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FORMATION OF THE SALINITY WEDGE IN THE ZONE OF CONFLUENCE OF TWO RIVERS

Tatyana Lyubimova (1), Anatoly Lepikhin (2), Vladimir Konovalov (1), Yanina Parshakova (1), and Alexey Tiunov (2)

(1) Institute of Continuous Media Mechanics UB RAS, Computational Fluid Dynamics Laboratory, Perm, Russian Federation (lubimova@psu.ru), (2) Mining Institute UB RAS, Surface Hydrology Laboratory

The peculiarities of the formation of density currents in the zone of confluence of two rivers with strongly different hydrochemical regimes are studied numerically and experimentally on the example of Sylva and Chusovaya rivers (Perm Region, Russia). The three-dimensional numerical simulation shows that at small and moderate flow rates substantial density stratification in vertical direction is formed and leads to the formation of density currents: the higher mineralized water which is characterized by higher density propagates close to the bottom and lower mineralized water which is characterized by lower density propagates near the upper surface. Besides, the higher mineralized (more dense) water of the Sylva river after the confluence with the Chusovaya river moves both downstream and upstream of the Chusovaya river (the part of the water body under consideration downstream from the confluence of the Chusovaya and Sylva rivers is called Chusovaya river). And lower mineralized (less dense) water of the Chusovaya river moves after the confluence in the upper layer both downstream of the Chusovaya river and upstream of the Sylva river. Thus, the calculations show the formation of the salinity wedge at small and moderate flow rates. The results of calculations are confirmed by in-situ measurements. Both numerical modelling and in-situ measurements show that the upstream propagation of vertical stratification of water mineralization is observed only in the case of small or moderate seasonal flow rate and is absent in the case when flow rates in the rivers is maximal. The density currents, producing the effect of the overflow and underflow of water masses of two streams, arise due to the difference in mineralization of water streams in the conditions of low flow velocities. The length of the salinity wedge depends on the flow rates and on the difference in the mineralizations of two rivers. As follows from the numerical results, the wedge length decreases with the increase of flow rates and the decrease of difference in the mineralizations and at sufficiently high flow rates and small difference in mineralizations it disappears. These results are qualitatively consistent with the dependence of the salinity wedge length on the density Froude number and the Reynolds number obtained presented in [1].
The flow of two overlapped oppositely directed water streams was previously discovered in the mouth zone of the rivers flowing in the sea. Our study reveals the existence of a new type of the hydrological systems, in which such a phenomenon occurs.

1. M. Arita, G.H. Jirka, M. Asce. Two-layer model of saline wedge. J. Hydraul. Eng. 113 (1987) 1229-1246.