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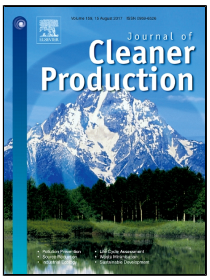

Review on Available Biogas Upgrading Technologies and Innovations Towards Advanced Solutions

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Highlights

- **A concise and coherent review of state-of-the-art is provided**
- **A novel and promising desulphurization technology is proposed**
- **Gaspermeation is illustrated as powerful and efficient biogas upgrading technology**
- **Reliable numbers for specific energy consumption and upgrading costs are given**

Abstract

Biogas from anaerobic digestion of organic wastes or energy crops has proven to be a valuable alternative energy source both climate-neutral and sustainable on a global scale. The alternate valorization path of cleaning the biogas for the production of biomethane to be injected into the natural gas grid or to be used as a local vehicle fuel has gained significant importance in the last years. Considerable efforts in contemporary research are undertaken in order to improve efficiency and flexibility of biogas upgrading to enhance economic viability of biogas plants in times of expiring green-electricity feed-in tariffs, rising or strongly fluctuating costs for substrates and the currently low global energy prices. Current work tries to contribute to these questions suggesting and introducing innovative and highly effective technologies along the whole chain of biomethane production. A novel technique to separate high and fluctuating amounts of hydrogen sulphide from raw biogas is presented that relies on a highly intensified method of chemical-oxidative scrubbing. Single-stage separation efficiencies of 92 % have been identified with this technology. A recently commissioned three-staged demonstration plant with an expected separation efficiency > 99 % is presented briefly. Furthermore, membrane-based gaspermeation is presented as a capable and economic method of CO_2 removal and drying of raw biogas. While this technique is not new, authors try to demonstrate the huge potential for further development and exploitation peculiar to this method. Specific power demand for upgrading of 0.26 kWh/m³ biogas and specific upgrading costs of less than 0.15 €/m³ biomethane can be achieved. Today and in the future similar concepts and systems will be able to increase economic and ecologic performance of biogas plants thus contributing to strengthen biogas industry within the renewable energy sector.

Keywords: biogas upgrading, biomethane, desulphurization, chemical-oxidative scrubbing, gaspermeation, membrane