Using Synthetic Resins for Removal of Emulsified Oil from Produced Water

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Abstract

In this study, adsorption of emulsified oil in produced water was experimented using synthetic resins. Adsorbent dosage, contact time, initial oil concentration, and PH were the main key parameters evaluated for Optipore L493, Amberlite IRA 958, Amberlite XAD 7 and Lewatit AF 5. Oil removal rates have reached up to 98% using AF 5, XAD 7 and L493, while they are lesser than 25% for IRA 958. Isotherm data were fitted using Langmuir, Freundlich, Toth, Flory Huggins and Dubinin-Radushkevich models. Adsorption isotherms for XAD 7 and L 493 were best fitted using Langmuir model, whereas AF 5 curves were best fitted using Dubinin-Radushkevich. Kinetic data describing the rate of adsorption for each resin were studied and fitted using pseudo-first and second order equations in addition to intraparticle diffusion models. The experimental results were best fitted using pseudo second order kinetics. The obtained results confirm the applicability of the resins for the removal of oil from produced water.

Produced Water and its Management

It is defined as waste byproduct generated in the exploration and production of oil and gas from onshore or offshore wells. It is also defined as water extracted from underground formations and brought up to the surface along with the oil and gas.

Management of PW

- Reinjection into formation
  - Maintain well pressure
- Reuse in petroleum industry operations
  - Drilling
- Apply in other uses
  - Irrigation, wildlife consumption
- Discharge to the environment
  - Treatment to meet regulations

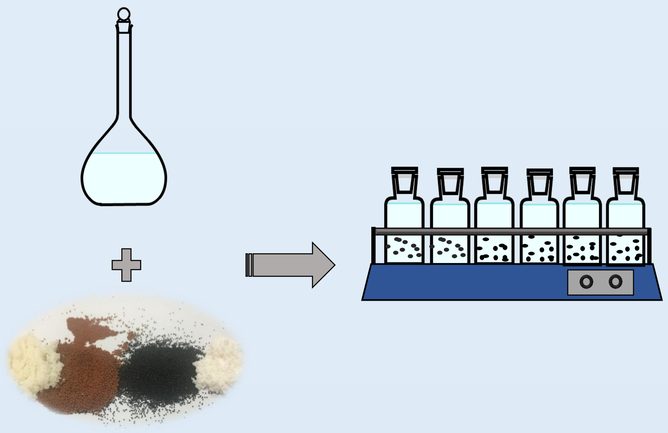
Primary
- Skim tanks
- API separators

Secondary
- Hydrocyclones
- Gas flotation
- Centrifuges

Tertiary
- Membranes
- Biological treatments
- Adsorption

Methodology

The adsorption potential of the synthetic resins was determined by various parameters. The parameters investigated are: Changing adsorbent dosage, contact time, initial adsorbate concentration and the effect of pH. The experiments were conducted on four different resins. The solution was exposed to resins and placed in glass bottles which were then placed on a mechanical shaker for the mixture to be well agitated. The experiments were considered to be batch experiments and were performed at room temperature and pressure. The pH was remained constant in the all parameters but the effect of pH at about 6.7, and the mechanical shaker was set at 180 rpm.

