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Hydrodynamic and Sediment Transport Analysis of Computational Fluid Dynamics Designed Flow Regulating Liner (Smart Ditch)

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Abstract : Agricultural ditch liners are used to prevent soil erosion and reduce seepage losses. This paper introduced an approach to validate a computational fluid dynamics (CFD) platform FLOW-3D code and its use to design a flow-regulating corrugated agricultural ditch liner system (Smart Ditch (SM)). Hydrodynamic and sediment transport analyses were performed on the proposed liner flow using the CFD platform FLOW-3D code. The code's hydrodynamic and scour and sediment transport models were calibrated and validated using lab data with an accuracy of 94 % and 95%, respectively. The code was then used to measure hydrodynamic parameters of sublayer turbulent intensity, kinetic energy, dissipation, and packed sediment mass normalized with respect to sublayer flow velocity. Sublayer turbulent intensity, kinetic energy, and dissipation in the SM flow were significantly higher than CR flow. An alternative corrugated liner was also designed, and sediment transport was measured and compared to SM and CR flows. Normalized packed sediment mass with respect to average sublayer flow velocity was 27.8 % lower in alternative flow compared to SM flow. CFD platform FLOW-3D code could effectively be used to design corrugated ditch liner systems and perform hydrodynamic and sediment transport analysis under various corrugation designs.

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