ABSTRACT

Phenomenon of mixing in drinking water storage tanks and reservoirs has a direct effect on the quality of water. Creation of poor mixing zones and volume stratification can have negative effects in public health. The design of a storage tank must consider the conditions of the inlet and outlets, and also their orientation (vertical or horizontal) to prevent the formation of these zones. Experiments done in a reduced scaled-model with a rectangular base and three different inlets (a waterfall situated in the middle of the large side, another waterfall in the middle of the short side and finally a pipe inlet in the middle of the short side) had the objective to decide which of these inlets achieved the best mixing efficiency. Four situations were considered while three entrances, two unsteady: filling and drawing, and two steady with different outlets. Moreover the effects of columns that support the roof of the tank were studied by running the three entrances with and without columns in the four situations.

Using a digital treating image technique the results are found in a quantitative way.

The conclusion achieved within the experiments about the best inlet, is that the pipe gets better results in model and prototype than waterfalls because of the horizontal momentum. As waterfalls are made of four different inlets, the friction between inlets and the ambient fluid increase because the specific surface increases. Then, although waterfalls have higher horizontal momentum in the beginning than pipe has, when the mixing starts, momentum has decreased enough to mix the water worse than the pipe. It is important to say that time taken to mix the volume stored depends on the distance between the inlet and the opposite wall as though as its orientation

In terms of columns, neglecting the viscous scale effects and taking into account the whole tank columns have a negative effect on mixing efficiency although they divide the flux and create local zones of turbulence around them, increasing local mixing.

Finally some unexpected phenomena occurred during the experiments, started a study about bifurcations of Navier-Stokes solution. The bibliography found talks about the depending of Reynolds number in the quantity of solutions: at higher Reynolds number, more solutions can appear. The interesting thing related to water stored tanks is that direction of solutions do not affect the mixing time.

Vertical vortexs in outlets where also studied because they let air enter the pipe and diminish its capacity. Vortex observed in the model shall not occur in the prototype because the flow ranges are not the operating ranges.