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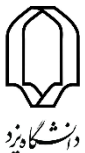
Increasing the Efficiency of Vacuum Belt Filter in Gol-E-Gohar iron ore concentrate production by adding surfactants

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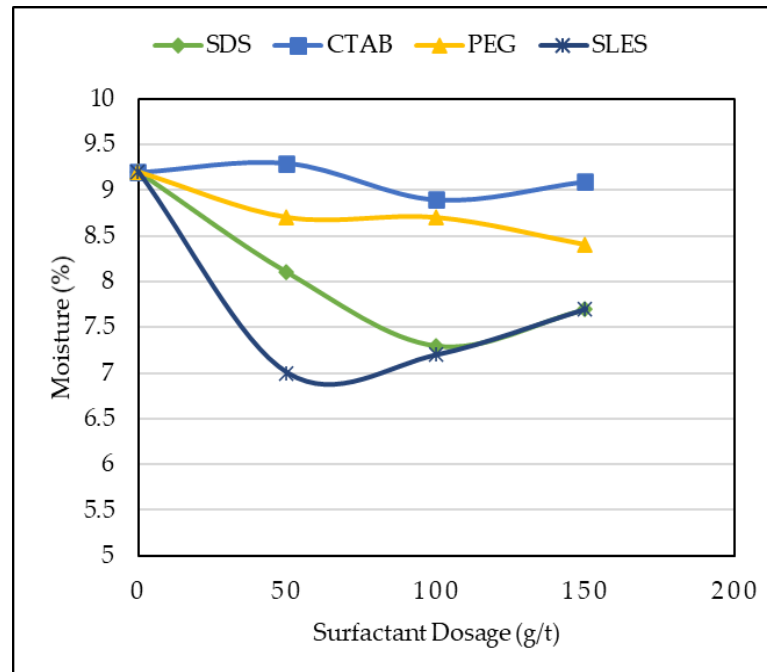
Abstract: In this research, filtration experiments were carried out by four types of surfactants as filter aid. Sodium dodecyl sulfate and sodium lauryl ether sulfate as anionic surfactant (SDS and SLES), Polyethylene glycol as nonionic surfactant (PEG) and Cetyl trimethylammonium bromide as cationic surfactant (CTAB) were used to evaluate their effects on moisture reduction of concentrate and improvement filtration process. All of tests were done at the optimal conditions include 60 KPa vacuum pressure, 120 seconds filtration time, 105 microns particle size and 60% (w/w) solid content of pulp. results showed that in all of tests, cake moisture decreased by adding surfactants however anionic surfactants SDS and SLES were better than other chemicals. by adding 100 g/t SDS and SLES to the pulp, the filter cake moisture content was reduced by 2%. SDS and SLES improves filtration performance by increasing the ratio of throughput to moisture. At the concentration of 100 g/ton SDS and SLES, the highest throughput and lowest moisture was achieved. Although both of SDS and SLES have similar chemical structure and action, but SLES was selected Due to better solubility in hard water, economic justification and availability.

Keywords: Horizontal belt filter, Cake filter, Surfactant, Blain, Vacuum Filtration, Dewatering

Results and Discussion

Effect of surfactants on moisture

At a dose of 50 g/ton, all of surfactants reduced moisture except PEG. In this dosage, SLES caused the greatest decrease in moisture and reached 7%. At a dose of 100 g/ton SDS and SLES, the moisture content of the concentrate was the lower than others and that was %7.2. At a dose of 150 g/ton, increasing the surfactant concentration increased the moisture. Lowest moisture in this dosage was value of %7.7 obtained for SDS and SLES.



