Final Report

Project acronym: *BIOVALUE*

ADVANCED MEMBRANES FOR BIOGAS UPGRADING AND HIGH ADDED VALUE COMPOUNDS RECOVERY

Project number: *ID6178*

M-ERA.NET Call 2018

Period covered: 01/06/2019 to 30/11/2022

Publishable project summary

Bio-digester gas streams contain valuable products such as bio-methane and VOCs whose recovery has important advantages for the environment protection, energy saving and waste valorization. BIOVALUE focused on the development of a membrane-based innovative process for the treatment of biogas produced by a real bio-digester. Advanced membrane units were used to valorize the biogas by separating its various components, i.e., bio-methane, VOCs, water.

Membrane operations are nano-based key enabling technologies, based on advanced functional materials, capable to selectively separate small molecules. This confers to the membrane a specific functionality that, coupled to its configuration (very thin layer), leads to continuous separations operated in steady state. BIOVALUE project used these membranes - advanced nano-structured functional materials - for driving environmental-friendly and little energivorous novel separation processes valorizing waste as required by circular economy dictates. During the course of the project, it was possible to optimize, n the production conditions of the membranes so that they could be produced in quantities of approximately 6000 m/h of hollow fiber, also with the support of ad-hoc developed Cahn-Hilliard model of hollow fiber morphology evolution. These membranes, assembled in modules, were continuously exposused to gas stream, also in presence of H_2S, for 646 days, maintained their integrity and their separation properties. A membrane condenser with a total membrane area of 200 cm^2 was built and tested showing a stable performance during the whole testing time and reaching an efficiency higher than 98% with a water recovery ranging from 11 to 13%. On the basis of the results obtained in lab, an integrated membrane process for biogas upgrading was designed for the purification of a 1 Nm^3 h^{-1} biogas stream with a concentration of biomethane up to 98%, reaching more than 90% of CH_4 recovery, keeping the purity target. Moreover, we got the opportunity to industrially validate one of the pilot modules developed within the Consortium, by installing it in a specific point of the main industrial plant under a continuous exposure to real biogas stream. After 6 month of continuous exposition, the membrane module demonstrated only a moderate loss of separation properties, but confirmed the suitability of BIOVALUE membrane separation unit for large scale application.