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EXPERIMENTAL STUDY FOR THE BREAKING OF OIL-WATER EMULSIONS

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Introduction

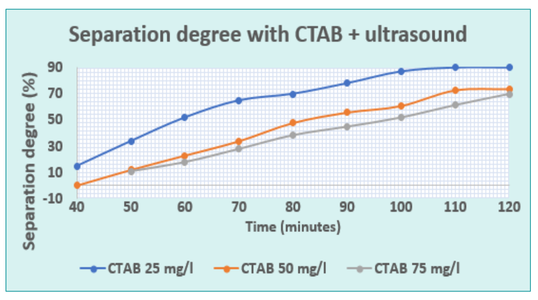
Water pollution is a highly important domain that requires continous improvement since water is the life source and the quality of water has a great impact on every environmental factor, industry sector and daily human activity. A specific type of water pollution is adressed in this paper which fits the "waste from modeling and mechanical and physical treatment of metal surfaces and plastic surfaces" waste category, code 12 01 09*. This type of waste is mostly generated by petroleum production plants, manufacturing industry (cars, materials), agriculture (insecticides, herbicides), geology, home and personal care products, which are very difficult to treat. Globally more then 30% of extracted crude oil contains significant amount of water (brine) in emulsified form, which requires effective and costly separation techniques. Emulsions are colloidal systems which contain two or more immiscible fluids (one oil based and one water based) completely dispersed in one another with droplets size between 1-100 μm. Most emulsions are thermodynamically unstable, but those from industry applications are stabilized with emulsifying agents (usually a surfactant) also may contain solid particles or even gas, making them harder to separate.
This work aims to characterize the composition of emulsion waste and to determine the most cost-effective methods for separation.

Materials and methods

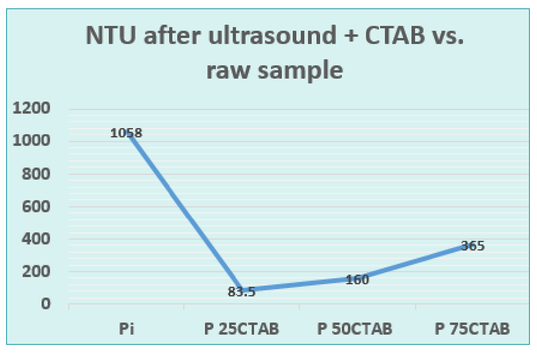
► The selected samples were first analysed by measuring their initial turbidity (1058 NTU), viscosity (190cP), pH (9.5), water content (85.02%) and calorific value (10385 kcal/kg).
► 450mL emulsion was submitted to ultrasonication at 20 kHz using apparatus VCX 500 (right picture) , at three different energy exposure levels 25, 50 and 100kJ at 100% amplitude.
► After sonication we measured NTU for every treated sample to determine the turbidity reduction, thus the efficiency of separation method.
► The second experiment involved mixing the emulsions with demulsifier CTAB (Cetyltrimethyl ammonium bromide) - **$CH_3(CH_2)_{15}N(Br)(CH_3)_3$**.

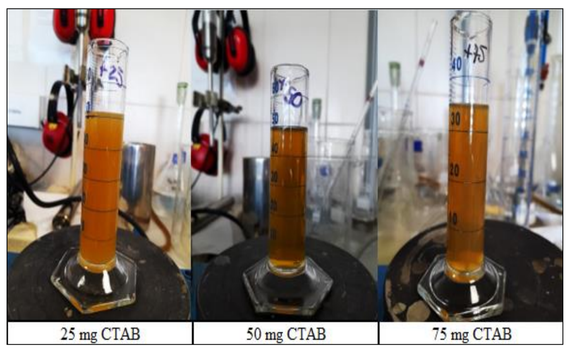
Results and Conclusions

► Each sample was mixed with demulsifier 25, 50 & 75mg/L CTAB and subjected to ultrasound (40kHz) for 120 minutes at 28°C. The separation degree over time was calculated for each sample and the best results were obtained for 25mg/L CTAB (graph & picture 1). Separation increases in time and after 120 minutes it registers a plateau.

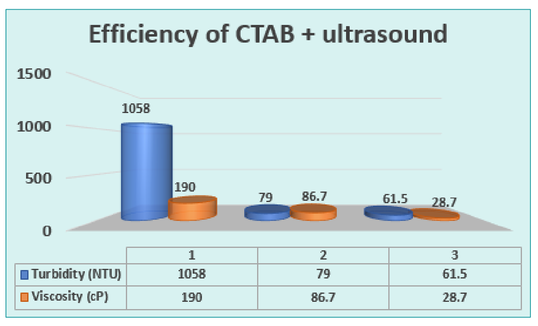


► The initial turbidity of emulsion was measured and compared to the three treated samples with CTAB + ultrasound. The sample with 25mg/L CTAB had the smallest NTU meaning it had the best clarity (graph & picture 2).
► The optimal separation conditions of the emulsion were obtained by using 25mg/L CTAB + 40 kHz ultrasound at 60°C and 400 rpm.





► Another comparative experiment involved heating the samples (with 25 mg/L CTAB and without CTAB) at 60°C, agitation at 400 rpm for 30 min and ultrasound for 110 min. Finally the turbidity and viscosity were measured. By increasing the temperature while using emulsifier 25 mg/L CTAB and ultrasound, the destabilization of emulsion is more efficient and was correlated with the decrease in turbidity and viscosity (graph 3).



► The optimum temperature required for emulsion separation was observed between 50°-70°C.
► The calorific value of the oil phase of the emulsion was 10385 kcal/kg (comparable to diesel fuel) which makes it suitable as an alternative to fuel.

Acknowledgments

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