Results and Discussion

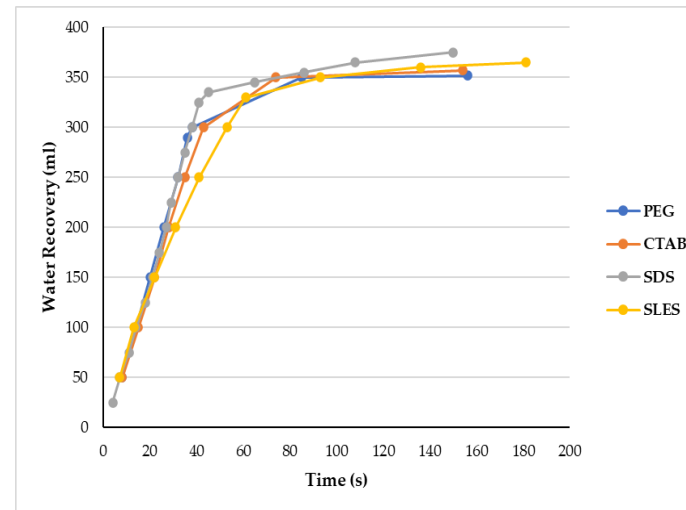
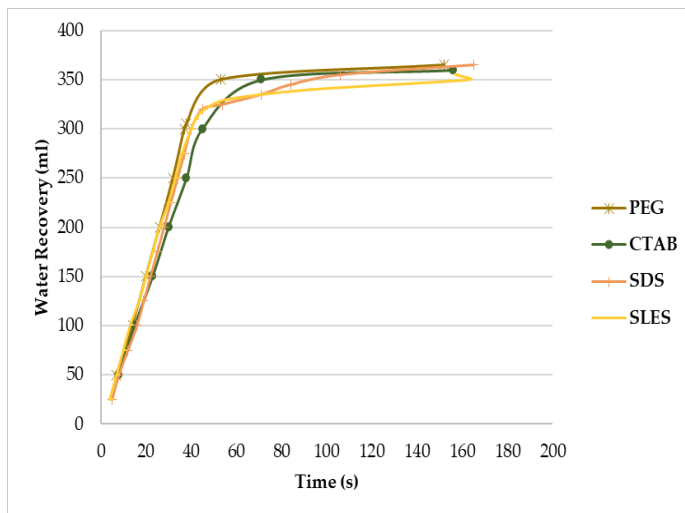
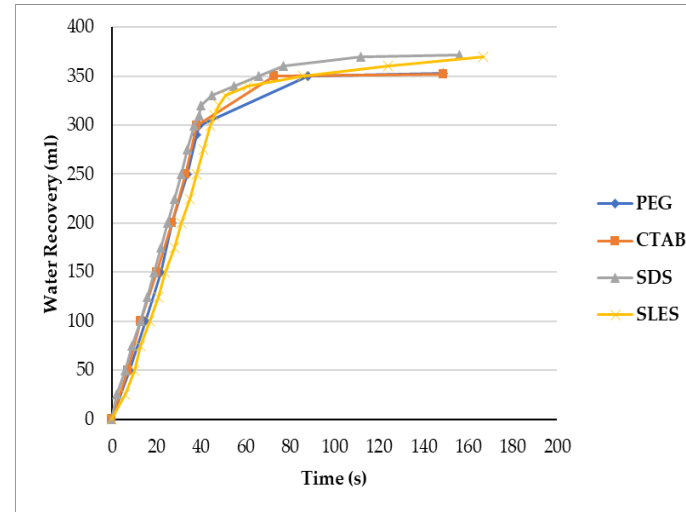
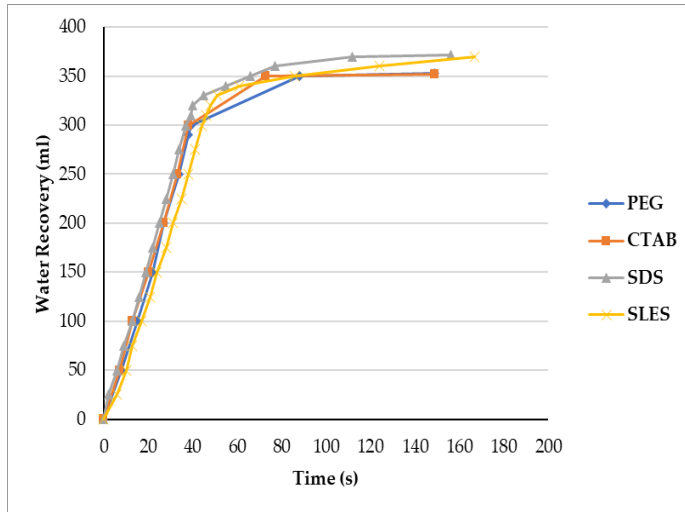
Effect of surfactants on water recovery

By increasing the surfactant concentration of 50-150 g/t, water recovery was increased. the maximum water recovery was obtained 375 and 365 ml for SDS and SLES as 150 g/t dosage. Figures 3-5 shows the amount of water recovery for each of the surfactants at concentrations of 50, 100 and 150 g/ton.

Water recovery indicates the amount of water separated from the suspension. But this factor is not enough to evaluate the filtration performance, and along with factors such as cake formation time and filter volume at the moment of cake forming can give us more accurate information to evaluate the effects of surfactants.

