*Proceedings of the 4th International Conference on Environmental Pollution and Remediation*
*Prague, Czech Republic, August 11-13, 2014*
*Paper No. 166*

# Oil Recovery from Petroleum Refinery Sludge through Ultrasound and Solvent Extraction

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***Keywords:*** Ultrasonic irradiation, Solvent extraction, Oily sludge, Oil recovery, Petroleum hydrocarbons.

## Extended Abstract

The oil and gas industry can generate a significant volume of oily sludge which usually exists as a complex mixture of various petroleum hydrocarbons (PHCs), water, salts, and solid particles. It has been recognized as a hazardous waste in many countries because it contains a high concentration of toxic components, and thus requires proper management. Oil recovery represents a desirable management option because it cannot only recycle valuable energy, but also minimize the concentration and disposal volume of hazardous waste. Many studies have been reported to investigate oil recovery through various methods, including solvent extraction, centrifugation, pyrolysis, microwave heating, and ultrasonic irradiation. These methods are associated with different advantages and limitations. Among them, solvent extraction is a simple but effective process, and ultrasonic irradiation is a promising technique with high efficiency, short treatment duration, and chemical-free application. Although they have shown great potential in oil recovery, a number of issues still need to be addressed, including the quality of recovered oil in terms of its PHCs and salt contents. These two processes may complement each other, but limited studies were reported to examine their combined effects on oil recovery from petroleum sludge. The objective of this study was then to understand the influence of ultrasonic irradiation and solvent extraction on both oil recovery and salt removal from petroleum refinery sludge through a series of laboratory experiments. The impacts of different factors were investigated, including solvent type, solvent to sludge (S/S) ratio, ultrasonic irradiation power, and ultrasonic treatment duration. The results revealed that the increased temperature of sludge slurry through ultrasound could enhance the treatment performance. More than 60% of PHCs in sludge was recovered at an ultrasonic power of 75 W, a treatment duration of 6 min, and a sludge to solvent ratio of 1:4. The salt content in the recovered oil was reduced to < 5 mg/L which satisfies the salt requirement of using it as refinery feedstock oil. It was also found that the recovered oil contained more PHCs than fresh crude oil, which implies its higher energy reuse value. Moreover, the treatment can be completed within a shorter duration, leading to lower treatment cost. As a result, oil recovery from petroleum refinery sludge through ultrasound and solvent extraction could be a cost-effective method for oily sludge treatment, and holds great potential to be used for waste management practices within the oil and gas industry.