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Study on the effectiveness of in-situ high intensity ultrasonic (HIU) in increasing the rate of filtration in palm oil industries

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Application of ultrasound wave fields in the filtration and separation technology is a new and clean technology and offers an attractive alternative to the classical cleaning processes. Fouling phenomenon is a major bottleneck in this separation technology, as expected in the industrial application of such finely porous media. As the filtration process continues, the concentration of solute keeps building up on the filter surface to form a filter cake. This results in a continuous declining of the flux. In this study, the effect of intermittent application of ultrasound wave fields on the filtration of bentonite in Refined Bleached Deodorized (RBD) oil suspension is presented. In general, the intermittent application of ultrasound fields increased the overall flux of the filtration. The main mechanism responsible in reducing the thickness of the filter cake, and hence increasing the rate of filtration, is the cavitation phenomenon. Four parameters affecting the ultrasound assisted filtration were investigated. The parameters include the filtration cycle time, sonication cycle time, applied pressure, and ultrasound intensity. The highest percentage of improvement achieved in the study was 88.47%, conducted at 5 minutes filtration cycle time and 12 minutes sonication cycle time. The result also showed that the degree of flux improvement was initially increased with the increase in the applied pressure. However, as the pressure was further increased, compaction of cake layer took place which constricted the filtrate path, and hence, reduced the degree of flux improvement. On the other hand, the degree of flux improvement was linearly related to the ultrasound intensity. In this study, the highest flux was obtained when the ultrasound intensity was set at 1.2109 W/cm^2. An Ultrasonic Clean-in-Place (UCIP) method of cleaning the filtration system was also developed in this study. The UCIP method showed an effective method of cleaning, with 71.5% flux recovery achieved after only 15 minutes of UCIP cleaning processes. Empirical models were developed in this study to represent the profile of the filtration process. The developed models showed good fitting with the experimental data, with error not more than 5%.