

Influence Simulation of Solid Ice on Pollution Distribution in Marine Environment

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ABSTRACT

The work contains the results of research on modeling the influence of solid ice on the concentrations formation of the impurity substances into the frozen sea waters. In a simulation model the block is developed, allowing to include in calculation procedure the change of ice area depending on the period of a cold season. Monte-Carlo method is applied to simulation of turbulent diffusion. For calculation of wind currents the equations of shallow water by are used. Wind currents are calculated under scenarios of directions and speeds of a wind, inherent in the given region. Residual currents are set by means of the stream functions, which has been shaped on the basis of experimental data. The analysis of calculation results has shown that the ice cover considerably changes total speeds in water areas and a picture of polluting substances distribution

KEY WORDS: ice cover, pollutants distribution, simulation modeling, shallow water, turbulent diffusion

INTRODUCTION

There are sea areas receiving considerable anthropogenous loadings in many shelf zones. Field data of an ecological conditions of some sea areas have shown that there are cases of sharp pollutants concentration increase in a cold season in them. Especially substantial growth of concentration is observed in the sea areas with ice cover, if discharge of sewage is made under ice.

The reasons of such deterioration of water quality are the speed decrease of biochemical oxygen demand for organic components and of water exchange intensity.

Synthesis of a modeling task and the program of calculation for definition of pollutants concentration, arriving on sea area, which are in full or in part covered by ice was a problem of our researches. For the long-term forecast also it was necessary to consider dynamics of sea ice formation depending on time.

On sea areas covered with ice residual currents, ebb-tide fluctuations, the currents connected with a drain of the rivers and pileup currents bear responsibility for advection of pollutants only. Pileup currents under an ice covering are provoked by a wind on free water area from ice. Wind currents are added to the currents designated above on sea

area, when ice are absent. Variability on time is property for wind currents.

Synthesized models are based on the equations of turbulent diffusion or are used Lagrange approach for the forecast of pollutant distribution in marine environment usually. In this paper the random walk modified method (a method of Monte-Carlo, Lagrange approach) was used for diffusion simulation.

The chief advantages of a method lie in possibility to realize modular construction of this model and possibility of long-term forecasting for pollutants distribution in marine environment.

The decision of assigned task is necessary in cases of civil work, which are conducted from a surface of ice and are accompanied by working out of underwater tranches. On small sea areas, for example, at building lengthy wastewater outfall such method of job practices turn out effective.

Offered work is executed on the basis up heretofore developed by us modification of the random walk method which, in turn, was based on the decision diffusion problems a Monte-Carlo method, stated in fundamental work by Galkin (1975).

Modified the random walk method allows to carry out long-term forecasting of water quality, to consider variable character of wind currents, to enter into modeling problems the description of decomposition processes of polluting substances, corresponding to the set representations about this process and to predict formation of stagnation zones on water shallow sea areas.

The researches undertook by us earlier have shown essential but sometimes and defining influence of the natural factors, which are in process of natural changes on formation of geoecological and biological abnormal zones in sea water areas. Possibility of imitating models to include in procedure of forecasting a set of the hydrological scenarios, taking into account these changes in any measure allows more valid to apply for reliability of the forecast.

The purpose of offered work consisted in expansion of possibilities of imitating modeling by inclusion of a variable ice covering in procedure of calculation of pollution concentration.

Some data of theoretical character from our previous works are more low presented that it was possible to understand statement of a modeling problem and the mechanism of its realization (Zemlyanaya, Lyakhov, 2003).