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PROCEEDINGS

Research on Channel Ice Sheet Stability Based on WC-TLSPH

Haitao Wu[1] and Shenglong Gu[2,*]

[1]School of Civil Engineering and Hydraulic Engineering, Qinghai University, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[2]Laboratory of Ecological Protection and High Quality Development in the Upper Yellow River, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[3]Key Laboratory of Water Ecology Remediation and Protection at Headwater Regions of Big Rivers, Ministry of Water Resources, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[4]School of Civil Engineering and Hydraulic Engineering, Qinghai University, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[5]Laboratory of Ecological Protection and High Quality Development in the Upper Yellow River, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[6]Key Laboratory of Water Ecology Remediation and Protection at Headwater Regions of Big Rivers, Ministry of Water Resources, No. 251, Ningda Road, Chengbei District, Xining, 810016, China

[*]Corresponding Author: Shenglong Gu. Email: sl.gu@qhu.edu.cn

ABSTRACT

Subglacial water conveyance is the prevalent operational mode for cold-region channels during winter, necessitating the stability of ice covers during flow regulation. The coupling of Weakly Compressible Smoothed Particle Hydrodynamics (WCSPH) and Total Lagrangian Smoothed Particle Hydrodynamics (TLSPH) provides a robust computational framework for addressing the intricate fluid-structure interaction in channel-ice-water systems. This study employs WC-TLSPH to analyze the influence of flow variations on the stability of channel ice covers, determining the range of extreme hydraulic pressure changes sustainable by ice covers of varying widths and thicknesses. Results indicate that flow variations are a significant factor affecting the stability of channel ice covers, with excessive flow changes leading to ice cover fracturing. Concerning the critical parameters of ice cover thickness and width, an increase in ice cover width initially amplifies the range of extreme hydraulic pressures it can withstand before diminishing, while an increase in ice cover thickness reduces the magnitude of pressure decrease and enhances the magnitude of pressure increase. Moreover, ice covers exhibit notably greater resilience to hydraulic pressure increase compared to pressure decrease. These findings bear crucial implications for guiding the design and operation of cold-region channels, suggesting that, once stable ice cover formation is achieved, elevating water levels within appropriate limits could effectively preserve ice cover stability.

KEYWORDS

Subglacial water conveyance; WC-TLSPH; ice cover stability

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