WATER QUALITY OF THE VENICE CANAL NETWORK: RESULTS OF AN INTENSIVE MONITORING

R. Zonta [1] *, M. Scattolin [2], M. Botter [1], F. Collavini [1]

[1] National Research Council – Institute of Marine Science. San Polo, 1364 – 30125 Venice, Italy *roberto.zonta@ismar.cnr.it
[2] Venice City Council – Environment Department. San Marco, 4136 – 30124 Venice, Italy

Abstract

An intensive monitoring activity was performed in spring 2003, to ascertain the water quality of five different zones of the Venice canals network. In consequence of the recent dredging interventions and realisation of sewage purification systems, the results testified acceptable quality conditions in the monitored canals. Further investigations are needed in order to highlight the presence of specific sources, which determine a decrease of the water quality, and to establish suitable methodologies for the future control of the canals network.

Keywords: water quality, pollution, urban wastewater, Venice

In recent years, a series of maintenance and restoration interventions has been started in the about 40 Km-long Venice canals network. They include both the removal of a thick layer of contaminated sediment resulting from more than 30 years of sedimentation, and the reduction of the amount of domestic and commercial wastewaters. As a consequence, a progressive improvement of the water quality in the network is expected, which must be ascertained by means of specific water samplings and analyses. However, due to the complexity and variable characteristics of the network, suitable methodologies for the evaluation of the present situation and the control of the water quality in the future are still to be defined. Different factors induce temporal variability of the water quality in a given site: level variation in different tide phases; meteorological conditions; the strewn wastewater effluents; bottom sediment resuspension due to shear stress and boat traffic; the flow of water masses coming from neighbouring parts of the network. In this picture, an intensive monitoring activity was performed in 28 stations belonging to five different zones of the City (Fig. 1): three marginal areas located in the North (A), South (D) and East (E) respectively, a inner area (B), and the Canal Grande (C), through which a large part of the canals network is fed and drained by tidal currents.

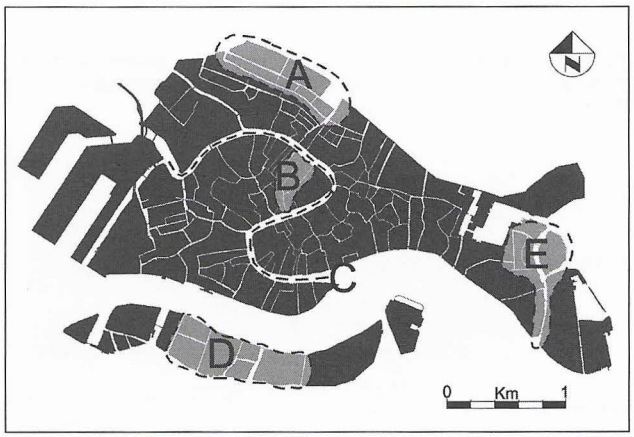

Fig. 1. Map of the City of Venice. The investigated zones are evidenced.

Each station was monitored at least ten times in the period between March 4th and April 16th 2003, collecting more than 300 water samples that were analysed for the following determinants: suspended particulate matter; heavy metals (Fe, Mn, Cd, Cu, Pb, Zn); nitrogen and phosphorous dissolved species; total and fecal coliforms; fecal streptococcus. Samples were mainly collected around the minimum tide, in order to account for the worst quality conditions occurring in the water column. The water sampling was always accompanied by the measurement of water dynamics and phisico-chemical parameters (salinity, temperature, dissolved oxygen, turbidity, pH, redox potential). Data clearly show differences in the quality conditions among the investigated areas. Marginal areas (A, D, E) have a lower contaminants and bacteria content and better physico-chemical characteristics (higher dissolved oxygen concentrations and redox potential values, lower turbidity) with respect to the inner area B. This is ascribed to both a better water renewal and the effectiveness of the interventions already realised in the three marginal areas. The water of the Canal Grande shows intermediate characteristics with respect to marginal and inner areas. Figure 2, for example, shows the average concentrations of dissolved inorganic nitrogen (DIN) measured in the five zones. It is worthwhile to observe that in the majority of the stations belonging to the marginal areas DIN concentration is close to - or even lower than - the imperative values (350 µg/l) established by the Italian law for the water of the lagoon. This feature also holds for dissolved phosphorous, whose imperative value is 25 µg/l. Concentrations of Cu and Pb – as well as those of Fe and Mn - measured in all the 28 stations are, with very few exceptions, lower than the average values that characterise the freshwater discharged into the Venice lagoon from its drainage basin. Zinc concentrations are instead of the same order or even greater. Cadmium always resulted lower than the detection limit (0.1 µg/l). Finally, coliforms show levels lower than the EC imperative values for the bathing waters (Directive 76/160/CEE) in the majority of the stations; the concentration of fecal streptococchi is instead greater than the EC limit. The investigation highlights an acceptable situation for the water quality of the Venice canals network, which is probably better than the expected one on the basis of the number of the planned interventions already performed and the time elapsed. Anyway, the high concentrations of some determinants systematically observed in some of the 28 stations require further investigations, in order to check the eventual presence of specific sources affecting the quality of the water column.

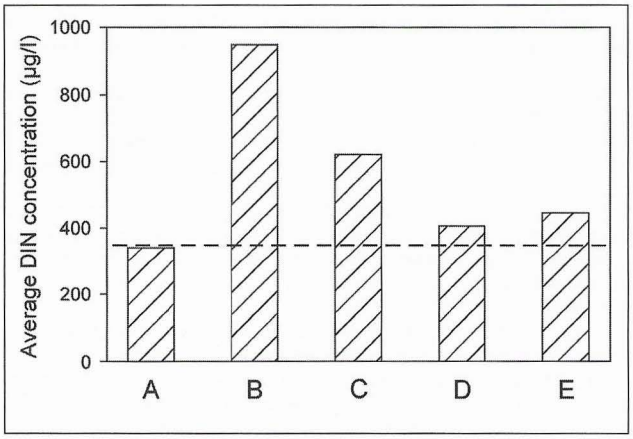

Fig. 2. Average concentration of dissolved inorganic nitrogen in the five zones. The dashed line corresponds to the Italian imperative value (350 µg/l) for the lagoon.