Integrated nitrification and denitrification in biofilm airlift reactors.

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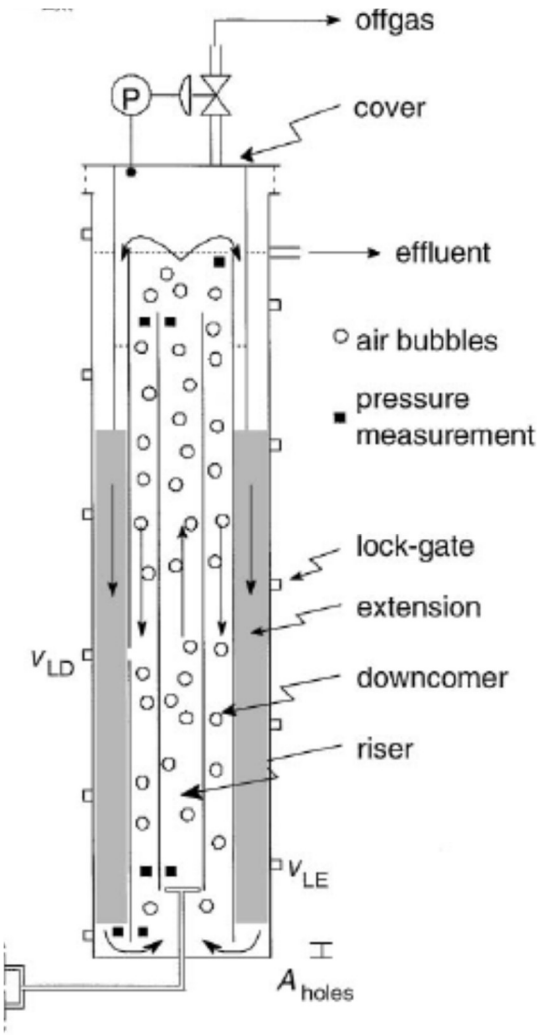
Project term: November 1993 – January 1998
Financed by: IOP (Innovation-Oriented research Programme) Environmental Biotechnology.

Description



Part 3: Development of the Biofilm Airlift Suspension Extension reactor
In part 3, the subject is design and hydrodynamics of the biofilm airlift suspension extension (BASE) reactor. Nitrification and denitrification are not carried out in the reactor, only hydrodynamic aspects are considered. The reactor consists of an internal-loop airlift reactor, which is extended with an external concentric downflowing fluidised bed, the extension. The internal compartment of the BASE reactor is a well-mixed pool of liquid, gas bubbles and solid particles. In the extension a gas bubble free mixture of particles and liquid moves downward in plug-flow. This mixture flows back into the aerobic compartment through small recirculation holes, with large frictional losses to reduce the liquid velocity in the extension. Two circulation patterns co-exist in the reactor: in the aerobic compartment between riser and downcomer, determined by the pressure difference at the bottom between riser and downcomer, and between the aerobic compartment and the extension, which is governed by the pressure difference over the recirculation holes. The recirculation flow rate between the extension and the aerobic compartment determines the removal efficiency of nitrogenous compounds from the wastewater. Manipulation of the overpressure in the headspace enables control of the liquid velocity in the extension and the recirculation ratio. Therewith the nitrogen removal efficiency can be maintained at the desired value.
A three-phase hydrodynamic model is developed, based on mass and momentum balances. Using the model, a full-scale reactor is designed for nitrification and denitrification of concentrated wastewater. With the model a pilot-scale BASE reactor (volume 1.7 m, height about 6 m) is designed and constructed and used for verification. Next, the hydrodynamic model is experimentally validated with three-phase systems (water, air and solid).

Dissertation

Wim van Benthum, Integrated nitrification and denitrification in biofilm airlift reactors: Biofilm development, process design and hydrodynamics. PhD Thesis, Delft University of Technology, 1998. ISBN 90-802879-0-3 (in TUD-repository, http://resolver.tudelft.nl/uuid:c23b0cd8-8e27-401c-a4c9-0466d319314c)

Publications from the dissertation (Part 3 Hydrodynamics)

Van Benthum, W.A.J., Van der Lans, R.G.J.M., Van Loosdrecht, M.C.M., Heijnen, J.J., 2000. The biofilm airlift suspension extension reactor. Part II. Three phase hydrodynamics. Chemical Engineering Science 55 (2000) 699-711.
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https://doi.org/10.1016/S0009-2509(99)00034-2