DIAGNOSIS OF POLLUTANTS ACTIVITY IN THE MARINE ENVIRONMENT

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The role of marine biota in the self-purification of the marine water is usually positively assessed, as it sufficiently accelerates this process. But actually the positive effect can be achieved if the pollutants are neutralized by biological degradation or biological sedimentation. Biosorption and biofiltration can't be regarded as a positive effect as they lead to accumulation of pollutants in the organisms. Besides, the excretion of pollutants by filter-organisms can facilitate their re-activation, which can also be considered as a negative effect.

The intensity of pollutants exchange between water and biota is commonly measured in biological components. In our opinion, water component is quite acceptable for this, as the pollutants activity is displayed as a deviation from conservative behaviour. Conservative behaviour is the dynamics of pollutants which depends only on the water mixing processes, and pollutants activity is their ability to transfer from water to other components of the marine environment, which main component is the biota.

This article describes the method for diagnosis of pollutants activity in marine water developed in the Caspian Marine Scientific Research Center. This method is applied for the assessment of marine environment in the areas of search, prospecting and development of oil and gas deposits. As the method is focused on the comparison of the dynamics of a selected pollutant with that of a conservative component, the prerequisite for its application is the presence of this component gradient in water. It should be noted that the best conservative component is the salinity.

In this method the concentration of the conservative component in marine water is denoted as $\mathbf{C_k}$, and the concentration of a pollutant (or active component) is denoted as $\mathbf{C_f}$. At the first stage of calculation $\mathbf{C_f}$ values are ranged by the conservative parameter $\mathbf{C_k}$ by ascending values. The results of parallel measurements of $\mathbf{C_k}$ and $\mathbf{C_f}$ in marine water samples taken in the research area are used as source data.

At the second stage the expected values of the active parameter (C_w) are calculated for each point of the ranged series (with the exception of two edge points[1]). This is done on the assumption that the dynamics of the active parameter is of conservative nature. The calculation is done according to the following formula:

$$C_w = C_{f-1} + [(C_k - C_{k-1})/(C_{k+1} - C_{k-1})]x(C_{f+1} - C_{f-1}),$$

where:

C_{f-1} -actual value of the active parameter in the previous point of the ranged series;

C_{f+1} - actual value of the active parameter in the following point of the ranged series;

C_k -actual value of the conservative parameter in the selected point of the ranged series;

C_{k-1} -actual value of the conservative parameter in the previous point of the ranged series;

C_{k+1} -actual value of the conservative parameter in the following point of the ranged series;

At the third stage ΔC is calculated for every point of the ranged series (it corresponds to a certain water sample) with help of the formula:

$\Delta C = C_f - C_w$, where:

[1] This exception concerns all the following calculations, but we won't dwell on it to save time.

C_w -expected value of the active parameter in the selected point of the ranged series;

C_f -actual value of the active parameter in the selected point of the ranged series;

At the fourth stage, the index of activity direction (**IF_S**) and the index of activity level (**IF_M**) are calculated for every point of the ranged series (water sample). The following formulae apply (it's obvious that these indices are dimensionless):

$$IF_S = \Delta C / \sigma_f$$

$$IF_M = \left| (\Delta C / \sigma_f) \right| ,$$

where $\boldsymbol{\sigma_f}$ is the mean quadratic deviation of the source series C_f.

As geographical coordinates are determined while taking water samples, the obtained series of IF_S и IF_M can be used to characterize the spatial distribution of pollutant activity. Positive IF_S values will correspond to the zones of local enrichment and negative values -to the zones of local depletion of water with the pollutant.

If observations of marine water pollution in the selected part of the water area are held regularly, it can help to determine the nature of temporal variability of pollutant activity. In this case every selected temporal interval can require determining the activity which characterizes the area under study as a whole. For this we recommend to calculate mean arithmetic value IF_M and accumulated sum IF_S.

The information on the composition of suspended matter and the presence of local pollution sources is important for the interpretation of obtained results. If there are no such sources, then water enrichment with pollutants can be interpreted in three ways: a) as desorption if mineral particles prevail in suspended matter; b) as excretion if living plankton prevails; c) as post-mortem excretion or decomposition if dead organisms prevail.

Correspondingly, water depletion with a pollutant if mineral particles and biogenic detritus prevail is interpreted as adsorption, and if living plankton prevails it can be interpreted as biosorption and biofiltration. From the point of ecology, physical and chemical processes of marine water self-purification are more preferable than biological ones, as the latter lead to accumulation of pollutants in biota, including commercially valuable organisms.