CHAPTER V

CONCLUSION

The water treatment residue from the Metropolitan Waterworks Authority (Bangkhen, Thailand) was firstly used as the alternative adsorbent for arsenic removal from contaminated water. The sludge was characterized by X-ray fluorescence spectrometry and inductively coupled plasma-optical emission spectrometer for elemental analysis. The result indicated that sludge have high content of silica (48%), aluminium oxide (21%) and iron oxide (8.7%). Moreover, the structure of aluminium and iron hydroxide in sludge might be amorphous because any peak of crystalline form was not observed in an X-ray diffraction investigation. Furthermore, pH of point of zero charge of sludge estimated from a mass titration method was 6.7.

In batch system, the sludge was put into contact at room temperature with arsenic in aqueous solution containing As(III), As(V) and DMA. Various parameters affecting the adsorption efficient were studied. The optimal pH of arsenic solution was 2 and the equilibrium contact time was 12 hours. The initial arsenic solution was studied at various concentrations of 1 to 100 mg/L. The adsorption behaviors of As(III), As(V) and DMA showed a good compliance with the pseudo-second order kinetic model. For the adsorption isotherm, As(V) adsorption fitted to the Langmuir isotherm and showed that this sludge has high efficiency for As(V) removal. While, As(III) and DMA adsorption fitted to both Langmuir and Freundlich isotherms. The maximum adsorption capacity from experiments ($q_{m(exp)}$), was found in the order of As(V) > As(III) > DMA. In addition, this study also indicated that phosphate affected the ability of arsenic adsorption, but sulphate did not.

In column system, the effect of arsenic solution flow rates and adsorbent bed height were studied. It was found that the optimal flow rate was 1 mL/ min and the proper adsorbent layer height was 2 cm.

The optimal operating conditions in batch and column study for arsenic removal in aqueous solution are summarized in Table 5.1.

Table 5.1 Optimal operating conditions for arsenic adsorption

	As(V)	As(III)	DMA
Batch system			
Solution pH	2	2	2
Contact time	12	12	12
Maximum adsorption capacity (mg/g)	9.01	2.29	2.44
Column system			
Flow rate (mL/min)	1	1	1
Column height (cm)	2	2	2

After that, the sludge sorbent was applied to remove total arsenic from real water samples under optimal adsorption conditions for batch and column systems. The batch system showed that the adsorption amount of arsenic form real wastewater samples (TK80 and TK81) were 2.6 and 1.7 mg/g sludge, respectively. While, the column systeml showed higher adsorption amount of 5.9 and 5.3 mg/g sludge, respectively. Furthermore, the surface water sample spiked with As(V) in 10 mg/L level was subject to the removal. The removal efficiency of As(V) was very good and the percent removal was close to the order of 100% (with an adsorption amount of 2 mg/g sorbent). This suggested that the sludge from the Metropolitan Waterworks Authority (Bangkhen, Bangkok, Thailand) was a good alternative low-cost adsorbent for As(V) in water.

Suggestion for the future work:

- As arsenic in real wastewater samples can be commonly found in arsenite (As(III)), arsenate (As(V)), and other organic arsenic species while this sludge has efficiently removed only arsenate (As(V)). Thus, arsenite (As(III)) and other organic arsenic species are suggested to be oxidized to arsenate form before adsorption by the sludge.
- The sludge can be coated with iron oxide for increasing the ability of arsenate adsorption in high arsenic concentration of wastewater.
- The sludge should be applied as alternative low-cost adsorbent for other pollutants such as heavy metals as well as organic pollutants for example phenolic compounds because it exists in a negatively charged phenolate anions like arsenate.