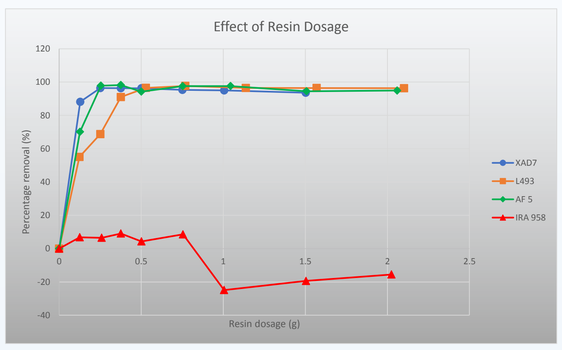


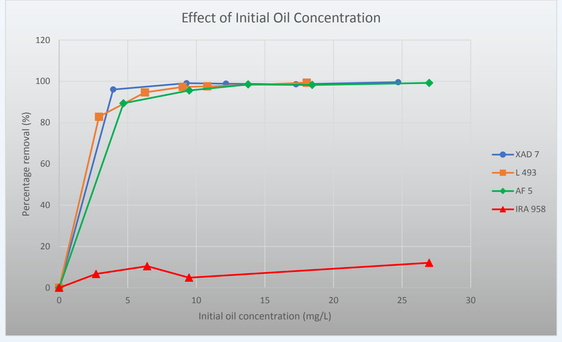
Objectives

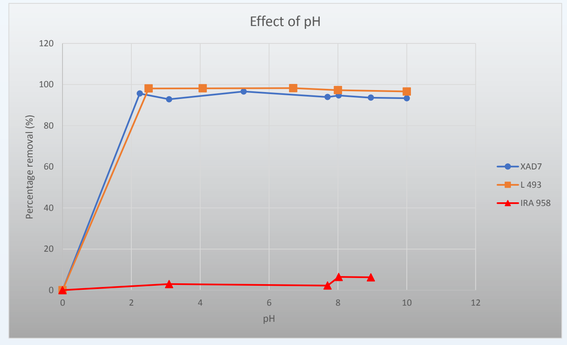
- Manually prepare a close-to-real solution of produced water to simulate the conditions for the tertiary treatment
- Conduct lab scale experiments to investigate the potential of synthetic resins to remove the organic compounds from the produced water
- Anticipate the batch kinetics and adsorption isotherms to evaluate adsorption capacity and efficiency of the synthetic resins
- Conduct regeneration experiments to determine the desorption capacity, reusability and effects on the synthetic resins

Results

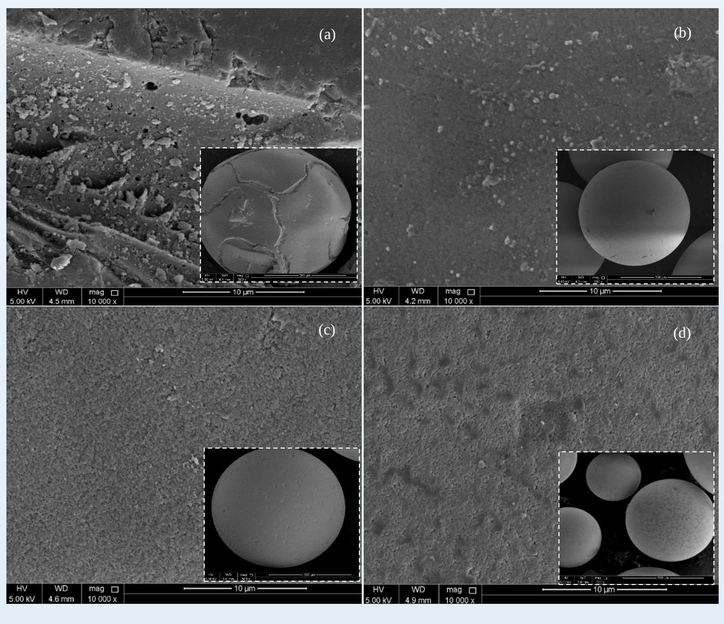
Effect of changing parameters







Surface characterization using SEM imaging. (a) AF 5, (b) IRA 958, (c) L493, (d) XAD 7.



Conclusion

After conducting the experiments and obtaining the results, XAD 7 and L493 were best fitted to the Langmuir model, AF5 was fitted to Dubinin-Radushkevich model and the IRA 958 was not fitted to any of these models. Moreover, the adsorption kinetics seemed to follow a pseudo-second order trend, which perfectly described the kinetics. The results shows the feasibility of using these resins in adsorbents processes.

Acknowledgement

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