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Effect of Ultrasound on Surfactant Aided Soil Washing for Diesel Decontamination

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1. Introduction

There are many kinds of in-situ and ex-situ remediation technologies for soil and ground water contamination. Soil washing is typically used ex-situ remediation method for contaminated soils by separating the contaminated fraction for disposal. Various researches have been undertaken to increase the effectiveness of the soil washing including surfactant aided method.

The objective of this study is to investigate the effect of ultrasound on the surfactant aided soil washing. It is known that sonication can not only directly degrade the chemical itself but also enhance the transport and transfer processes[1-3]. Sonication was used for the desorption of organic [4] as well as the heavy metals [5] from the sediments.

In this study, the effects of ultrasonic power on contaminant removal by soil washing were investigated. Test conditions involved ultrasonic power intensity at the soil slurry phase, particle size, and initial concentration on solid phase.

2. Experiment work

The soil sample was contaminated with a solution of diesel in pentane through mixing in a slurry phase, and air drying for 2 days. After placing diesel contaminated soil of slurry phase in a batch reactor with surfactant, ultrasound was applied. The surfactant of SDS(sodium dodecyl sulphat) was used with the dose 10 mM. The temperature of the reactor was controlled at 20±4℃. The horn type sonicator (Sonics & Materials VCX 500) tuned at the frequency of 20 kHz and maximum power of 500 W was used.

After sonication, the diesel concentration in the solid phase was analyzed after separation of soil from the emulsion. The solid-phase concentration of diesel on the soil was determined by measuring total petroleum hydrocarbon. The HP 6890 GC with FID was used after extracting soil with dichloromethane.

3. Results and discussion

Figure 1 shows contaminant removal from soil with ultrasonic treatment time. Note that the removal efficiency without ultrasonic treatment was 60%. In the figure, it is seen that the removal efficieny reaches around the maximum value over 5 minutes treatment.

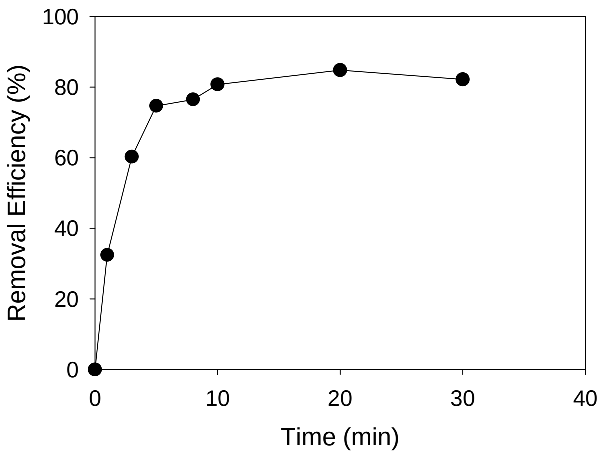

Fig. 1 Removal effeiciency with time (soil particle size: 0.18-0.25 mm, initial concentration: 8,000 ppm, ultrasonic power: 300 W)

Various intensities of ultrasonic power were applied to the diesel contaminated soil slurry samples and the results were given in Figure 2. The treatment time for the test was 5 minutes. The removal of diesel from the solid phase increased with power intensity, and remains constant over 300 W.

When power intensity and sonication time were controlled under the total energy of 90 kJ(100 W with 15 min., 300 W with 5 min., and 500 W with 3 min), the removal efficiency increased with power intensiry up to 300 W but decread at higher power intensiry as shown in Figure 3. This result can be used as a driving index at the field for economic

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consideration.

The effect of initial diesel concentration and particle size was investigated and the results obtained were given in Figure 4 and 5, respectively.

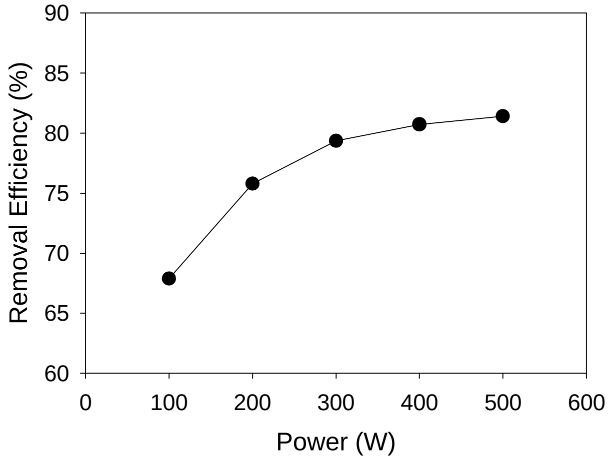

Fig. 2. Effect of power intensity (soil particle size: 0.18-0.25 mm, initial concentration: 8000 ppm)

