CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The findings of this research show that it is feasible to use the alkalinized saline groundwater to treat the chromium contaminated wastewater. Since the major content of groundwater is calcium and magnesium that can be precipitated as metal hydroxide and carbonate used as alkaline reagent for precipitation as well as coagulation of chromium. The conclusions are made as follow.

5.1.1 Selection of groundwater source

To make use of groundwater for this purpose, the content of magnesium and calcium should be sufficiently high. Groundwater source at Bandung Subdistrict, Udon-Thani Province presented the content of 3900-7500 mg Ca /L and 2100-2500 mg Mg /L, was selected for this study.

5.1.2 Determination of the optimum pH for precipitation of the white slurry by alkalinizing saline groundwater

As the divalent metal ions of calcium and magnesium are the main component of groundwater, the white slurry obtained after alkalinizing the saline groundwater with sodium hydroxide is composed mainly of calcium carbonate and magnesium hydroxide. A series dosages of sodium hydroxide were added to the saline groundwater to determine the optimum pH that yielded the maximum concentration of calcium and magnesium of the white slurry. The optimum pH of 13.5 was founded for maximizing precipitation of the white slurry. For the initial concentration of calcium and magnesium (3,690-7,500 mg/l, 2.010-2,500 mg/l) yielded the maximum precipitation of calcium carbonate and magnesium hydroxide (white slurry) of which the content were 28,000 – 30,450 mg Ca/L and 13,000- 18,300 mg Mg/L (in rainy season's samples) and 80,000 – 87,000 mg Ca/L and 33,200- 38,500 mg Mg/L (in dry season's samples), respectively.

5.1.3 Precipitation of chromium by the white slurry

The white slurry of calcium carbonate and magnesium hydroxide was then used to treat tanning wastewater containing chromium of 236-498 mg/l and pH of 3.7-4.6. The optimum dosage of the white slurry was determined by jar test experiment. It was found that in the pH range of 7.5 to 9.34, removal efficiency of chromium was in the range of 98.0 to 99.5%, of which the optimum pH of 9.0 indicated the maximum removal efficiency. The optimum dosage was determined by the volume that yielded the maximum removal efficiency at that pH. By adding the white slurry of 16-35 ml/one liter of wastewater will increase pH level to the control level at 8.8-9.5. The highly dense precipitate of chromium hydroxide was taken place and settled very quickly. The findings from the jar test experiments were used for the model scale test of 6 liters reactor. The removal of chromium could reach up to 99% efficiency at pH of 9.04. However, the concentration of chromium in the effluent of about 1.63 mg/l was still higher than the effluent standard (0.05 mg/l). Further steps of precipitation would be required.

5.1.4 Recovery of chromium by acidification

Recovery of chromium could be made by acidification. The precipitated chromium hydroxide was acidified with sulfuric acid at pH 1.6-2.8 to dissolve $Cr(OH)_3$ precipitate to $Cr_2(SO_4)_3$ solution. The recovery efficiency of chromium was in the range of 53.09-63.33% at pH 2.0.

In summary, this research is considered an appropriate technology since it is simple and economical for treating of heavy metal contaminated wastewater. The findings can be easily applied to the tannery industry to treat tanning wastewater containing trivalent chromium. As the saline groundwater is available and free of charged and the recovery of chromium could be made for reused (if required), which will save the chemical cost in the production process as well as wastewater treatment.

5.2 Recommendations

Recommendations for treatment of heavy metal contaminated wastewater by the unwanted natural resource that contain divalent metal ions are as follow:

1. Implementing the findings of this study to the pilot scale at the factory.
2. Studying other heavy metals removal by the alkalinized saline groundwater.

3. Studying chromium removal of tanning wastewater by alkalinized hardness water.