# CHAPTER 6
# DEMULSIFICATION OF EMULSION LIQUID MEMBRANE

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## 6.1 INTRODUCTION

Demulsification is the process of breaking or separating emulsions into their individual phases, typically separating oil and water. This process is often employed at the end of the emulsion liquid membrane (ELM) process as highlighted in Figure 6.1 to separate the liquid membrane and the internal phase. The aim of demulsification is to recycle the liquid membrane phase as well as to recover the valuable solute enriched in the internal phase. The reusability of the organic membrane in ELM is crucial since the carrier is the most expensive component in the ELM process. This could reduce the capital and operational costs in the ELM process. The ELM process is approximately 40% less expensive than conventional extraction methods (solvent extraction) (Admawi & Mohammed, 2023). Further discussion on the role of types of demulsification methods available and the effect of heating-ultrasonic demulsification treatment can be found in the subsequent section.

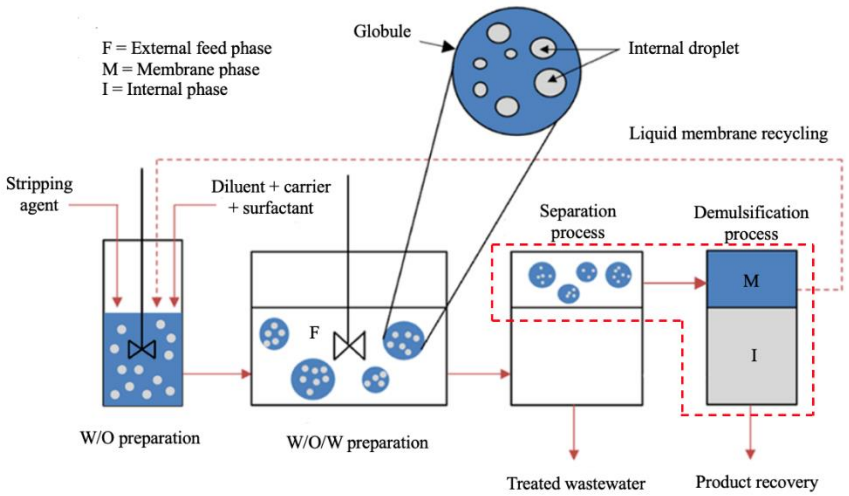


**Figure 6.1** Schematic diagram of the demulsification stage in the ELM process

## 6.2 DEMULSIFICATION MECHANISM

Demulsification of the emulsion in ELM is caused by coalescence. Ahmad et al. (2020) claimed that coalescence is a four-step process including flocculation, drainage of the continuous phase film between the droplets, breakage of the film and collapse of the droplets. Once the droplets coalesce and become larger, the dispersed and continuous phase of the system can easily separate with the assistance of gravity. On the other hand, Ostwald ripening causes direct phase separation without undergoing coalescence. Figure 6.2 exhibits the possible mechanism of the demulsification process of water-in-oil (W/O) emulsion.

## 6.3 TYPE OF DEMULSIFICATION TREATMENT

According to Buddin et al. (2020), the available techniques for the demulsification process in ELM are physical, chemical, biological, and combination treatment.

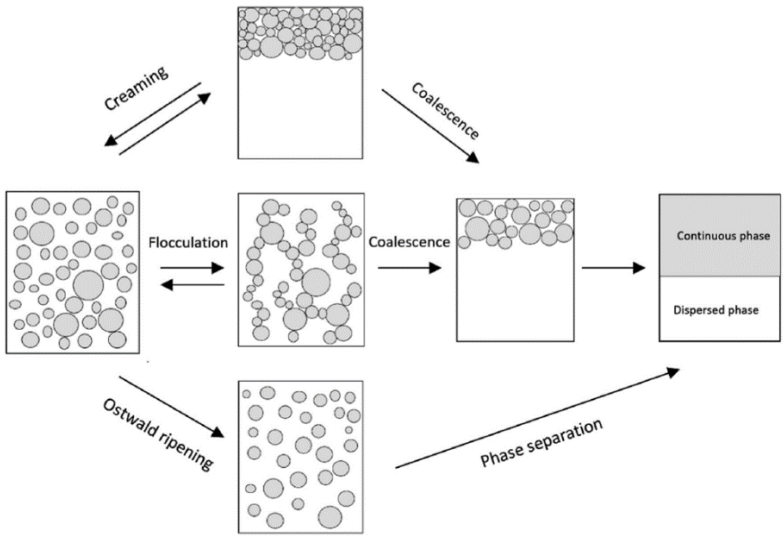


**Figure 6.2** Demulsification mechanism in the ELM process

### 6.3.1 Physical Demulsification

To date, there are several physical treatments that have been introduced in order to physically demulsify the emulsion, including heating, microwave, ultrasonic, electrical field, and membrane treatment. Among the aforementioned methods, heating is the most common method used in order to demulsify the emulsion. However, heating treatment offers a slow demulsification rate. Microwaves, ultrasonics, electrical fields, and membranes have been introduced in order to tackle this problem. These methods are attractive as they are typically fast, clean, and effective (Saad et al., 2019).

Microwave and ultrasonic demulsification are similar to heating methods, however, each of them offers different mechanisms to heat up and demulsify the emulsion. Microwave treatment uses electromagnetic waves to heat the emulsion, while ultrasonic demulsification uses high-frequency sound waves to create cavitation and shockwaves in the emulsion (Luo et al., 2020). These sound waves subsequently enhance the collision frequency of the water droplets in the emulsion, facilitating the separation rate. On the other hand, electrical field demulsification is