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Experimental and Numerical Study on Impact of Double Layer Vegetation in Open Channel Flows

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The influence of riparian vegetation on ecological and flow process in channels has become an increasingly important aspect of river flood risk and environmental management. Previous studies mainly focused on vegetation with the same height in either submerged or emergent condition which is not as real as natural rivers and channels. It happened while most of the rivers and natural channels consisted of different height of vegetation and experienced both emergent and submerged condition together. Therefore, understanding the hydrodynamics of flow in vegetated open channels with different types of vegetation and formations would provide valuable scientific means to evaluate the effect of vegetation on open channel flows. This study investigate the effect of different types and configuration of vegetation on the flow characteristics in open channels. Cylindrical cylinders with 6.35 mm diameter and two different heights of 10 cm and 20 cm which represent short and tall dowels respectively, have been planted in 10 mm thickness plates in staggered and linear formations to simulate the vegetation in both submerged and emergent condition. Different flow depths have been selected to cover all different submergence ration. The results reveal that the velocity profile is mostly uniform over the depth in different configurations, except at region behind the tall dowel. The increase of velocity profile above the short vegetation in three layers vegetation condition is much larger than that in two layers condition. Generally, in both cases the flow velocity inside the vegetation layer is significantly smaller than that in the surface layer (i.e. non-vegetation layer). A near-constant velocity dominates inside the vegetation layer, and then starts to increase near the interface at the top of vegetation. There is a sudden change in the shape of the velocity profile near the top edge of vegetation. The results also showed that for both two and three layers cases, the flow velocity is strongly dependent on locations, and that the distributions of the turbulent intensity attains maximum just around the edge of vegetation height. The same sets of vegetation configurations have also been simulated using K-e model with grid dependence analysis to capture the inflection over the short vegetation region. The simulated results are finally corroborated with experimental data and found to work satisfactorily for the present set of experiments.