

The Design of Large Diameter Skim Tanks Using Computational Fluid Dynamics (CFD) For Maximum Oil Removal

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Chang-Ming Lee, Ph.D. and Ted Frankiewicz, Ph.D. – NATCO Group Inc.
2950 North Loop West, Suite 750, Houston, TX 77092

Abstract

A new design of internals of a large diameter skim tank is discussed in this paper. Both transient and steady-state CFD simulations were performed to assist the development of the design. Excellent flow distribution was achieved on the inlet distributor as the variance in mass flow rates out of the laterals is less than $\pm 0.5\%$. The retention time of produced water was improved to almost 88.5% of the theoretical value with installation of two large perforated plates. Flow path lines were also improved with a much reduced recirculation pattern. This compares with a residence time of 43.4% of the theoretical value for the case without the two large perforated plates. The CFD model predicts that oil droplets size larger than 100 microns are expected to be fully skimmed off without assistance from gas flotation for produced water at the design flow rate of 100,000 BBL/Day.

Introduction

The production of oil and gas is usually accompanied by the extraction of associated water. After the initial bulk separation of the bulk produced fluids, the produced water still contains finely dispersed solids and oil. In order to reduce the contaminant content of dispersed oil in produced water, a large diameter skim tank can be used. Separation is based on the difference between the specific gravity of oil and water and the coalescence of small oil droplets. When the retention time is sufficient, oil floats to the surface and can be separated by an overflow. This technique is only suitable for removing dispersed oil with a sufficiently large particle size. Dissolved materials such as benzene and heavy metals cannot be separated using this technique.

The large diameter skim tank or its modified version, parallel plate interceptor (PPI) or corrugated plate interceptor (CPI), is mostly used as part of a set of techniques for the removal of dispersed oil. In this paper, we discuss the development of a new configuration of internals for a large diameter skim tank. The design of the internals was developed with aid from a series of CFD (Computational Fluid Dynamics) simulations. The objective of the CFD developed design is to provide a large diameter skim tank with optimized flow patterns that maximize liquid residence time and improve oil/water separation.