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2018

Dostupný z <http://www.nusl.cz/ntk/nusl-387477>

Dílo je chráněno podle autorského zákona č. 121/2000 Sb.

Tento dokument byl stažen z Národního úložiště šedé literatury (NUŠL).

Datum stažení: 29.05.2024

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Single-step purification of raw biogas to biomethane quality by hollow fiber membranes without any pre-treatment - a radical innovation in biogas upgrading

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Herein, a radical innovation in biogas production is presented using a single-step membrane purification technology without any necessary pre-treatment steps for contaminant removal. Asymmetric hollow fiber membranes with a thin, selective, non-porous layer made from polyester carbonate on the bore side were successfully used in a single-step raw biogas upgrading process at biogas plant Chořovice in Czech Republic. A double-stage arrangement operated at 17 °C exhibited the best CO₂/CH₄ separation factor ($\beta \sim 23$) with 96 vol. % CH₄ purity. This single-step biogas upgrading technology with highly H₂S and water-resistant membrane modules allows reductions in capital expenditures of ~20% and in operational expenditures of ~50% compared to high pressure water scrubbing (HPWS) and ~70% compared to pressure swing absorption (PSA). Due to small energy consumption required merely for biogas compression, our units consumed around only ~2 MJ/Nm³ CH₄. Thus, our approach with significantly improved performance and robustness of the membrane separation process can be seen as a major breakthrough of membrane gas separation for inexpensive biogas production.

Acknowledgements: The authors would like to extend thanks for partial financial support from the Technology Agency of the Czech Republic (project TE01020080).