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Petersen, Leander Adrian Haaning; Villadsen, John; Jørgensen, Sten Bay; Christensen, Ib ; Eliasson Lantz, Anna; Gernaey, Krist V.

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The effect of design and scale on the mixing and mass transfer in U-loop bioreactors

Leander Petersen^{1,2}, John Villadsen¹, Sten Bay Jørgensen¹, Ib Christensen², Anna Eliasson Lantz¹ and Krist V. Gernaey¹,

1)Technical University of Denmark, Kgs. Lyngby, Denmark,

2)Unibio A/S, Odense M, Denmark

Abstract

A system capable of handling a large volumetric gas fraction while providing a high gas to liquid mass transfer is a necessity if the methanotrophic bacterium *Methylococcus capsulatus* is to be used in single cell protein (SCP) production.

Previous studies have proven that a U-loop fermenter, a novel vertical forced flow loop reactor where gas and liquid are driven through a series of static mixers in a U-shaped pipe, is quite capable of coping with these challenges in pilot scale. The critical question remains; what happens when the scale undergoes a more than 10 fold increase and the geometry is altered?

In this study we have investigated the mixing time and mass transfer capabilities of U-loop reactors of different geometries (high vs. diameter ratio) in pilot (0.15m³) and semi-industrial scales (2.2m³). A new expression for the mechanical power input into the system is also proposed, which indicates that an even more favorable relationship between power input and mass transfer rate (compared to previous literature) applies to U-loop fermenters.