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Research on a wedge-wire water intake screen taking into account ichthyofauna protection

Abstract

Exploitation of surface intakes is associated with many difficulties caused, among others, by: variable hydrological and meteorological conditions causing fluctuations in flows, as well as the occurrence of ice phenomena. Moreover, exploitation is difficult in the case of water pollution and sediment transport. Another important aspect is the need to ensure the ichthyofauna protection.

This doctoral thesis covers research on a slotted water intake screen, the design of which allows to reduce the aforementioned operational problems. Small dimensions of the inlet slots and the use of the so-called the deflector guarantees low inlet velocities and their even distribution on its surface and in its vicinity.

The developed model of the water intake screen was subjected to laboratory tests, in which the speeds were measured near the screen located in a hydraulic channel filled with water. Several scenarios were considered with different flow rates in the hydraulic channel and taking into account the use of two deflectors with different opening sizes, as well as the lack of the deflector.

The results obtained during the experimental tests were verified during the conducted numerical simulations using computational fluid dynamics (CFD) methods.

On the basis of the conducted analyzes, it was found that the use of the designed water intake screen allows to avoid the problem related to the threat to the ichthyofauna near the water intake screen. In addition, the use of deflectors resulted in the equalization of velocity distributions near the screen's surface, allows the water intake screen to be operated with higher efficiency without exceeding the permissible inlet velocity values.