

Radial and vertical velocity modeling under deflector in vortex chamber

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Abstract

Vortex chambers utilize vortex flow within the chamber in order to separate sediment particles from the flow. The structure of flow inside the vortex chamber is complicated and fully three-dimensional. In this paper, a comprehensive research was conducted in a physical model with circular deflector installed in the whole periphery of a vortex chamber. The three-dimensional flow velocity was measured using a Micro-ADV, to understand the flow structure and also to distinguish secondary currents above and below the circular deflector. The velocity of flow was measured at 448 different nodal points and at eight different horizontal layers within the flow depth. The measurements were taken at radial sections of 0, 45, 90, 135, 180, 225, 270 and 315 degrees from the inlet. The secondary currents below the deflector increase, these secondary currents approach towards the central orifice. Secondary currents below the deflector are useful to impinge deposited sediment particles towards the flushing orifice.

Keywords: Flow structure, vortex chamber, circular deflector, Acoustic Doppler

Velocity meter (ADV), secondary currents

1. Introduction

When a canal receives sediment particles in excess of its sediment transport capacity, the canal gets silted up and the discharge carrying capacity of the canal decreases. As such, the exclusion of sediment particles from the streamflow is one of the major design concerns for this type of chamber. A vortex chamber makes use of vortex flow as a separation device, as it is devoted to exclude sediment particles from the diverted water. The structure of flow in a vortex settling chamber is complicated and fully three-dimensional. Chrysostomou (1983) and Rea (1984) have shown that provision of a deflector ensures maximum residence time. Mashauri (1986) applied a horizontal buffer plate from the inflow section to the overflow weir to investigate the efficiency of vortex chamber. Lyn and Rodi (1990) utilized a vertical deflector inside a rectangular settling