Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

S.M.A. Bod

will give a presentation, entitled:

Experimental and Numerical Study of a Co-Current Cyclonic Gas-Liquid Separator

Date: Friday June 14, 2013

Time: 14:00

Room: **Carré 2G**

Summary:
FMC Separation Systems (Arnhem) develops a cyclonic gas-liquid separator in cooperation with Statoil (Norway), which is called the InLine PhaseSplitter. This separator consists of an inlet section, a swirl element, a separation section, a gas pick-up tube that serves as the light-phase outlet and a heavy-phase outlet. The goal of this cooperation is to establish a mechanistic model for the prediction of separator performance. The present study provides the theoretical basis, experimental results and numerical simulations utilizing computational fluid dynamics (CFD) which can serve as input for such a model.
A theoretical and experimental study has been carried out to investigate flow regimes in the gas outlet piping for the present design of the separator. Theory according to Baker predicts a change in flow regime from dispersed to annular to slugging flow when increasing the diameter of the gas outlet tube from 9 mm to 34 mm. Results from experiments employing the prototype separator support Baker's empirical theory.
The size of the bubbles in the inlet section serves as input for the CFD method and is an input parameter for the model. Based on a simplified theory an estimate has been made of the bubble size in the inlet section of the separator, this in presence and in absence of a mixing element upstream of the swirl element. Bubble size measurements have been performed in the presence of a mixing element. These are in good agreement with the theory.
A dimensional analysis has been carried out which reveals the scaling rules of the design. Furthermore, the so-called cut-off diameter of the bubbles has been calculated, which is the diameter of the smallest bubble that, in the swirling flow in the separation section, will be captured by the pick-up tube.
Numerical simulations using CFD have been performed for a set of design variables. These numerical results have been compared with experimental results. The separation performance obtained from CFD is in good agreement with the performance determined from experiments as far as gas-carry-under is concerned. However, the liquid-carry-over is over predicted by CFD. The profiles of the azimuthal component of the velocity obtained from the CFD match reasonably well with experimental results.
In conclusion, the experimental and theoretical results obtained in this study can be used as input in the mechanistic model of the InLine PhaseSplitter.

Assessment committee: **Chairman,**

Prof.dr.ir. H.W.M. Hoeijmakers	(mentor/chairman)
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Dr. T. Krebs	(mentor FMC)
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