Short Communication

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General outlook of hollow fiber supported liquid membrane separation and its application on petrochemical related industries

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Recently, membrane processes have been highlighted as promising alternatives to conventional separation methods. Many researchers have attempted and have been undertaken, using bulk liquid membranes, supported liquid membranes, emulsion liquid membranes, liquid membrane contactors and carrier membranes. Liquid membrane extraction has received considerable attention due to the advantages of combining liquid-liquid extraction with membranes in one single process. Furthermore, most membrane separations can be performed at room temperature, which makes them energy economical. Hollow fiber supported liquid membrane (HFSLM) draws considerable interest due to its industrial applications. These include the removal of dilute heavy metals from waste waters to meet stringent environment quality standards as well as a simple design amenable to scaling up in industry.[1]

The hollow fiber supported liquid membrane (HFSLM) technique has specific characteristics of simultaneous extraction and stripping processes of low-concentration of target species in one single stage. HFSLM is an effective simultaneous process to extract and recover compounds from a very dilute solution of interested components in the feed by a single-unit operation. Great progress has been made in such applications, as in metal ion separation, organic separation and petrochemical wastewater treatment. The simultaneous process of extraction and stripping in a single unit operation of HFSLM system is very interesting. The advantages of HFSLM over traditional separation techniques include high selectivity, lower operating costs, lower energy consumption, and low organic diluent. The outstanding feature of HFSLM technique is its ability to treat metal ions of a very low concentration that are hardly treated or impractical by the conventional techniques. Therefore, based on the concept of mass transfer we, for example, deployed the HFSLM to remove low concentrations of heavy metal such as arsenic and mercury in the produced water.[2]

In offshore oil and gas production, produced water contaminated with toxic metals, in particular lead and mercury came along with oil and gas. Arsenic (As) and mercury (Hg) are naturally trace components in petroleum reservoir. In certain Gulf of Thailand fields, the concentration levels vary widely and Hg, in particular, is drawing local statutory attention since its concentration is found typically higher than those found in the rest of the global petroleum production areas. A number of hypotheses have suggested the origin of As and Hg in the petroleum reservoirs laid underneath the Gulf. But one common fact agrees that mercury predominantly presents in an elemental form Hg (0) with the rest in an inorganic form ($HgCl_2$), organic forms (CH_3HgCH_3 and $C_2H_5HgC_2H_5$) and an organo-ionic form ($ClHgCH_3$). For arsenic, it presents as As (III) and As (V). Arsenic and mercury are grouped in the most hazardous metals since arsenic compounds are carcinogens, both severe acute and chronic toxicity, while mercury can evaporate in soil or water; short-term exposure results in kidney damage; and a lifetime of exposure can lead to impairments in neurological functioning.[3]

The removal of Arsenic (As) and mercury (Hg) by hollow fiber supported liquid membrane (HFSLM) has been applied. The modules of hollow fiber can be put in series after the conventional operation to scavenge the remaining arsenic/mercury down to the environmentally acceptable permits.[4] The HFSLM technique is relatively recent. It can supplement or can replace the conventional separation techniques if the concentrations of as and Hg ions in produced water are very low and hardly handled by those conventional methods. To date based on the concept of mass transfer by using HFSLM with either a single extractant or a synergistic one. The result was successfully achieved by using the HFSLM in conjunction with the selection of the suitable single or synergistic organic extractant, and the stripping solution. The removal of mercury contamination was very effective. In many cases, the mercury content could be reduced to meet the permissible discharge limit to the environment from only single extraction cycle. The removal of arsenic was found inferior to the mercury. More than one extraction cycles were required to treat arsenic in the produced water.[5,6]

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Conflict of interest

The author declares no conflict of interest.

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