
# Effective mass transfer of hydrogen into digester mixed liquor for biomethanisation of biogas $CO_2$

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| **Related website** | www.anaerobicdigestionnet.com | |

The addition of $H_2$ into anaerobic digesters or methanogenic bioreactors to produce biomethane is an innovative energy storage solution which improves the carbon utilisation of anaerobic digestion. The high methane content in the gas produced after $H_2$ addition ( >95 % $CH_4$) can be used as a replacement for natural gas.

The installation of renewable energy technologies such as wind and solar are helping to reduce $CO_2$ emissions, however in many cases the electricity grid is unable to fully utilise the renewable energy produced. One of the main challenges with these renewable energy technologies is the lack of control over when the electricity is produced and storing this energy for use when needed. The electrolytic production of $H_2$ has been proposed as a solution for energy storage; however there is currently a lack of infrastructure for storage and usage of $H_2$. The supplementation of $H_2$ in anaerobic digesters or separate methanogenic bioreactors could utilise this $H_2$, which would biochemically react with $CO_2$ in biogas to produce $CH_4$. The biomethane produced could be utilised in the current natural gas grid infrastructure and there would also be benefits with an increased utilisation of carbon from the waste biomass.

The limiting step which has been identified in the biochemical conversion of $H_2$ and $CO_2$ into $CH_4$ is the mass transfer of $H_2$ from the gaseous phase into the liquid phase. The conversion of $CO_2$ into $CH_4$ will also reduce the bicarbonate concentration in the digester, reducing the pH buffering capacity of the digester liquor. The effects of this will be considered in this research project which aims to develop a robust system for $H_2$ injection into food waste digesters to achieve in-situ gas upgrading and efficient feedstock carbon utilisation.

*Objectives*

- To select a hollow-fibre membrane (HFM) diffuser suitable for use in a digester liquor
- To quantify the mass transfer efficiency of the device and to size it in relation to the anticipated $H_2$ demand within the digester
- To assess the kinetics of $H_2$ uptake in a hydrogenotrophic-adapted digestate derived from food waste treatment
- To assess any inhibition as a result of disruption of syntrophy in the system biology

- To test the diffuser system in a modified continuously-stirred tank reactor (CSTR) digester
- To operate the digester continuously with a food waste and $H_2$ feed with the objective of producing an output concentration equal to natural gas (>95% $CH_4$)

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*Partners*

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