Results and Discussion

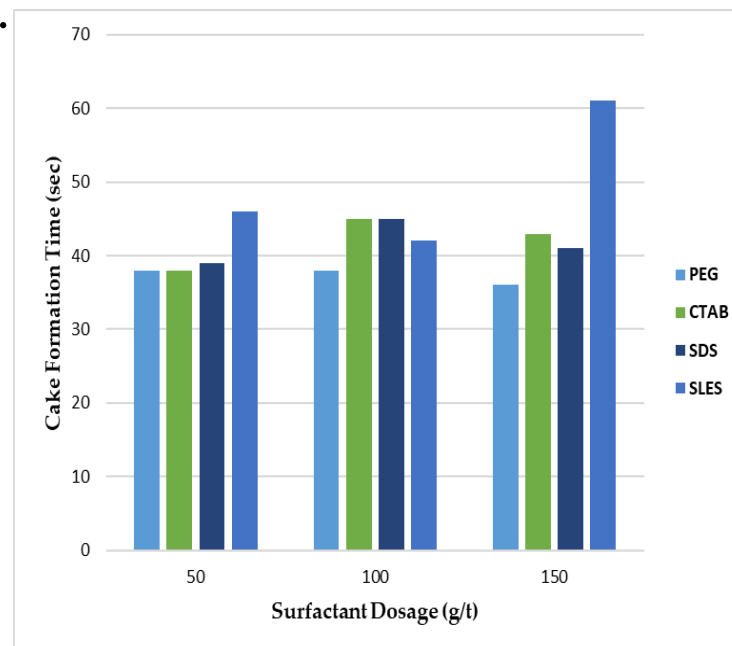
Effect of surfactants on water recovery



Results and Discussion

Effect of surfactants on cake formation time

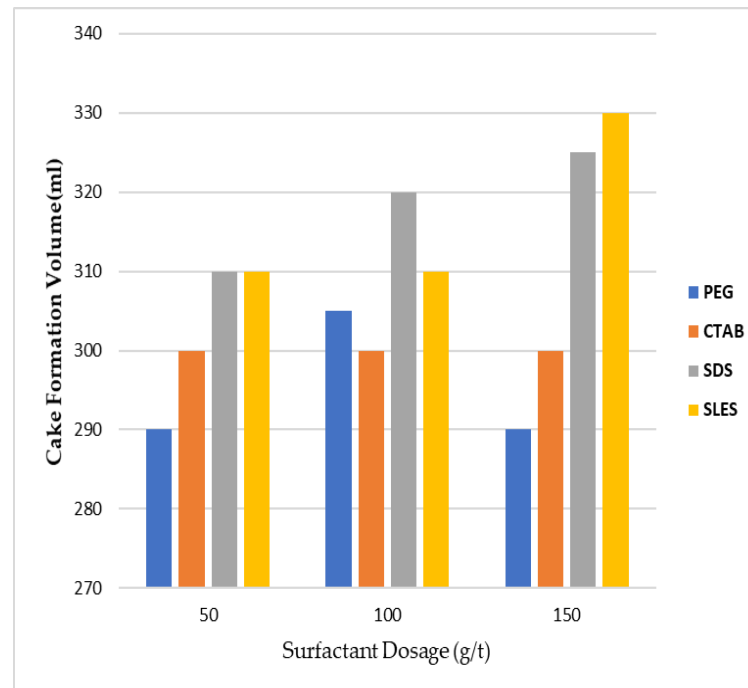
Cake forming time without additive was 36 seconds. In all dosage of additive, cake formation time was increased. At concentrations of 50, 100 and 150 g/ton, the minimum cake formation time was for adding PEG. As the dosage increased, the cake formation time increases. However, this factor is one of several factors to evaluate filtration performance. SLES at a dose of 150 g/ton had the longest cake formation time.



