CO_2methanation based on carbon recycling system using electrolysis treatment

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1. Introduction

Due to the growth of industrialization, amount of non-degradable contaminants are being released to water system. Accordingly, the importance of water management is being issued. Hence, South Korean is planning to add TOC (Total Organic Carbon) as a part of the water quality criteria. Therefore, a lot of domestic wastewater plant would be necessary to put post-treatment process due to the addition of TOC at water quality criteria. Basically, advanced wastewater treatments used for effluents treatment are electrolysis, ozone oxidation and UV. In this, electrolysis process not only dispose of pollutants efficiently but also produce hydrogen. In this regards, a novel carbon recycling system using the CO_2 produced from CH_4 purification in biogas plants and H_2 from electrolysis process was suggested followed by assessment of energy balance.

2. Material & methods

In this research, 100L batch reactor was used as water electrolysis device. Titanium electrode was used for electrolysis and amount of hydrogen was analyzed. Reagents used for manufacturing the catalysts were obtained from Sigma Aldrich and Ni-Ce-Zr ternary catalyst was used.

3. Results & discussion

This system can reduce TOC in effluent by water electrolysis process, and collect the by-product hydrogen. Also, the hydrogen can be convert to methane (CH_4), by using carbon dioxide (CO_2) which has been thrown out during the biogas purification. In this study, around 200 Nm^3/d of hydrogen has been collected from 50 m^3/d scale of effluent, and at the same time, the water electrolysis system that can remove TOC, and pellet type catalyst which shows 95% CO_2 conversion has been applied. The schematic diagram of carbon recycling system which is using in this study is shown in Fig. 1. In the suggested carbon recycling system, 140 kwh is used for electrolysis process and 201 kwh for methanation equipment. Also, it was assumed that 50 kwh is used for CO_2 capture.Heating value of methanation reaction was calculated as 102 kwh and heating value of produced CH_4 was estimated by 524 kwh. Moreover, considering the CER (Certificated Emissions Reduction) price, it is expecting to produce the economic value around 100 \$/ton CO_2.

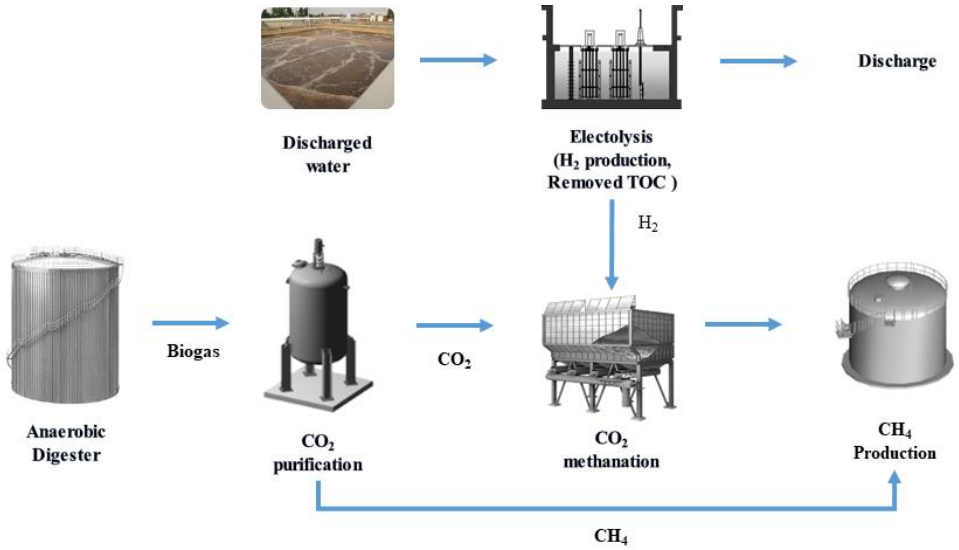

Fig. 1. Schematic diagram of carbon recycling system linked with electrolysis process

4. Conclusions

In this research, a novel carbon recycling system in 50 m^3/d scale was suggested and assessment of energy balance was accomplished. The suggested system includes the water electrolysis device which can produce 200 Nm^3 of hydrogen and methanation system with 95% of CO_2 conversion. Regarding the energies used and produced by the individual systems, it was able to produce 285 kwh of electricity and showed 100$ per ton of CO_2 as economic value when considering the carbon credit.

5. References

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