Assessment of Vac Flush Chambers

Southern Water
Portsmouth, UK

Introduction

During periods of heavy rainfall, Eastney Sewage Pumping Station diverts flow to the Fort Cumberland Storm Tank. The flow contains a substantial solids load, which must be removed from the tank once the storm has ceased.

One option considered to achieve this involved vac flush chambers. Under a vacuum, the chambers stores a quantity of fluid, which is released once the tanks have been drained down. The fluid that is released generates a wave that propagates down a channel within the tank, flushing deposited solids from the tank floor.

In order to assess the effectiveness of the vac flush chambers, MMI undertook a Computational Fluid Dynamics (CFD) study.

CFD Model

Figure 1 presents the vac-flush chamber and a representation of the channel within the tank.

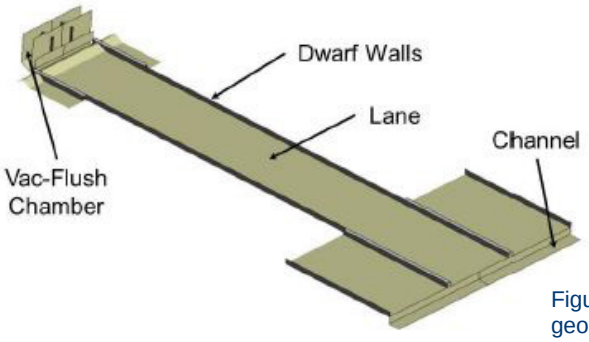

Figure 1: The resolution of the geometry in the CFD model

Modelling the Flow

The release of fluid from the flushing chamber was calculated using a ‘free surface’ model, also known as a Volume of Fluid model. This tracks the position of the interface between the fluid and air. Using the shear stress that was calculated at the floor of the tank, the likely transport of particulates could be concluded.

Results

The release of fluid from the chamber is presented in the animation below (please click the ‘play’ icon). A small quantity (~1%) of fluid overtops the dwarf walls upon release of the fluid. No significant quantity of fluid was found to splash back from the channel into the adjacent lanes. It was discovered that the wave of fluid generates a shear stress at the floor of the tank, which was higher than that quoted in literature for eroding mature sediments in sewers, and was also high enough to transport the largest particulates that were considered in the study. The results therefore suggested that the use of a vac-flush system may be a reasonable means of flushing the floor of the tank, and provided enough confidence in the concept to comission a physical scale model.

Value Added

The use of CFD enabled the assessment of the chambers at conceptual level, creating a much lower expense as opposed to the commissioning of physical scale models. The results provided sufficient confidence that the physical scale models should be commissioned to investigate the concept further.

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