

Preliminary observations of oil and phenol
distribution in the central Adriatic

*Preliminarna opažanja o rasprostranjenju ulja i fenola
u srednjem Jadranu*

by

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INTRODUCTION

Sea pollution, due to modern intensive urbanization and industrialization of the coastal zone of the Adriatic, requires permanent and systematic control. The problem of the sea polluted by industrial waste waters and naphtha and its derivatives from vessels is particularly actual. Nowadays, in addition to the investigations of pollution, which is predominantly bacteriological in character (Majori et al., 1969; Pavletić and Stilinović, 1969; Pavletić et al., 1971, and others), the sea water is analyzed with the aim to establish an eventual presence of naphtha derivatives like oils and phenols because of their noxious effect on the sea life.

The data on the concentration of mineral oils and phenols in the Adriatic surface waters are few and poor. Recently, data have been collected in the channel region along the line from Split to the island of Ugljen (Munjko and Jardas, 1970), in the coastal zone at Olib, Opatija and Poreč (Munjko and Jardas, 1970/71), and results have been obtained of the investigations conducted in the pollution of the sea's surface along the line from Selca to Plomin (Pavletić et al., 1971; Munjko, 1971) and on the line from Karlobag to Makarska (Munjko, 1971).

Theoretical studies of the problem of sea pollution can be found in the works by Buljan (1953; 1958), Parun (1971), Golubić (1962) and many others.

Besides being interested in the pollution of the surface of the coastal sea near the islands of Vis, Svetac and Biševo, we were particularly interested in the vertical distribution of oil and phenol concentrations in the sea water.

MATERIAL AND METHODS

The samples of the surface coastal waters were taken at the islands of Vis (the bay of Komiža; near the »Biševo« hotel, in the Kamenica cove and near the »Neptun« factory), Svetac (the Zankić cove) and Biševo (Modra spilja — the Blue Grotto), and at the station Stončica at the depths 0 (0.5), 5, 10, 20, 30, 50, 75 and 100 m (Fig. 1).

The samples of the surface coastal sea water were taken in clean (sterile) Winkler's flasks.

The samples from the stations Stončica and Modra spilja, in which exclusively the concentrations of phenol and oil were determined, were fixed with copper sulfate, and the other samples were examined in their native states. The time between sampling and conducting individual analyses was from 36 to 48 hours.

Phenols were elaborated after Emerson's method with 4-aminoantipyrine, and oils were extracted by means of carbon tetrachloride, CCl_4 , after Simard's method. Oil concentration was determined with IR-spectrophotometer, and phenol with Perking-Elmer's spectrophotometer, Model 202.

Oil concentration is expressed in **ppm** units (parts per million), and phenols in **ppb** units (parts per billion; 10^{-9}).

The other values were obtained by routine methods.

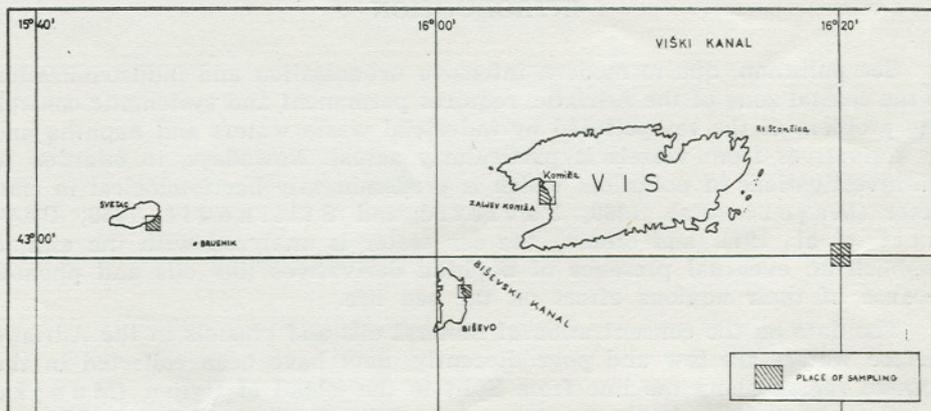


Fig. 1 Geographical position of the place of sampling

RESULTS AND DISCUSSION

The analysis of the sea water at the station Stoniča has given the following results (Table 1).

