# CHAPTER VI

# CONCLUSIONS

## Conclusions

Soil washing is one of the useful pretreatment methods widely applied to treat many soils contaminated with hazardous contaminants. This method greatly reduces the levels of contaminants; however, it does not remove them totally. There are limitations, however with continued research soil washing can be developed further and limitations can be overcome. More research into other solvents and washing compounds is needed. Treatment methods need to be able to render the contaminants harmless to allow us to use these formerly contaminated sites for other uses. Soil washing is able to clean the soil to a level that allows sites to be utilized for future development. With the landfill space running out, increased population and an increased industrial base contamination will continue regardless of the laws. Simply shifting the problem to another site is no longer acceptable.

The soil washing system which involves adding organic solvent or surfactant to the system has been prove useful in promoting overall soil-washing performances. This work has demonstrated that maximum diuron contaminated soil washing using 10% (v/v) *n*-butanol, exhibiting the desorption efficiency of approximate 50.99±2.32% w/w for diuron-contaminated soil and 72.95%±1.7% w/w for diuron80 contaminated soil. The leaching efficiency of diuron from contaminated soil facilitated by surfactant was found to be less effective. The results suggest that aging of residues leads to increased sorption and reduced availability for leaching. Commercial diuron (80% active ingredient) was shown higher leaching efficiency from soil than analytical grade diuron (98% active ingredient), suggested adjuvant are added to enhancing the solubility. Leaching efficiency of the herbicides from soil in soil column was higher than under shaking condition.

The combination of *n*-butanol (10% v/v) and Triton X-100 (at various concentrations) did enhance the leaching efficiency of either diuron or diuron80 compared to that when *n*-butanol or Triton X-100 was used alone.

Higher ionic strength decreased the leaching of non-ionic herbicide diuron from soil using *n*-butanol, while leaching of the diuron using Triton X-100 was not strongly affected by ionic strength, but both systems was influenced by pH. The decreased in pH of the soil reduced the adsorption.

Accordingly, the results offer information suggesting that it might be possible to extend use of the pump-and-treat technique to the recovery of soils with a long history of contamination. The enhanced leaching achieved will be governed by the hydrophobic character of the herbicide, the nature of the solvent and surfactant used, the aging time, and the characteristic of soils.

One of the main objectives of this work was to demonstrate that detoxification of solution containing herbicide diuron that leached from soil-washing process is possible without total mineralization and in a reasonable time. The photolytic destruction of diuron by the use of $TiO_2$ following a soil-washing process was found to be a useful process in decontaminating polluted soils. The data was showed diuron in leached solution from soil using 10% (v/v) *n*-butanol that higher concentration and higher rate of photodegradation than other system, indicated that at high initial concentration of diuron, rate of the photodecay of diuron is higher than low initial concentration. Nevertheless, conditions for photodecomposition need to be optimized. However, Cost-effective treatments to complete compound mineralization are usually not practicable, and the presense of byproducts during and at the end of the treatment appears unavoidable. Therefore, by-product evaluation is one of the keys to optimize each treatment and to maximize the overall process. Quantification of intermediates will help further in the mechanistic studies of the photocatalytic reaction. The better understanding of the photocatalytic process and the operative conditions could give great opportunities for its application for the destruction of environmental contaminants.

For the future work of soil decontamination, one should vary the type of soil, mixing of other organic solvent and surfactant and study other variables such as temperature, type of salt added, flow rate for soil column, or shaking speed for mixing condition that can affect the results. For further study of photodegradation should be done for analysis of organic intermediate and various conditions for photodecomposition need to be optimized.