

Effects of Hyper-Concentrated Sediment on Flow Resistance Characteristics and Flow Pattern in an Open Channel with Cylindrical Roughness

Hiroto Kondo, Terunori Ohmoto, Kanji Adachi, Hirotaka Une and Kazuki Kuranaga
*Master's student, Graduate School of Science and Technology, Kumamoto University, 2-29-1
Kurokami, Japan.*

E-mail: 182d8306@st.kumamoto-u.ac.jp

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Abstract

The dynamic characteristics of hyper-concentrated sediment flow are greatly different from the clear water flow, and as the viscosity and the density increase, the turbulence intensity, the distribution of the concentration of the sediment, the resistance characteristic of the flow and the sediment transporting ability change is expected. However, there are many unclear points for the flow mechanism of hyper-concentrated sediment flow. In addition, it is important to consider the effect of hyper-concentrated sediment on the flow resistance in order to evaluate the safety level of flood control. This study investigated the effects of hyper-concentrated sediment on the resistance and flow structure in flow over cylindrical roughness used as two-dimensional roughness elements. Flow pattern was measured by using Particle Image Velocimetry (PIV). And reproduction of hyper-concentrated sediment flows used poly sodium acrylic (PSA) solution because PSA has viscous similar properties as Kaolin suspended flow and the advantage of enabling measurement using the PIV method. The results showed that it was clear that Reynolds stress decreases with increasing PSA solution concentration. From this, it was understood that turbulence was suppressed as the concentration increases, and momentum transport due to turbulence became smaller. In particular, at PSA solution concentration $C_w=800\text{mg/l}$, Reynolds stress becomes distinctly smaller than that of clear water flow, and momentum transport due to turbulence is negligible.