Shaking gas-liquid flows in porous media with a hexapod swell simulator – Towards understanding multiphase flow dynamics on floating platforms

F. Larachi, G.P. Assima
Laboratory of Chemical Engineering, Faculty of Science and Engineering, Laval University, Québec G1V 0A6, Québec, Canada

Abstract Boundaries for hydrocarbon exploitation are being increasingly stretched towards remoter and deeper spots around the Globe. This entails recourse to floating production systems as an alternative to conventional off-shore oil platforms seated at sees' bottoms. Examples of such systems include Deep Draft Semi Sub (DDSS), Extendable Draft Platform (EDP), Tensioned Leg Platform (TLP), Single Point Anchor Reservoir (SPAR) that are traditionally used for deep-see or offshore exploitation of oilfields.[1] Floating platforms are commonly integrated with floating units such as Floating Storage and Offloading (FSO), Floating Production Unit (FPU), Floating Liquefied Natural Gas (FLNG) and Floating Production Storage and Offloading (FPSO) which are used to replace costly pipeline infrastructures and onshore refining-treating facilities.[2] It is thus not a surprise that development and application of floating units, e.g., FPSO and FLNG in deep-water oilfields, are subject to vivid research by the petroleum industry. One of the challenges confronting well-designed units resides on how the efficiency and performance of offshore facilities are correlated (degraded or improved) with the restless sways caused by marine swells and how these latter impact the hydrodynamic characteristics of the reactors on board. In this work, a packed-bed reactor is mounted on a six-degrees-of-freedom hexapod robot to simulate swell movements and to analyze the hydrodynamic modifications brought about by separate or combined degrees of freedom under yaw and pitch rotations, and jerky swell movements versus stationary (straight and inclined) bed configurations. A twin-plane capacitance Wire Mesh Sensor (WMS) installed on the moving packed bed is used to measure the dynamic features at high frequency of local phase distribution patterns, local and averaged liquid saturations and velocities, and flow regime changes under various configurations, e.g., concurrent two-phase upflow, downflow and drainage mode. Deviations from well-known behavior of straight and stationary packed-bed two-phase flows will be highlighted, quantified and interpreted.

References

1. J. Halkyard (2005) Floating Offshore Platform Design, Chap. 7, Handbook of Offshore Engineering, pp. 419-661 (http://dx.doi.org/10.1016/B978-008044381-2.50010-2)
2. ISSC 2003 - 15th International Ship and Offshore Structures Congress, Vol. 3, 2003, pp. 241-264, Eds A.E. Mansour, R.C. Ertekin (http://dx.doi.org/10.1016/B978-008044076-7/50016-7)