L-V2

TRANSFER OF HEAVY METALS BY SUSPENDED MATTER IN THE KRKA RIVER ESTUARY, YUGOSLAVIA

Mladen JURAČIĆ[1] and Esad PROHIĆ[2]

(1) Center for Marine Research, Rudjer Boskovic Institute, Zagreb, Croatia (Yugoslavia)
(2) Institute of Geology, Zagreb, Croatia (Yugoslavia)

This paper describes research in the Krka River estuary in the Yugoslav Eastern Adriatic. It is a region of exceptional natural value, but also one under strong development pressure. Research reported here is part of a modelling exercise, intended to develop environmental managment strategies, particularly with respect to pollution from land-based sources.

The role of suspended matter as a major transfer agent in transport of heavy metals from river to the sea has been recognized long ago (1,2). There is conflicting evidence in literature on the processes occuring in the estuary. Data reported indicate the transfer of trace metals either from particulates to solution, or from solution into particulates (3).

Suspended matter samples were collected by filtering large volumes of water from the surface layer in the fresh water Visovac Lake and the brackish water Prokljan Lake (Fig. 1).

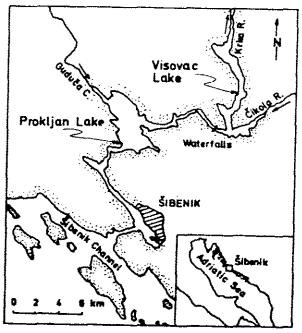

Figure 1. The investigated area: the Krka River Estuary.

X-ray diffraction analysis has shown the prevalence of calcite, over quartz and dolomite, and traces of montmorillonite and some manganese mineral, probably manganite ($Mn_2O_3 \times H_2O$) in the suspended matter of the Visovac Lake. In the suspended matter of the Prokljan Lake quartz is the most abundant mineral, with minor quantities of feldspar, calcite, illite, montmorillonite, and kaolinite. Also, amorphous, prevalently organic phase is much more abundant in the suspended matter of the Prokljan, than of the Visovac Lake.

Different mineral composition of the two suspended matter samples indicates that the source of Prokljan Lake suspended matter is not the main water supplier, the Krka River, but the Guduča Creek, which drains an area where flysch marls and sands are dominant (4,6).

We report here data (cf. Table I) on heavy metal concentrations, obtained by emission spectroscopy analysis, in suspended matter from the Krka River estuary and compare them with concentrations in sediments and in water in the same area (4,5).

Table I Heavy metal concentrations in suspended matter and sediments ($\mu g/g$) and in water (ng/dm^3) in various parts of the Krka River estuary

Sample	Ni	Zn	Pb	Cu	Mn	Cr	Reference
Suspended matter*							this work
Visovac	150	210	92	180	2500	210	
Prokljan	130	230	145	120	2300	130	
Surface sediments							(4)
Visovac	42	72	67	95	70	30	
Guduča Creek	100	38	18	2	500	200	
Guduča mouth	72	50	33	33	900	105	
Prokljan	40	50	30	42	800	37	
Prokljan exit	52	35	70	65	1200	60	
Estuarine water range		650-1560	150-440	98-415			(5)

The review of data shows that suspended matter samples have higher concentrations of heavy metals than the surface sediments. Nickel and chromium have naturally elevated concentrations (4), originating from basic and ultrabasic eruptives. High manganese concentration can be attributed to bauxites, since several mines exist in the drainage area. Zinc, lead and copper have moderatly elevated concentrations, as a consequence of antrhoprogenic input. Very low concentrations found in water (background levels) indicate that most of the trace metals reach the estuary bound to the suspended matter. We assume that a large part of these metals is associated with the organic fraction, and thus subjected to cycling in the estuary. Lead and copper were found to accumulate in surface sediments of the Prokljan Lake, in spite of their higher concentrations in suspended matter (4).

References:

1. J.-M. Martin and M. Whitfield: The Significance of the River Input of Chemical Elements to the Ocean. In: Trace Metals in Sea Water (Wong, Boyle, Bruland, Burton, and Goldberg, eds.), Plenum Pub. Co., 1983, 265-296.
2. D. Eisma: Suspended Matter as a Carrier for Pollutants in Estuaries and Sea. In: Marine Environmental Pollution. 2. Mining and Dumping (R.A. Geyer, ed.), Elsevier, 1981, 281-295.
3. J.C. Duinker: Suspended Matter in Estuaries: Adsorption and Desorption Processes. In: Chemistry and Biogeochemistry of Estuaries (E. Olausson and I. Cato, eds.), John Wiley and Sons, 1980, 121-151.
4. E. Prohić and M. Juračić: Heavy Metal Concentrations in Sediments. Problems Concerning Determination of Anthropogenic Influence, Environ. Geol., 1986, submitted for publication.
5. M. Branica, Z. Peharec, Z. Kwokal and S. Kozar: Trace Metals in the Šibenik Aquatorium Rapp. Comm. int. Mer Med., 29, 7 (1985) 111-113.
6. M. Juračić, E. Prohić and V. Pravdić: Sediment Surface Properties and Adsorption of Heavy Metals in a Typical Karst Estuary, VIIes Journees Pollutions, CIESM, Lucerne, 1984 (in press).

L-V3

SEWAGE TREATMENT AND DISPOSAL - CONSTRAINTS AND OPPORTUNITIES, SARONIKOS GULF

N. FRILIGOS

National Centre for Marine Research, Hellinikon (Greece)

Summary

The variation of nutrient concentrations and physical characteri stics were studied in the vicinity of the Athens sewage outfall during 1974-1976 and 1982. In conclusion, in areas such as the Saronikos Gulf, where the surrounding waters are naturally unproductive and where the bottom shoals rapidly, primary treatment may be preferable to secondary treatment. In such unproductive areas, the adverse effect of sewage discharge into the sea on the phytoplankton community apparently can be made insignificant if the outfall is properly designed. Highlights from these results are as follows:

Primary treatment is essential. The separation of domestic wastes from industrial effluents should be done to make possible biological treatment.

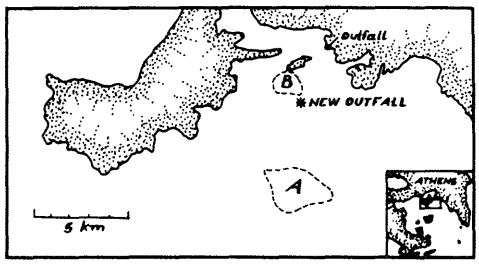

Fig. 1. Location of stations in the Saronikos Gulf.

Partial biological treatment is a desirable step before committing to full biological treatment.

The removal of nutrient is the only way to improve far-field water clarity but to the detriment of fisheries. That of nitrogen would be very costly and is not usual for major sea discharges.

A 2000 m long outfall diffuser at a depth of 60 m or more between Stations A and B is needed for either primary or secondary effluent to take advantages of stratification.

Provided that the concentration of toxic materials in the sludge is limited to safe levels, we are of the opinion that the addition of sludge to the open sea should be beneficial to fish production.

L