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# Toward gas-phase controlled mass transfer in micro-porous membrane contactors for recovery and concentration of dissolved methane in the gas phase

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## Abstract

A micro-porous hollow fibre membrane contactor (HFMC) operated in sweep-gas mode has been studied to enable the recovery of dissolved methane from water in concentrated form. At high sweep-gas flow rates, up to 97% dissolved methane removal efficiency is achievable which is sufficient to achieve carbon neutrality (around 88%). An increase in methane composition of the recovered sweep-gas was achievable through two primary mechanisms: (i) an increase in liquid velocity which improved dissolved methane mass transfer into the gas phase; and (ii) a reduction in gas flow which lowered dilution from the receiving gas phase. It was posited that further refinement of the methane content was provided through counter-diffusion of the nitrogen sweep-gas into the liquid phase. Within the boundary conditions studied, the methane composition of the recovered gas phase exceeded the threshold for use in micro-turbines for electricity production. However, reducing the gas-to-liquid ratio to enhance gas phase methane purity introduced gas-phase controlled mass transfer which constrained removal efficiency. Whilst this reduction in removal efficiency can be compensated for by extending path length (i.e. more than one module in series), it is suggested that the gas-phase controlled conditions encountered were also a product of poor shell-side dispersion rather than an approach toward the limiting theoretical gas-to-liquid ratio. This implies that further optimisation can be ascertained through improved membrane contactor design. Importantly, this study demonstrates that micro-porous hollow fibre membrane contactors provide a compact process for recovery of dissolved methane in sufficient concentration for re-use.

**Keywords:** dissolved methane recovery; degas; degassing; anaerobic; landfill leachate

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