A SIMPLIFIED MODEL FOR DESIGN OF HORIZONTAL PIPE SEPARATOR, HPS©*

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ABSTRACT

The natural segregation of crude oil and water due to density difference can occur not only in gravity based vessel-type separators, but also when flowing through pipes, if the conditions are favorable for flow segregation. Thus, the use of pipes as separators is especially suitable for sub-sea applications. The ease of installation and simple operation of pipe separators ensure reliable performance of the entire production system. The proposed Horizontal Pipe Separator (HPS©) is a simple concept: a pipe spool with appropriate geometry promoting natural separation under favorable flow conditions. In 2005, Dr Ciro Perez published the results of an experimental and theoretical investigation of the developing region of oil-water flow in horizontal pipes. A model was developed for the prediction of the flow evolution in the developing region of the HPS©. However, no simplified model/design codes were developed.

The objective of the present study is to develop design criteria and a design code to be used by the industry for field applications. The design procedure can be divided in two successive steps. The first step is the determination of the flow conditions and pipe diameter promoting oil-water stratified flow. This can be done using FlowpatOW-vx1.1 for the prediction of oil-water flow pattern map for horizontal flow. The second step is the determination of the pipe length required to reach fully developed stratified flow. An extension of the batch separation model (Jeelani & Hartland, 1999) describing the evolution with time of oil-water dispersion is used here to complete this second objective.

In order to validate this approach, an experimental program is currently conducted at the University of Tulsa using a 3.75-in.-ID, 19.33-ft-long acrylic horizontal pipe. Experimental data concerning the evolution of the phases along the pipe have been acquired for different mixture velocities (0.22, 0.3 and 0.44 ft/s) and different water cuts (20, 30, 40 and 60%). Key results of the experimental validation will also be presented.

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