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COMPARATIVE ANALYSIS OF THE CO_2 EXTRACTION FROM BIOGAS ABSORPTION PROCESSES EFFECTIVENESS

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Abstract – Currently, the developed EU countries have implemented biomethane production projects from biogas, supply it to natural gas distribution grid with subsequent production of electricity or (and) heat, and use biomethane as motor fuel or supply to the gas network. It is also extremely relevant for Ukraine, supposing the problems with gas import due to Russian aggression and the presence of a large agricultural potential. The concern that arises is the rational choice of the technology for producing biomethane from biogas. The Gas Institute of the National Academy of Sciences of Ukraine has extensive experience in the development of technologies for the biogas collection, its direct usage, and CO_2 extraction by the amine absorption method. Some of the technologies have been implemented at landfills in Ukraine. Data on other methods of CO_2 extraction are widely available in world publications, so the authors compared the technologies from the point of view of their practical use possibility. Using computer modeling, the energy costs during the production of biomethane from biogas using the most advanced amine and water absorption processes for cleaning biogas from carbon dioxide were analysed. The combined water-amine absorption method of biogas purification from CO_2 was included in the comparative analysis in which carbon dioxide was previously removed by water absorption at a pressure up to 0.3 MPa and output finally purified by amine absorption. Calculations for amine technology are verified in a pilot study. For a range of the CO_2 concentration in biogas 32–42 % vol., the specific energy consumption when using water absorption, the extraction of carbon dioxide from biogas is on average two times less compared to amine absorption, but at the same time the loss of CH_4 due to its solubility during water absorption amounted to 7.1–7.6 %, with practically no losses of CH_4 in amine absorption, and minor losses (0.17–2.8 %) in combined water-amine technology. The energy consumption of combined water-amine absorption is comparable to that of water absorption due to: a) reduction of heat losses for regeneration process of saturated amine absorbent, as part of CO_2 has already been removed with water technology; b) using the CH_4 excess to compensate power consumption of the biogas compressor during the preliminary water absorption of CO_2 and/or to compensate heat costs of the saturated amine absorbent regeneration. The results of extracting carbon dioxide from biogas processes modeling can be used to optimize technological absorption schemes for the production of biomethane, an analogue of natural gas.

Keywords – Absorption; amines; biogas; biomethane; carbon dioxide; landfills