SINTEF

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"Description of the Two-phase Flow laboratory in Trondheim"

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Background and present status

The erection of the laboratory was finished in the fall of 1982. The construction was overseen by SINTEF acting on behalf of Esso who was the main sponsor and owner of the laboratory the first year of operation (1983). Four other companies(Getty Oil, Mobil, Statoil and Texaco) sponsored the project with equal minority shares during the Esso period.

The reason for establishing the Two - Phase Flow Laboratory was basically the need for experimental data from a large scale two - phase flow line to develop and improve calculation tools and design criteria for two-phase flow field installations.

In 1983 SINTEF conducted about 1000 experiments under a research contract with Esso. Upon termination of this contract (January 1984) the laboratory was given to SINTEF for further utilization.

The investments covering the construction and the 1983 research program amounted to about NOK 100 millions.

A project called the The Two-Phase Flow Project 1984 - 86 commenced in January 1984 . This three year project is a continuation and supplement to the work executed in 1983 and includes about 3000 experiments and further refinement and development of a dynamic simulation program for two- phase flow named OLGA.

The project is jointly carried out by SINTEF and IFE (Institute for energy technology) and is presently sponsored by eight oil companies(Conoco, Esso, Mobil, Norsk Hydro, Petro Canada,Saga , Statoil and Texaco).
The sponsors pay equal shares .

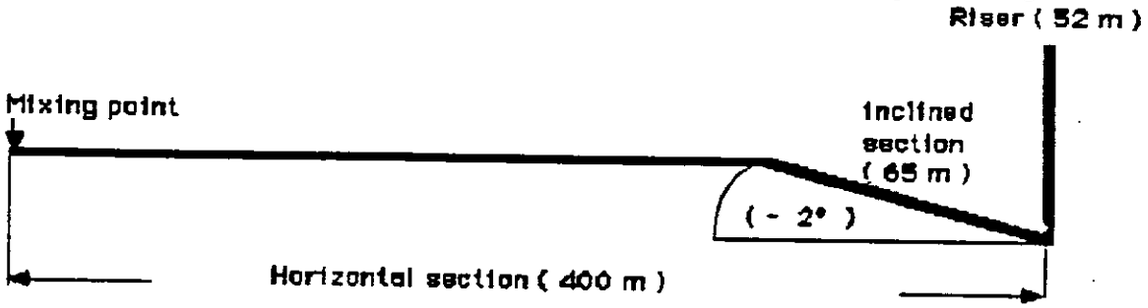
Experimental results and improved simulation tools are systematically released for the benefit of the sponsors.
New versions of of the OLGA simulation program are released with a one year cycle and the OLGA 84 is now in operation within the sponsoring companies.

The results of the Two - Phase Flow Project are already being used for field calculations and SINTEF and IFE have also executed quite a few studies for single clients.

MAIN FEATURES OF THE SINTEF , TWO - PHASE FLOW LABORATORY.

The test unit is arranged as a closed loop and consits of a 400 m horizontal section of 8 inch pipe , terminating in a vertical riser 52 meters high. The two -phase flow mixture coming out from the riser top is separated and oil and gas are taken to the circulating pumps and compressor respectively and discharged through separate pipelines to the starting point of the two-phase test pipe.

The present geometry allows for terrain effects . The last 65 meters of the horizontal pipe can be dipped prior to the riser entrance for investigating terrain effects on heavy slug formation. This feature is extremely important for the understanding of the onset and behaviour of very long, terrain induced liquid slugs.



In 1986 the horizontal section of the test pipe will be reconstructed to allow for small deviations from the horizontal (1° and 1/2° up and down) over the full pipe length (approximately 350 meters) .

The absolute pressure in the test section can be varied from 20 to 95 Bars.

The whole facility is fully insulated and heat traced and constant temperature is maintained by a temperature control system.

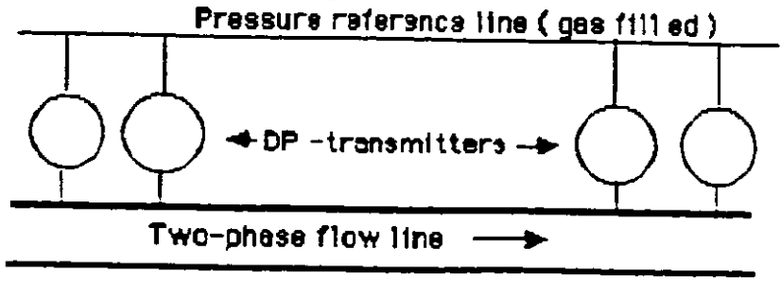
One of three hydrocarbon liquids may be applied ; naphtha, diesel or a lube oil base. The liquid viscosity is 0.2 , 2.0 and 20 cp respectively.
The liquid density varies from 660 kg/m3 to 860 kg/m3.

The gas phase is always nitrogen.

The single phase volumetric flowrate can be varied from 0.004 m3/s to 0.13 m3/s for the liquid phase and from 0.014 m3/s to 0.4m3/s (at the actual pressure) for the gas phase.

Flow pattern , liquid holdup and slug front velocities are established by means of eight single beam gamma-ray densitometers and by a socalled TEXACO -IFE Fast Volume Weight Meter , which also is based on gamma ray technology.

Absolute pressure and pressure drop are measured by means of differential pressure transmitters with the high pressure side linked to a pressure reference line and the low pressure side linked to the two-phase flow line.



Pressure taps and transmitters must lay in the same horizontal plane.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.