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ASSESSMENT OF LOAD INFLUENCE OF THE AKADEMIK VERNADSKY ANTARTIC STATION ON THE QUALITY OF ADJACENT MARINE AREA

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Abstract. Discharge of pollutants into Argentine Archipelago marine environment is assessed and the discharge loads are calculated as a follow-up of the work performed at the Ukrainian Antarctic Station "Akademik Vernadsky". The calculations were made on the basis of the model used for development of "The Procedure for Accelerated Inventory of Environmental Pollution Sources". Basic points of the used method-model are described to show its capacity to develop the measures and priorities to reduce pollution of the adjacent sea areas. Comparison is made between the calculated discharge value and the experimental data. The proper comparison of calculated data with experimental results makes it possible to come to the conclusion about the possibility to use the Procedure in practice to assess the effect of the Ukrainian Antarctic Station on the marine environment. The nomograms presented in the paper/report can be used for such assessment.

Key words: Antarctic, "Akademik Vernadsky", monitoring, The Procedure of Accelerated Inventory of the Environmental Sources of Pollution, nomogram.

Оценка воздействия нагрузки антарктической станции Академик Вернадский на качество морской среды прилегающей акватории. С. Бондарь

Реферат. Представлена оценка воздействия и результаты расчетов нагрузки стоков загрязняющих веществ, поступающих в морскую среду островов Аргентинского архипелага в результате функционирования украинской антарктической станции "Академик Вернадский". Расчеты выполнены посредством модели, заложенной в основе "Методики ускоренной инвентаризации источников загрязнения окружающей Среды". Описаны основные положения используемой методики - модели, показаны ее возможности для разработки мероприятий и первоочередных задач, направленных на снижение загрязнения прилегающих морских акваторий. Приведены результаты сравнения расчетной величины нагрузки с экспериментальными данными. Хорошая сравнимость расчетных данных с экспериментальными результатами позволяет сделать заключение о возможности практического применения Методики для оценки воздействия украинской антарктической станции на окружающую морскую среду. Для этой цели могут быть использованы соответствующие номограммы.

Until recently it was supposed that the pollution of the Antarctic coastal ecosystems is small and at the background level because of their relative remoteness from the basic sources of direct anthropogenic influence and limited navigation. But it was revealed that the pollution of this area (on separate components of the chemical pollution) is at the level of some relatively polluted areas of the World Ocean (Bondar et al., 2000).

Such situation in conditions of low temperatures and some other physical, geographical and biochemical conditions which are characteristic for this area causing low ability of marine ecosystems to self-cleaning can rise to certain anxiety for normal functioning of the vulnerable Antarctic ecosystems.

Under the legislation in force in Ukraine the Akademik Vernadsky activity is not a subject to the obligatory state ecological assessment. At the same time the regular assessment of influence on the environment is necessary for the station located in the operative range of the Antarctic Treaty and in accordance with the Memorandum signed by Ukraine and Great Britain.

The station is located on the Galindez Island in the shallow shelf zone of the Argentine Islands. It has been operating all-the-year-round since 1934. There are no means for the waste water refinement at the station. Therefore, according to the requirements of the International Scientific Committee on research in Antarctic, the station should be considered among those, which have the largest ecological influence on vulnerable Antarctic ecosystems (Videnina et al., 1997).

The influence of the station activity on the marine environment is presented in following: dumping of the crude waste water and food waste; washing the oil residues from the place of diesel fuel spilling in 1992; using of small motor vessels; navigation; operation of diesel generators and other technical equipments.

The load of the crude municipal and household waste waters of Akademik Vernadsky on the marine environment was estimated by Bondar S. et al. (2000). In the course of a year the load on the marine environment changes in compliance with the number of people staying at the station, which was accepted as a unit in the estimation of the loading source activity. The number of people simultaneously stayed at the station changed from the minimum number of 13 persons (wintering personnel) up to 247 persons (personnel together with the tourists). On the average there were 38 persons at the station during the period 16.12.98 - 02.03.99. Judge by data from (Bondar S. et al., 2000) one may consider that the rather large anthropogenic influence on the marine scarried shallow of the Argentine Islands occurs. In summer this load is about three times as much.

