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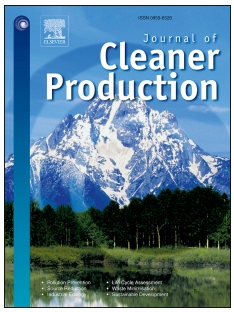

Upgrading of biogas to bio-methane with chemical absorption process: simulation and environmental impact

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Abstract

As a renewable substitute for natural gas, bio-methane from biogas is a key option on the way to sustainable and renewable energy supplies in the future. A large number of technologies for biogas upgrading have been developed in order to improve the overall efficiency, to reduce the investment, operation and maintenance costs. In this paper chemical absorption processes with aqueous solution of MEA (mono-ethanolamine), NaOH (sodium hydroxide) and KOH (potassium hydroxide) are compared through ChemCad 6.3® simulations. Results show that mono-ethanolamine solution provides the best performances: at the same operating conditions a lower quantity of absorbent solution equal to 400 kg/h is required and an higher thermal and electrical power equal to 51 kW and 15 kW are obtained. These results are in agree with other works reported in literature. A sensitivity analysis is carried out to evaluate the effect of some parameters as flow rate and inlet temperature of MEA solution into the absorber on CH_4 concentration of produced bio-methane. Also the methodology of life cycle assessment is used to evaluate the environmental impact and to compare these processes. Results show that the chemical absorption using KOH solution gives lower environmental impacts. Considering MEA solution, it is need to change the rate of absorption or the concentration of solution in order to have a better process in technical and environmental aspect; the concentration of absorbent solution plays an important role on CO_2 removal efficiency. it is necessary to optimize different parameters in order to reduce the CO_2 content and to produce a valuable bio-methane. Future researches will have to develop mathematical model and response surface methodology to this purpose.

Key words: Biogas upgrading, Bio-methane, Chemical absorption process, Sensitivity analysis, LCA analysis, Process simulation.