Results and Discussion

Volume filtrate at the moment of formation cake

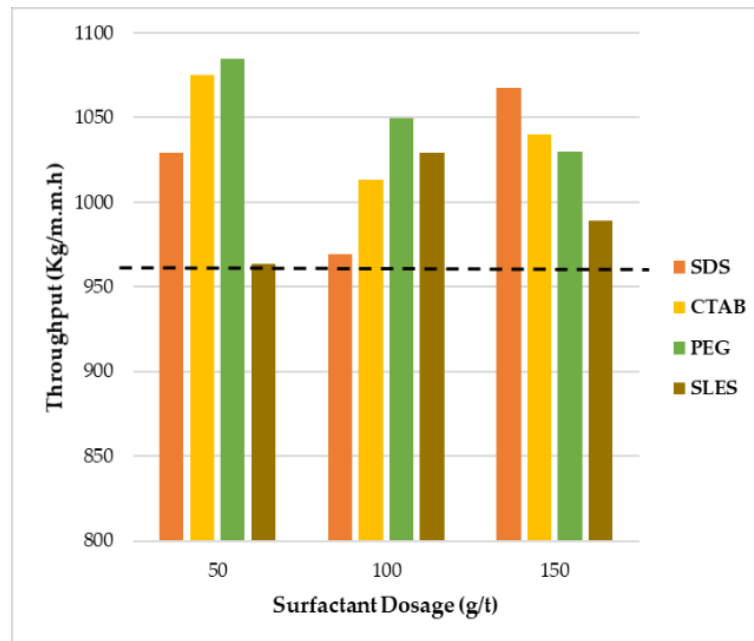
In the case of no additive, the volume of filtrate was 285 ml. By adding surfactant at all concentrations, the filtrate volume at the moment of cake formation increased. At dose 100, the maximum volume was SDS. The highest volumes were 330 and 325 for surfactants SLES and SDS, respectively, at a dose of 150 g/ton.



Results and Discussion

Effect of surfactants on throughput

The amount of throughput without additive was equal to 962 Kg/m².h Which is marked in the diagram with a dashed line. The maximum throughput was obtained by adding 50 g/ton of PEG. At a dose of 100 g/ton, the throughput for all surfactants had a decreasing trend except SLES. At a concentration of 150 g/ton, the highest throughput was obtained by adding SDS.



Discussion

Moisture

Surfactants increase the contact angle between liquid and solid particle. Increasing the contact angle increases the particle's hydrophobicity. Therefore, the capillary forces are reduced and the surface tension of the water is reduced.

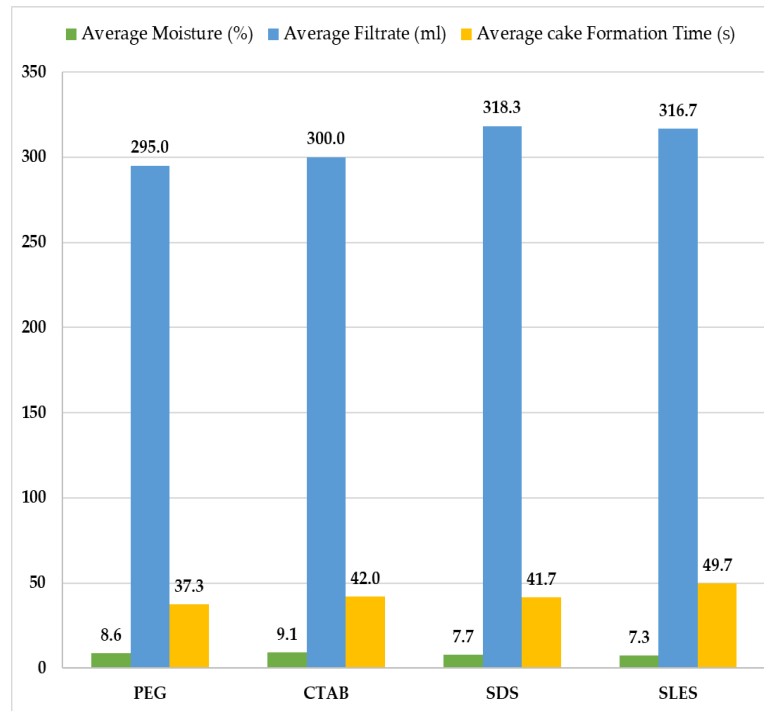
The main mechanism of adsorption of CTAB on magnetite is charge neutralization. This is due to the positive charge of CTAB and the negative charge of the magnetite surface of SDS and PEG surfactants is often bridging. In CTAB the adsorption mechanism is interaction of electrostatic and neutral loads prevails.

So based on the figure 2 It can be concluded that surfactants SDS and SLES by the mentioned mechanism causes hydrophobicity of particles and as a result, achieves the lowest moisture content.

Discussion

Moisture vs. Cake formation time vs. Filtrate volume

Figure Shows the average values of moisture, filtrate volume and cake formation time for each surfactant So it can be concluded that in the presence of SDS, all three factors are in balance however SLES is preferable to SDS because of better solubility in hard water, economic justification and availability.