For quick estimation of the station load on the marine environment it is convenient to use nomograms. For their construction the dependence of load on the pollution source activity and load parameter is used. It is possible to present the load, pollution source activity and load parameter on a plane in the Cartesian coordinates (u, v) as three types of curves with the parameters of x, y, z accordingly. If the curves of the types appropriate to meanings of x, y, z, are crossed in one point, these meanings are considered as appropriate each other.

For construction of nomograms the equation from (Bronshstein et al., 1981) is used:

$$H(z) = F(x) \cdot G(y), \tag{2}$$

where: $H(z)$ - the load function ($z > 0$);

$F(x)$ - the pollution source activity function ($x > 0$);

$G(y)$ - the load parameter function ($y > 0$).

The representation of this function can be realized by several ways. One of them is the construction of the grid nomogram, when:

$$H(z) = E; \quad F(x) = A; \quad G(y_j) = \text{tg}(\alpha_j) = e_j, \tag{3}$$

As the load parameters of various components can differ in a few orders, it is expedient to use the logarithmic scale for the axis of ordinates in this case. Such a nomogram is shown in fig. 1.

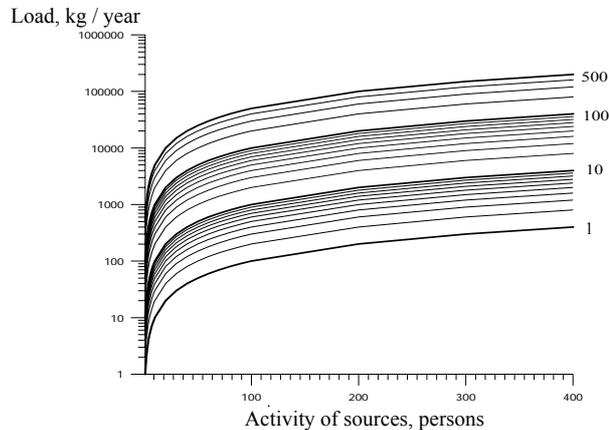


Fig. 1. Grid nomogram for estimation of the pollutants load at the Akademik Vernadsky station

For another type of nomogram each component is presented separately along the axis of ordinates when conditions are follows:

$$H(z) = E_j / e_j; \quad F(x) = A; \quad G(y_j) = \text{tg}(\alpha_j) = 1, \quad (4)$$

This nomogram is shown in fig. 2.

Load Oil, Total P, Total N, SM, BOD,
kg/y kg/y kg/y kg/y kg/y

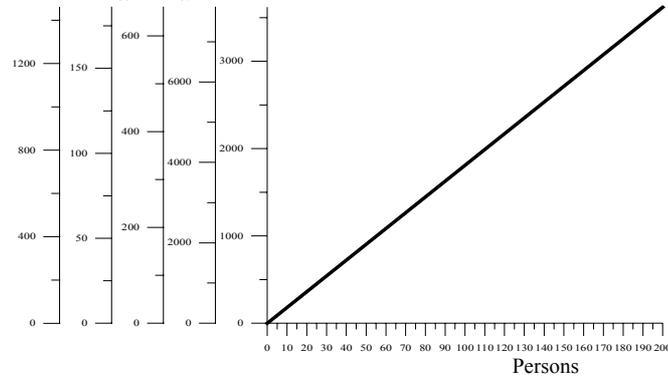


Fig. 2. Nomogram for estimation of the pollutants load at the Akademik Vernadsky station.

To determine potentialities of The Procedure of Accelerated Inventory of the Environmental Sources of Pollution (Economopulos, 1993) for assessment of anthropogenic loads of the Vernadsky station, only crude household waste waters influence was considered. But it is necessary to develop and fulfil complex of measures directed on prevention influence on the marine environment caused by the “physical aging” of the station and increase in the international tourism and navigation.

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