Table 1 Phenol and oil concentrations in the sea water at the station Stoniča at the depths from 0 — 100 m (samples taken October 12, 1971)

Depth m	Phenol concentration ppb	Oil concentration ppm
0 (0.5)	6.5	2.7
5	2.4	1.2
10	1.0	0.8
20	0	0.4
30	0	traces
50	0	0
75	traces	0
100	traces	traces

As expected oil and phenol concentrations were the highest on the sea's surface and they decreased gradually according to depth. A very rapid decrease in concentration was observed in the first 5 m.

If oil and phenol concentrations in the same depth are compared a considerably higher concentration of oil can be registered. Similarly we can also notice the differences in the rate of decrease in their concentrations in relation to depth (Fig. 2).

The decrease in the concentrations in the first 5 metres is more or less equal in both cases, i.e. 55% for oils and about 63% for phenols of the surface concentrations. However, a further decrease in phenol concentration with the increase of depth is considerably quicker than the decrease in oil concentration. While oil traces have been registered at 30 m, all the traces of phenol disappear at the depths beyond 10 m.

Small concentrations of oil (less than 0,1 ppm) and phenol (less than 1 ppb) have been registered again at greater depths (above the bottom) i.e. phenols at 75 and 100 and oils at 100 m. These small quantities of oil and phenol have probably originated in the bottom processes of disintegration and mineralization of free organic matter and detritus and they are not the result of pollution. Their occurrence in these layers is probably closely connected with bacterial activity.

The results of pollution of the surface coastal waters are given in Table 2. The highest degree of pollution of the coastal sea has been found at Komiža,

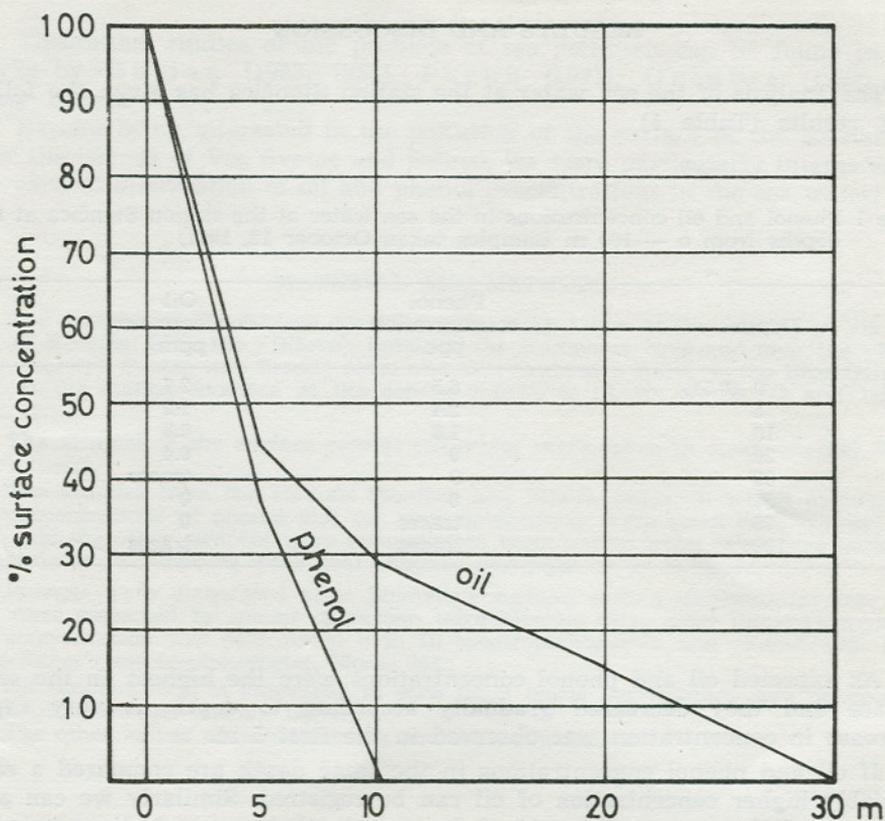


Fig. 2 Decrease in oil and phenol concentrations (%) at the station Stončica from 0 to 30 m in relation to their surface concentrations

especially near the »Neptun« factory where the influence of the waste waters of the factory is particularly felt. Here the highest quantities of oil and phenol are found, then free organic matter and germs accompanied by muddled water. At other localities under examination considerably better conditions have been found especially near the island of Svetac (the Zankić cove).

