SDEWES2017.0656

Power to Gas-Oxycombustion Hybridization: Lab-Scale System Design and Economic Evaluation

M. Bailera*[1], P. Lisbona[2], L.M. Romeo[1], B. Peña[1]

[1]Universidad de Zaragoza, Spain; [2]Universidad de Valladolid, Spain (*mbailera@unizar.es)

Abstract

In order to decarbonize the current energy system, renewables sources are being promoted to penetrate in electricity production mix. At the same time, carbon capture from fossil power plants is under development. However, the management of variable renewable production has brought into light the necessity of deploying energy storage systems. Furthermore, there exists the need of valorizing captured CO_2, which otherwise must be compressed and stored, thus implying additional penalties.

Power-to-gas (PtG) has been proposed in the last years as one of the most promising technologies to overcome these problems. In general terms, PtG converts electricity surplus into synthetic natural gas by combining water electrolysis and CO_2 methanation. This technology valorizes captured CO_2 to produce a 'CO_2 neutral' natural gas, while allowing the temporal displacement of renewable energy. Thus, the interconnection of the electric and gas networks leads to higher flexibility of the energy supply.

To better integrate energy and mass flows in the PtG plant, the PtG-Oxycombustion hybridization is proposed. In oxyfuel combustion, a mixture of pure oxygen and recycled flue gas (mainly CO_2 and H_2O) acts as comburent. The requirement of an air separation unit (ASU) to produce oxygen would be replaced with the electrolyser which by-produces O_2. Thus, the electrical consumption of the ASU would be reduced, and CO_2 would be taken from flue gas without extra energy penalty in its separation.

The research group has participated in several projects related to PtG-Oxycombustion, in which we have studied the overall effectiveness that this hybrid system could have. The current project MERCURIA (ENE2016-76850-R) focuses on the design, construction and testing of a methanator at laboratory scale (15 kW output). It is intended to characterize experimental SNG production under different temperatures and pressures, as well as quantify potential integrations of the technology in different industrial sectors. First results to be presented comprise the detailed design of the lab-scale system together with the economic itemization of the installation, to help other research groups during the first steps of applied research on methanation.