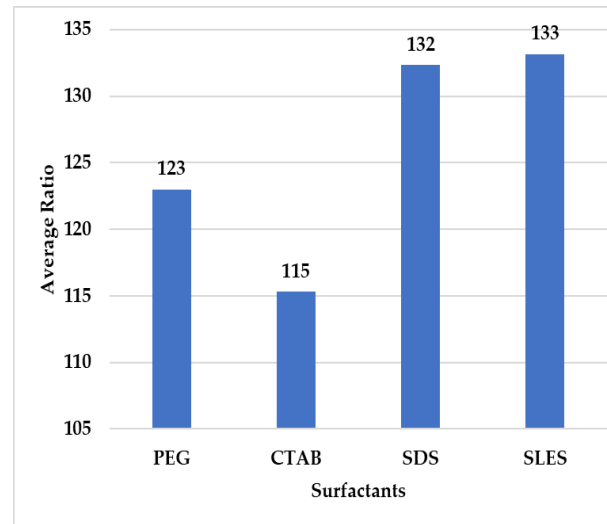
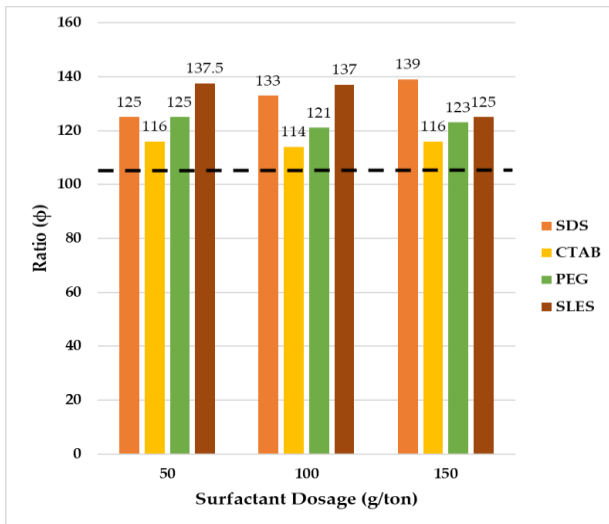


Discussion

Ratio of throughput to moisture (ϕ)

A ratio of throughput to moisture was used to compare the performance of surfactants.

Left figure shows the Ratio of throughput to moisture for different doses of surfactants. Right figure shows the average of this ratio for surfactants.

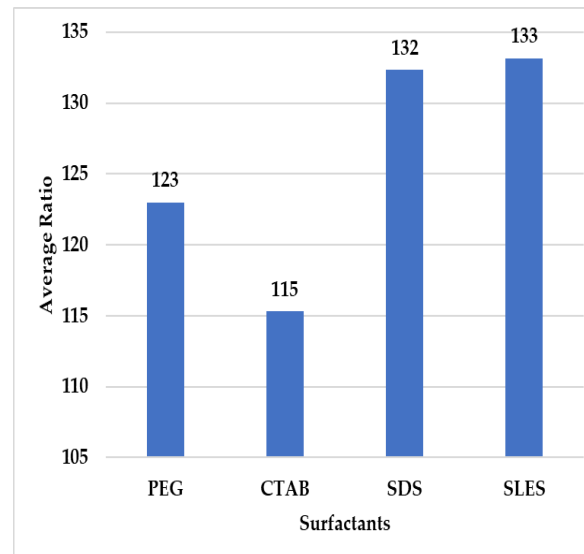


Discussion

Ratio of throughput to moisture (ϕ)

According to below Figure:

- the average ratio (ϕ) in three dosage for PEG, CTAB, SDS and SLES surfactants are 123, 115, 132 and 133 respectively.
- the highest average for this ratio is obtained by adding SLES and SDS respectively.
- Although both of them have similar chemical structure and function, but SLES was selected due to better solubility in hard water, economic justification and availability.



Conclusions

- in all of tests, cake moisture decreased by adding surfactants however anionic surfactants SDS and SLES were better than other chemicals. by adding 100 g/t SDS and SLES to the pulp, the filter cake moisture content was reduced by 2%.
- The SDS and SLES increased filtration efficiency by decreasing cake formation time and increasing the total separated water from pulp, especially at the cake formation time. SDS and SLES improves filtration performance by increasing the ratio of throughput to moisture.

Conclusions

- At a concentration of 100 g/ton SDS and SLES, the highest throughput and lowest moisture was achieved and This result was the best compared to other surfactants. So SDS and SLES are suitable for filtration of iron concentrate. Although both of them have similar chemical structure and function, but SLES was selected due to better solubility in hard water, economic justification and availability.

Acknowledgments



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