

1. Introduction

Crude oils, also referred to as petroleum, are commonly used as a source of energy for transportations and industries throughout the world (Speight, 1999). The two types of crude oils that are primarily used for transportations and industries are diesel fuel and gasoline. Although the physical properties and chemical composition of these crude oils are similar, diesel fuel is more rampantly used in transportations and industries because it has higher energy content than gasoline. Moreover, diesel fuel burns more effectively than gasoline (Bacha et. al., 1988).

However, one drawback of utilizing diesel fuel is the presence of sulphur compounds. Combustion of sulphur-laden diesel fuel leads to the production of sulphur dioxide and sulphate particulate matter. The accumulation of sulphur dioxide and nitrogen oxide in the atmosphere results to the formation of acid rain, while sulphate particulate matter can cause respiratory problems (Bach et. Al., 1998; Sachdeva & Pant, 2010).

2. Review and Literature

2.1 Ultrasound

Ultrasound is a sound with a frequency of more than 20 kHz but lower than 100 MHz, which is above the scope of human hearing (Suslick et. al., 1999). In sonochemistry, the power output is inversely proportional to the ultrasound frequency level. Typically, high frequency ultrasound with frequency higher than MHz is considered as non-destructive ultrasound due to its low power output.

The first commercial of ultrasound was in 1917 with Langevin's echosounding technique for estimating the depth of water. The discovery was the direct result of an idea to find a method to detect icebergs in the open sea in order to avoid the disaster that befell the Titanic. Then in 1980, Cracknell reported that ultrasonic cleaning was performed in Germany during the Second World War.

2.1.1 Fundamentals of Ultrasound

2.1.1.1 Acoustic Cavitation

The phenomenon of ultrasound is attributed to acoustic cavitation. Acoustic cavitation provide a unique interaction of energy and matter through the creation, growth, pulsating and implosive collapse of microscopic bubbles during the sonolysis or ultrasonic irradiation (Abramov, 1994; Casadonte, 2000; Hiller et. al., 1994). In the

process, a sinusoidal pressure variation of alternating rarefaction (negative pressure) and compression (positive pressure) is imposed on the liquid as presented in Figure 2.1.

Figure 2.1

3. Methodology

Presence of sulphur in diesel fuel is a worldwide concern because the combustion of sulphur-laden fuel from transportation and industries releases sulphur provide and sulphate particulate matter in the atmosphere.

With this content, the aim of the present study is to determine the viability of utilizing TOPB as an alternative PTA for ODS in comparison to its ammonium counterpart. As well as, to determine the reusability of the quaternary ammonium and phosphonium salt in terms of the desulfurization efficiency of the recycled PTAs and how many times it can be reuse.

4. Results and Discussion

4.1 Reactivity and selectivity of two onium salt using model fuel

In the development and enhancement of the ultrasound-assisted oxidative desulfurization (UAOD), selecting the right type of PTA is fundamental. Among the different types of PTAs, the most commonly employed are quaternary ammonium and phosphonium salt.

4.2 Effect of process parameters on desulfurization efficiency

There are two important steps that strongly affect PTC reactions, namely transfer step and the intrinsic reaction. Proper combination of these steps is necessary to achieve good PTC reactions. Furthermore, there are several variables that affect the PTC reactions that should be considered in order to enhance these steps.

5. Summary and Recommendation

5.1 Summary and Conclusion

The increase of worldwide consumption of diesel fuel has resulted in environmental and health hazards arising from elevated concentrations of sulphur dioxide and sulphate particulate matter in the atmosphere. With intensifying environmental and health awareness, legislative regulations on sulphur content in transportation fuels in most countries have become from stringent. Therefore, an advance desulfurization method is required to produce ultra-low sulphur diesel fuel with sulphur content of less than 15ppm.

From the result obtained from this research, the use of phosphonium salt showed high selectivity and desulfurization efficiency toward sulphur compounds in model fuel. At optimized condition, the use of high shear mixer had the potential as an alternative mixing method to ultrasound.

5.2 Recommendation for future work

The emphasis of the future work on ODS should be on the development of the system taking into mind the present insight on its technological and financial viability for possible manufacturing functions. Several important issues can be recommended as follows:

Bibliography and/or References

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Appendix (if applicable)

Glossary (if applicable)

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