The conditions found at the localities under examination can only partly satisfy the requirements. According to the researches conducted by Liebmann (1967) the quantities of phenol found near the »Biševo« hotel, and especially near the »Neptun« factory, are enough to spoil the taste of fish the more so as shin, liver and muscle tissues absorb phenol more rapidly. In such cases accumulation of monochlorophenol becomes notably rapid. Light oils have a similar capability of spoiling the taste of fish meat.

Table 2 Results of the investigations of the surface pollution of the coastal sea water near the islands of Vis (the bay of Komiža), Svetac (the Zankić cove) and Biševo (Modra spilja — Blue Grotto)

Kind of analysis	Place of sampling				
	Komiža (hotel »Biševo«)	Komiža (Kamenica cove)	Komiža (factory »Neputn«)	Svetac (Zankić cove)	Biševo (Modra spilja)
Time of sampling	Aug. 4, 1971. (14 hours)	Aug. 4, 1971. (12 hours)	Aug. 4, 1971. (10 hours)	Aug. 3, 1971. (12 hours)	July 24, 1971. (10 hours)
pH	8.3	8.4	8.2	8.1	—
Consumption KMnO ₄ mg/l	170	136	388	102	—
BPK ₅ mg O ₂ /l	8.0	10.3	40.4	3.2	—
Germs/ml No.	420	180	660	107	—
Phenol (ppb)	13.0	4.0	95.5	0	0
Oil (ppm)	5.0	1.8	15.0	2.5	1.0—3.4
Appearance of water	muddy	clear	muddy	clear	clear

The other values found — the quantity of organic matter, the appearance of water — at the same localities also exceed all the norms for the sea meant for recreation.

REFERENCES

- Buljan, M. 1953. O uplivu izbacivanja mineralnih ulja i organskih otpadnih tvari u more. *Mornarički glasnik*, 3 (4). 418-420.
- Buljan, M. 1958. Biološki aspekti problema zagađivanja mora. *Mornarički glasnik*, 7 (4). 447-455.
- Golubić, S. 1962. O problemima zagađenja i zaštite vode s osobitim osvrtom na jezero Vrana na otoku Cresu. *Obavještenja*, 5 (4). 273-285.
- Liebmann, H. 1967. Detergentien und Öle in Wasser und Abwasser. Minchen — Wien.
- Majori, L. Morelli, M. L. Diana, L. & Rausa, G. 1969. L'inquinamento delle acque del mare nell'Alto Adriatico (I — Ricerchi Microbiologiche). *Con. Naz. Ric., Serie B.* 37. 115-125.
- Munjko, I. & Jardas, I. 1970. O zagađivanju Jadranskog mora fenolom i mineralnim uljima. *More*, 13 (5-6). 24.
- Munjko, I. & Jardas, I. 1970/71. O problemu onečišćevanja in zaštiti vod pred fenoli in mineralnimi olji. *Proteus*, 33 (5). 221-224.
- Munjko, I. 1971. Nastavak ispitivanja fenola i ulja u Jadranskom moru. *More*, 14 (2) 28.
- Parun, E. 1971. Zagađivanje mora i njegov utjecaj na riblje resurse i ekonomiku ribarstva u svijetu. *Morsko ribarstvo*, 23 (2). 52-58.
- Pavletić, Z. & Stilinović, B. 1969. Preliminarna bakteriološka istraživanja u zaljevu Valdibora kod Rovinja. *Thalassia Jugoslavica*, Vol., 5. 251-255.
- Pavletić, Z. Stilinović, B. Črc, Z. & Munjko, I. 1971. Zimski i ljetni aspekt heterotrofnih i koliformnih bakterija i nekih ekoloških karakteristika onečišćenja u području Riječkog zaljeva. *Acta Adriatica*, (u tisku).

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KRATAK SADRŽAJ

U ovom radu iznesena su preliminarna opažanja o onečišćenju površinskog priobalnog mora na nekim karakterističnim lokalitetima kod otoka Visa (zaljev Komiža), Sveca (uvala Zankić) i Biševa (modra spilja) i o vertikalnoj raspodjeli ulja i fenola na postaji Stončica na 0, 5, 10, 20, 30, 50, 75 i 100 metara dubine.

Uočena je znatno veća koncentracija ulja s obzirom na fenole na svim dubinama i brzi pad njihovih koncentracija u odnosu na dubinu, naročito kod fenola.

Najlošije stanje — što se tiče onečišćenja površinskog priobalnog mora — na istraženim lokalitetima je nađeno u zaljevu Komiža, gdje se jasno očituje utjecaj otpadnih voda.