ISGC 2022

N°1175 / PC
TOPIC(s) : Waste and side streams valorization / Chemical engineering

ZERO OFF GAS EMISSION - From biogas upgrading to CO2 valorization

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PURPOSE OF THE ABSTRACT

Sustainability in the energy industry is one of the main objectives nowadays, meant to be addressed by maximizing production efficiency and minimizing environmental costs. In order to develop an eco-friendlier relationship with our planet, society has created new legislation which encourages the process design using greener strategies. This research aims to allow any biogas purification plant to be aligned with current and future environmental management regulations.

The approach of this research is based on a hybrid process concept, to get the best out of the coupling of the chosen processes. In this case of study ZOE (name of the project) is defined as a biogas treatment process in which the biogas passed in the gaseous state through a first membrane's separation stage to entry to a cryogenic distillation stage under temperature and pressure conditions that will allow to recover all the carbon dioxide.

The project was divided into 4 steps :

1. Process simulation and optimization
2. Membranes separations study
3. Coupling of technologies and study of interfaces
4. Scale up to the industrial scale

Besides the membranes separation step which is well known, the CO2 recovery step is made up of drying, compression, separation, cooling and expansion elements designed for minimum energy consumption, production of the purest possible CO2 in liquid form and recovery of residual CH4 to be reinjected at the very first process inlet . The liquid CO2 leaving the installation is at a temperature of around -21°C and a pressure of around 18 barg. This combination of pressure and temperature maintains a quasi-pure CO2 in liquid equilibrium which will then be stored for subsequent use.

In this investigation, the objective was not only limited to the recovery of CO2, and 0% CH4 emissions but also extended to energy efficiency. The coupling of the biogas upgrading process with cryogenic distillation also resulted in a reduction of the number of membranes necessary to obtain the desired final concentration of CH4, the size of the compressor to be used, and to avoid the use of the void pump on the permeate side to enhance the permeation process. This combination promises to be an interesting way to intensify the biogas valorization and CO2 recovery.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Biogas upgrading | Biomethane | CO2 Valorization | Green Energy

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