RECOVERY OF BIO-BASED VOLATILE FATTY ACIDS BY PERTRACTION TECHNIQUES FROM WASTEWATER USING GREEN SOLVENTS

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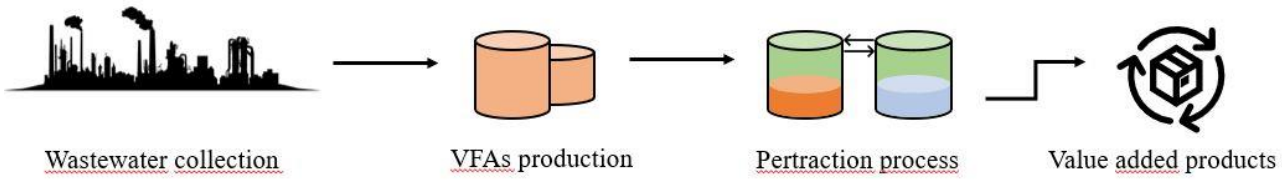

In recent years, events such as the COVID-19 pandemic and the Russian invasion of Ukraine negatively influenced the supply chain of raw material in Europe. Recently, the chemical industry has suffered a significant detriment due to the energy crisis, which has led to a drop in production of more than 10% (Navarro et al.,2010). In order to cope with the energy crisis, industries are pursuing virtuous strategies that are more resilient in the long run and decoupled from the supply of fossil-based raw materials and energy sources. For instance, bio-based Volatile Fatty Acids (VFAs) (eg., acetic, butyric, propionic acids, etc) from the acidogenic fermentation of organic waste have gained considerable attention as they represent a readily carbon source with several applications (eg., preservation, antimicrobials and acidity regulators) and biological precursors of biopolymer such as PHAs and bioenergy (Strazzera et al.,2018). Typically, bio-based VFA are produced from non-renewable petrochemical sources. However, petroleum-based (cradle to grave) pathways are considered unsustainable and, therefore, recent research has focused on cradle to cradle technologies such as biological production of VFA from waste streams and recovered of them. One of the recovery methods for VFAs is pertraction through liquid membranes is a widely studied approach for the recovery of low- concentration chemicals (such as VFAs) by exploiting the mass transfer that takes place between two aqueous phases of different pH (a feed solution and a adsorption solution) separated by an organic membrane layer (Torri et al., 2019). The receiving phase is represented by an alkaline solution rich in volatile fatty acids that can be used as raw materials for several applications seen before. Traditionally, the organic solvents used in extraction processes have been environmentally unsustainable. Therefore, the ability to recover bio-based VFAs using alternative solvents was analyzed during this experiment. This work proposes to study the pertraction process from a real fermentation broth rich in volatile fatty acids, and to test three organic solvents (kerosene, Biodiesel and HDES) and three alkaline solutions (Na_2CO_3, $NaHCO_3$ and NaOH). This study aimed to determine the conditions that maximize the recovery and purity of VFAs. Recovery using kerosene and biodiesel lead to an overall VFA capture between 55 and 28,8 %. The transfer of short-chain fatty acids would seem to be more difficult ($0.21 < gCODtransfer\ L^{-1} < 2$). Instead, long-chain fatty acids, such as caproic acid, recorded the highest transfer ($gCOD\ L^{-1} = 9.02$), with a final purity of 45 %. The objective of this work was to test the feasibility of using a eutectic mixture (Menthol:Lauric acid) for the extraction of VFAs from real fermentation broth to evaluate its performance. HDES has a capture capacity that follows the lipophilicity trend of individual fatty acids, from acetic acid to caproic acid, with a capture rate from 31 to 92 %. Mass transfer to an alkaline solution was recorded for the first time in this work. A high mass transfer of caproic acid of 16 $gCOD\ L^{-1}$ corresponding to 6.40 $g(HCa)\ L^{-1}$ with an acid purity of approximately 50% was also found.

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