REDUCING ENERGY PENALTY OF OXYCOMBUSTION THROUGH POWER-TO-GAS HYBRIDIZATION

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The constant increase of electricity production from renewable energy has brought to light the necessity of deploying energy storage systems. The management of intermittent surplus power generated by renewable sources is crucial for reaching a future reliable electricity system. Power-to-gas (PtG) has been proposed as a promising solution to overcome this problem.

PtG stores electricity in natural gas form through catalytic methanation of hydrogen from electrolysis. This technology broadens the application of hydrogen as energy vector by connecting the electric and gas networks as a unique system thus increasing the supply flexibility. Furthermore, synthetic natural gas from methanation is "CO_2 neutral" since uses carbon emissions.

In order to take advantage of the oxygen generated by electrolysis, it is proposed the hybridization with oxyfuel combustion. This carbon capture method uses a O_2/CO_2 mixture as comburent to burn the solid fuel which generates flue gases mainly composed by CO_2 and water (easily removed from the mixture). Highly concentrated CO_2 is obtained avoiding the air separation unit for oxycombustion, thus reducing the associated energy penalty an 81.4%.

The key variable in this system is the size ratio relating the energy contained in the hydrogen produced by electrolysis and the useful thermal output of the oxyfuel boiler. One of the most suitable applications of the hybridization is district heating (1-2MW), in which up to the 81% of thermal energy from methanation could be used.

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