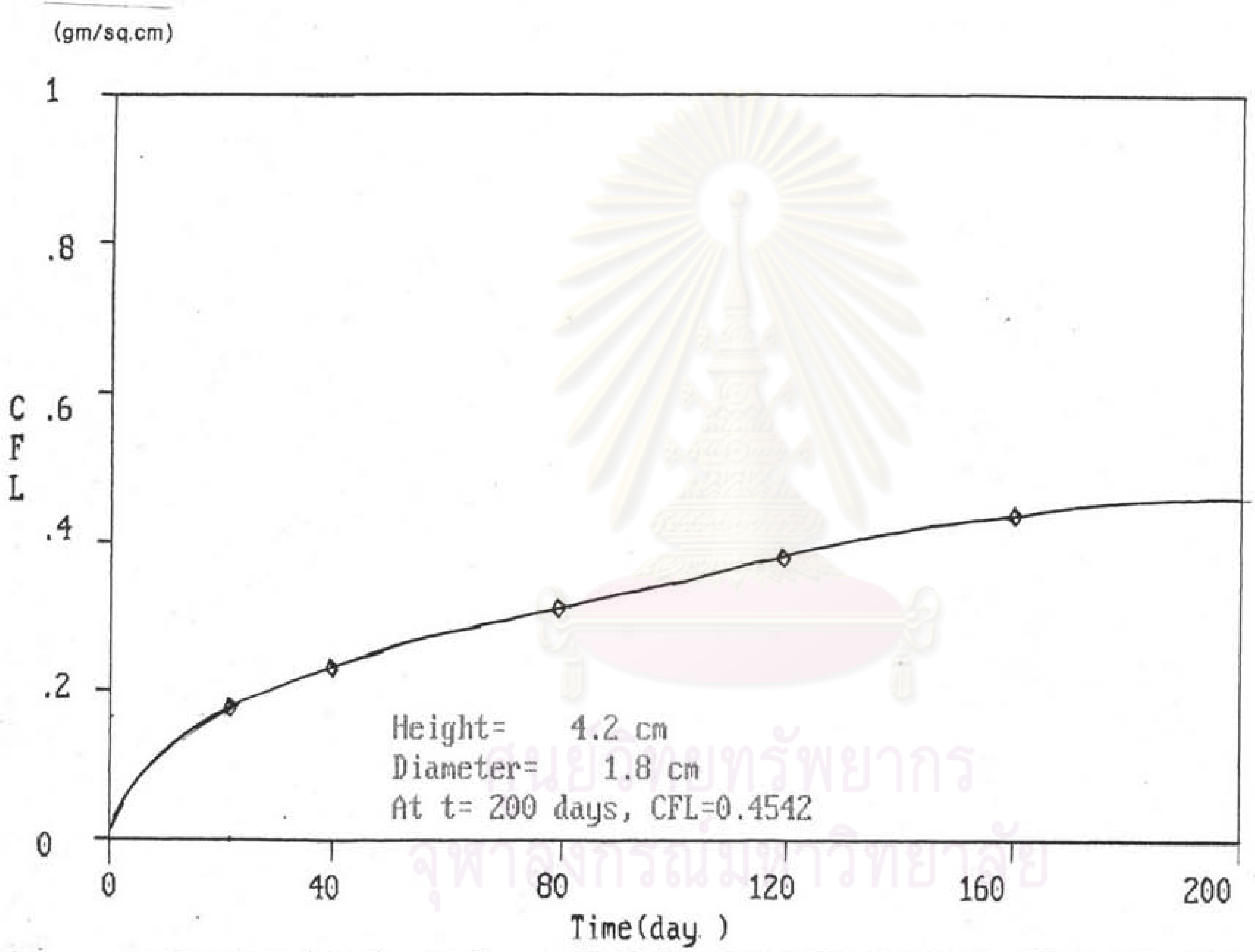

Figure 4.21 A Prediction of ^{137}Cs Leachability for Kaolinite/Cement Waste Forms at 25°C, for 200 days.

