Capability Statement
Modelling Clarifiers with CFD

Introduction

There are two basic approaches for modelling solid-liquid systems with Computational Fluid Dynamics (CFD). Where the solids are largely dispersed, and there is little interaction, a Lagrangian or discrete particle tracking approach may be used. In systems with solids retention at high volume fraction, it is important to use a continuum approach, such as an Eulerian multiphase model.

However, for sedimenting systems, where solids move from free settling into hindered settling and then into a compression zone, it becomes very difficult to fully describe the inter-particle dynamics in an Eulerian frame, and so empirical models are required. The IWA model for sludge settlement combines empirical relationships with the drift flux or algebraic slip model.

Figure 1: Bench tests determine empirical settling function

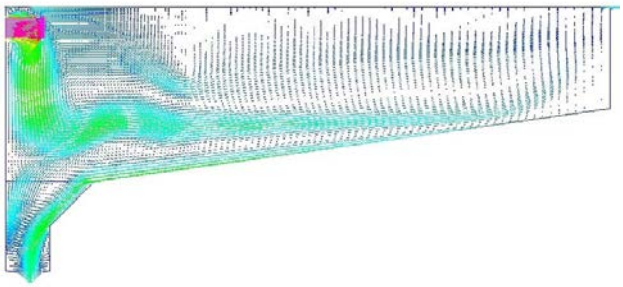

Figure 2: Density waterfall and shear layer forming above the sediment bed for a radial section through a circular clarifier

Modelling Circular Clarifiers

The flow solution is calculated using a three dimensional model of the clarifier augmented with a transport equation for the suspended solids. The settling rate of the solids is directly related to the solids concentration through empirical correlations. In addition, the sludge bed rheology is modelled with a non-Newtonian relationship.

Validation Studies

MMI have performed a number of experiments at rig-scale to verify the performance of CFD results against experiments. In addition, full scale velocity profiling in clarifiers has been compared with CFD prediction.

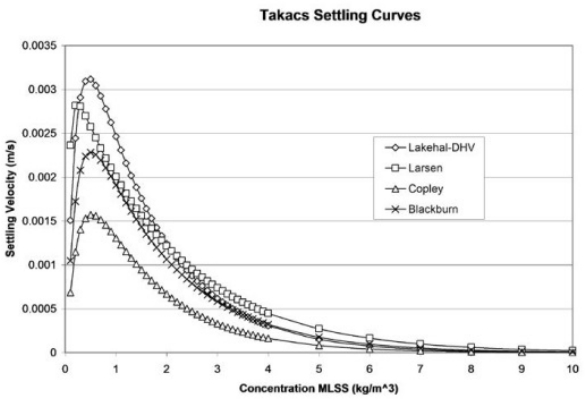

Figure 3: SSVI experiments can be used to determine hindered settling constants for the Takács relationship

Internal Design

MMI Engineering uses this technique to design the internal geometry of clarifiers to determine the most efficient configuration of influent, effluent weir, baffles and stilling wells.

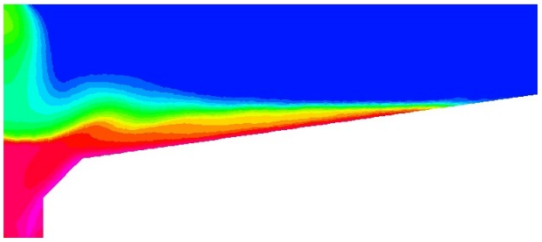

Figure 4: Solids distribution in settled bed of the clarifier

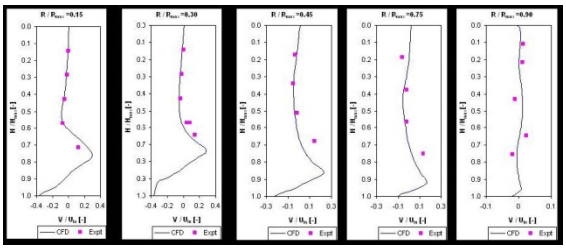

Figure 5: Solids distribution in settled bed of the clarifier

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