Flow measurements in the wake of screen cylinders in shallow water

I. Mert Hakligor[a], Gokturk M. Ozkan[a] and Huseyin Akilli[a]

Screen cylinders have been utilized for flow control around bluff bodies where most studies focused on controlling the vortex shedding. However, screen cylinders are commonly used in various engineering applications such as wastewater treatment plants, oil and gas refineries, desalination plants, food and beverage factories, farms, chemical and pharmaceutical industries, as well as in mining operations, to filter and remove contaminants and impurities. Hence, particular interest in the flow structures around screen cylinders has appeared in recent studies ([1,2,3])

The main objective of this study is to obtain detailed information on the flow structure in the near wake of a screen cylinder in shallow water. Particle image velocimetry (PIV) measurements were conducted in a closed-loop water channel. The diameter of the screen cylinder and the water height was kept constant at D=60mm and h_w=50mm, respectively. The depth-averaged free-stream velocity was maintained at a constant value of U = 0.18 m/s during the experiments which corresponded to the Reynolds number of Re_D = 11778 and Froud number of Fr=0.066. To investigate the effect of porosity (β) on flow characteristics, screen cylinders with 4 different porosities (β = 0.4, 0.5, 0.6, and 0.7) were located on a shallow water plate. It was revealed by the results that the flow characteristics in the near wake of the screen cylinder were significantly affected by the porosity. Time-averaged Reynolds shear stress (<u`v`>) and Turbulent kinetic energy (<k>) distributions were utilized to interpret the effect of porosity on turbulent statistics. It was observed that the concentrations of normalized <u`v`>and <k>contours diminish with increasing porosity due to the higher momentum entrance through larger gaps on the screen cylinder. As expected, the highest peak magnitudes appeared for β=0.4, which behaves like a solid cylinder. Compared with β=0.4, the reduction in peak magnitudes of <k> and <u`v`> of β=0.7 were evaluated as 64% and 68%, respectively. Moreover, shear layer formation was significantly weakened with increasing porosity, whereas velocity deficit was found to be reduced.

---

[a] Dep. Mechanical Engineering, Çukurova University, 01330, Saricam, Adana, Turkey

[1] Sun et al., *International Journal of Heat and Fluid Flow.* **85**, 108643 (2020).

[2] Azmi et al., *Physical Review Fluids.* **3**, 074702 (2018).

[3] Sun et al., *Fluid Dynamics Research.* **49**, 015506 (2016).