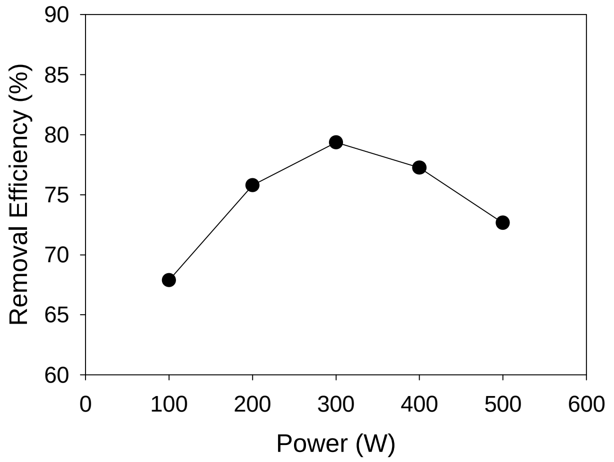

Fig. 3. Removal efficiency at constatnt energy level

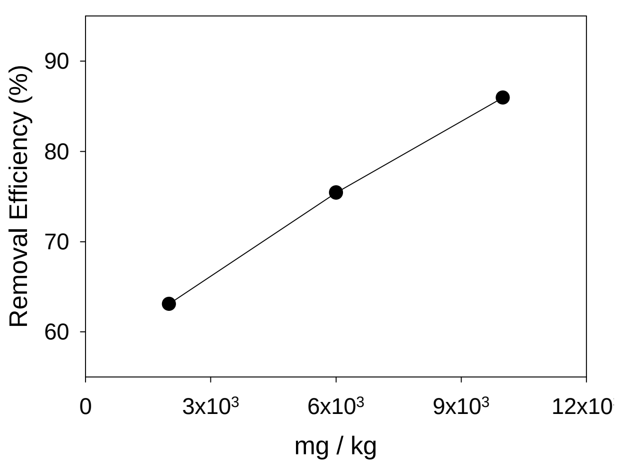

Fig. 4. Effect of initial diesel concentration on removal efficiency (particle size of 0.18~ 0.25 mm)

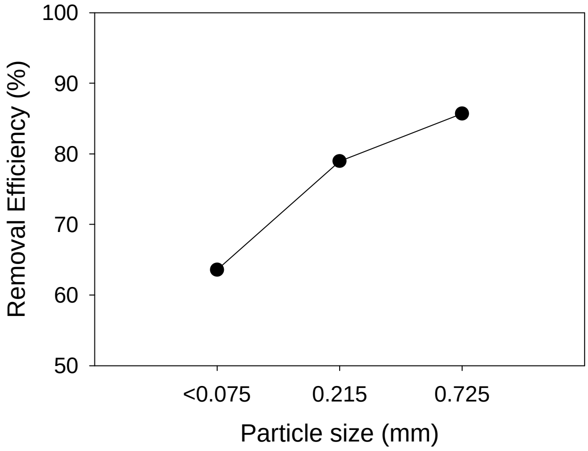

Fig. 5 Effect of particle size on Removal efficiency; (initial concentration: 8000 ppm)

As shown in Fig. 4 and 5, the higher removal efficiency was obtained at higher initial concentration and bigger particle size as it would be expected. These results can be attributed to the interaction of the solid surfaces and diesel. The bonding force between the soil surfaces and diesel is bigger than that between the diesel phase. As particle size and diesel concentration decreases, the surface area and capillary force increases, respectively. As a result, the force for contaminant removal increases and there is a reduction in removal efficiency.

References

1. S. P. Vijayalashmi and G. Madrs : J. Applied Polymer Science. **100** (2006) 4888.
2. Y. Nagata, M. Nakagawa, H. Okuno, Y. Mizukosh, B. Yim and Y. Maeda: ultrasonic sonochemistry **7** (2000) 115.
3. C. Petrier, Y. Jiang and M. Lamy: Environ. Sci. Technol. **32** (1998) 1316.
4. D. Liu, I. Aoyama, H. Okamura and B. Dutka :J. Environ. Toxicol. Water Qual. **11** (2000) 103
5. J. N. Meegada and R. Perera: J. of Hazardous Materials. **85** (2001) 73.