ISGC 2022

N°171 / OC
TOPIC(s) : Alternative solvents / Chemical engineering

COMPARISON OF VARIOUS ABSORBENTS FOR BIOGAS UPGRADING

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PURPOSE OF THE ABSTRACT

Biogas is nowadays considered as an alternative renewable energy. However, CO2 and impurities (VOCs, hydrogen sulphide) removal from raw biogas (i.e. biogas upgrading) is needed for producing biomethane to be used as vehicle fuels or injected into the natural gas grid1. Biogas upgrading with physical absorbents, such as water and other commercial organic solvents, is simple, efficient and with low energy requirements for regeneration. Recently, deep eutectic solvents (DESs) with nonvolatility, nonflammability and low price have been reported as promising alternatives to replace conventional physical absorbents in many research areas including VOCs absorption2?4. However, studies aiming to take benefit from DESs properties for biogas upgrading are scarce5 and the performances of physical absorbents, including conventional and DES-based solvents, have not been evaluated and compared with each other.

In this work, the feasibility of biogas upgrading using three hydrophobic DESs, based on fatty acid (C8:C12, C9:C12 and C10:C12) as well as conventional solvents (glycerol, propylene glycol and propylene carbonate) as absorbent was studied. Three major volatiles compounds found as biogas impurities were selected (toluene, limonene and octamethylcyclotetrasiloxane) to evaluate the efficiency of these absorbents. The influence of different parameters like temperature, water content and VOC concentration were investigated.

Among the examined solvents, hydrophobic DESs achieved the highest absorption capacity of the three VOCs with partition coefficient (K) divided up to 20000 compared to water in the case of limonene and C10:C12 (1:3) DESs. The use of low temperature (<0°C) allows the conventional solvents (propylene glycol and propylene carbonate) to reach K values close to the one obtained with DES at 30°C. The reusability of gas absorbents is critical from a practical and economic point of view and was therefore evaluated. All the absorbent used in this work maintains a high VOCs absorptivity between 96 and 99% during five consecutive reuse cycles.

The obtained results prove that the studied DESs are an excellent alternative to enhance the performance of VOCs capture in industrial applications of biogas upgrading.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Deep eutectic solvents | Biogas upgrading | Partition coefficient | Volatile organic compounds

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