CHAPTER V

CONCLUSION

According to the results shown in Tables 4.1 - 4.5, the studies of sensitivity on Shimadzu AA-670 atomic absorption spectrometer for analysis of Ag, Cd, Cu, Ni, and Pb are 0.02, 0.03, 0.03, 0.10, and 0.12 ppm, respectively. The detection limit of Ag, Cd, Cu, Ni, and Pb that are shown in Table 4.6 are 0.06, 0.03, 0.09, 0.05, and 0.30 ppm, respectively. To analyze trace amounts of some heavy metals, i.e., Cd, Pb, Ni, Cu, and Ag in water by using solid-phase extraction technique, various factors having effect on the percentage of recovery are studied and results are shown in Tables 4.10 - 4.24. The concentration of PAR at 10-fold of the concentration of the interested metal, pH value of the extracted solution at 7-8, 500 mg of sorbent mass, flow rate at 6.0 mL/min in the retention and elution steps and 4.0 mL of 1.0 M nitric acid are chosen as the optimal condition of solid-phase extraction for the analysis of heavy metals in water samples. By using this optimal condition, the precision of each metal is studied as a single component in water and shown in Tables 4.25 to 4.30. The percentage of recovery and the relative standard deviations for the determination of Ag, Cd, Cu, Ni, and Pb are 81.82± 3.11, 84.81±3.47, 96.08±1.53, 95.36±1.48 and 81.64±1.01, respectively. The percentage of recovery for determination of these metals as the mixture components in water with relative standard deviation for Ag, Cd, Cu, Ni, and Pb are 81.05±4.97, 89.41±3.88, 100.86±1.15, 98.62±1.93 and 83.57±4.35, respectively. This technique can be used as the efficient sample preparation for determining each metal in a single component the same as in mixture components. Percent recoveries of these metals in both cases are shown insignificant difference. For analysis these metals as a single component in water, the selected conditions can be changed to obtain the maxima percentage of recovery and used the minimal sorbent mass as possible.

The accuracy of this technique is also evaluated by determining the synthetic unknown solution of mixture metals and the results are shown in Table 4.32. The percentage of errors of Ag, Cd, Cu, Ni, and Pb are -15.98, -4.34, 0.29, -5.00, and -13.40 % (direct calculation). The large value of error can be reduced by correcting this value with the recovery factor. When the recovery factors are concerned, the percent errors of Ag, Cd, Cu, Ni, and Pb are 3.64, 6.98, -0.59, -3.69, and 3.63 %, respectively. It is indicated that this technique is suitable for determining of trace quantity of these metals with high confidential results.

To verify that this technique is suitable for the analysis of real samples, six water samples collected from several places are analyzed by this solid-phase technique and the results of the analysis that are shown in Table 4.33. The study of real water samples, i.e., various drinking waters which are sold in the market are collected as: Sample A (Purist-drinking water) has Cu 0.0128 ppm and Ni 0.0033 ppm. Sample B (British Portacel-drinking water) has Cu 0.0358 ppm and Ni 0.0111 ppm. Sample D (Rain water) has Ni 0.0027 ppm. Sample E (Chao Phya River water) has Cu 0.0058 and Ni 0.0057 ppm. Sample F (Chulalongkorn University Pool water) has Cu 0.0087 ppm and Ni 0.0034 ppm. The data shows that the very low concentration (lower than detection limit of the instrument) can not be detected by using direct aspiration Atomic Absorption Spectrometry, but it can be detected by using this technique.

This work can be developed for the efficient sample preparation method using solid-phase extraction technique for enhancing the concentration of some heavy metals in water. High percent recoveries are obtained as a result of none formation of emulsion, a few sample transfers, and small volumes of extraction solvent usage that is little or no evaporation. It is also simple, rapid, economical and safe method.

For the further work, the study of higher extracted volume should be done in order to enrich quantity of metals in final volume. It take more analysis time but it can improve by design the new apparatus for incresing the flow rate of studied solution. The detection limit and sensitivity of any metals can be down by using this sample preparation technique with the other instruments, i.e., graphite furnace atomic absorption, inductively couple plasma. The other ligands are also interested to study for finding or improving sensitivity and selectivity. The investigation of the others heavy metals in water samples and various environmental samples should be also considered.