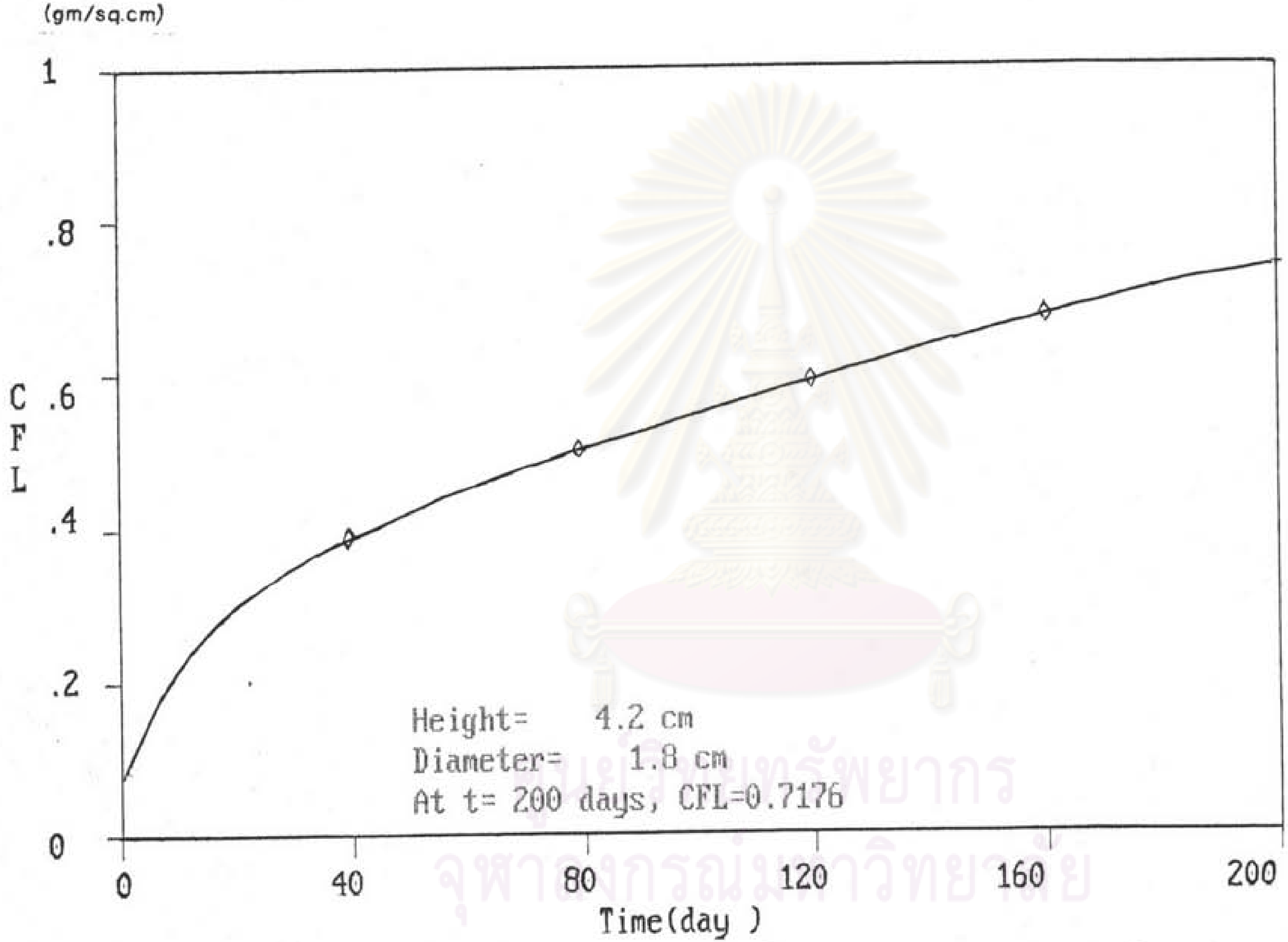

Figure 4.22 A Prediction of ^{137}Cs Leachability for Kaolinite/Cement Waste Forms at 50°C, for 200 days.