

WATER QUALITY AND HYDRODYNAMIC ANALYSIS OF A PARTICULAR LAGOON

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In the present paper water quality and hydrodynamic analysis has been carried out concerning the environmental degradation of Lake Fusaro also referred to a series of surveys recently acquired (ENEA, 2002) for its rehabilitation on the initiative of the Government Commissioner for Water Conservation of Campania (Region of southern Italy). The Lake Fusaro is a coastal lagoon, situated to the south-western extremity of the volcanic zone of Campi Flegrei, it has surface of about 0.97 km^2 , a maximum natural depth of about 6.00 m and a volume of about $3 \cdot 10^6 \text{ m}^3$. The lagoon is separated from the sea by means of a narrow sandy dune along north-south direction. In the sandy dune there are three mouth channels through which water flow regulated by tidal cycles takes place. Among the three mouth channels the Central Mouth (the most recent one) effects, at the present time, almost alone (over 90%) the exchange between sea and lagoon with an appraised maximum flow rate equal to $5 \text{ m}^3/\text{s}$. Indeed the more ancient mouth channels, the Roman Mouth and the Bourbon Mouth, result particularly obstructed by sand. Along the sandy dune (western side), between Central Mouth and Roman Mouth, deep scours are present whose largest depths reach 12 m; such scours are of anthropic origin as a consequence of a dredging. The anthropic action, that caused the scours, and the sandy obstruction of mouth channels have produced in the lagoon habitat both temporary and permanent degradations. The hydrodynamic conditions relative to an elevated trophic level are confirmed by the simulation of mean velocity and turbulent agitation fields obtained through the use of a 2-DH mathematical model under the Shallow-Water hypotheses (Cioffi and Curto, 1996; ENEA 2002). In fact lagoon hydrodynamic characteristics contribute to regulate the oxygen balance since low levels of turbulent agitation give rise to:

- smaller oxygen flows supplied by atmosphere to water and, from this, to the sediments;
- diffusion and sedimentation processes of organic material and nutrients, with consequent less exchange, through channels connected to the sea, during the tidal cycles.

The simulation has confirmed a rather low turbulent agitation which is substantially located in correspondence of the Central Mouth in the lagoon, as a direct consequence of the scarce tidal supplying and of the presence of the deep anthropic scours.

Moreover the analysis of sediments shows remarkable concentrations of heavy metals, such as Cu, Ni, Zn, Cd, Pb, Cr, Hg and As, in the central area of the lagoon, where small size sediments are present, due to a wastewater inlet. Thus, sediment dynamic analysis is very important to predict their location inside the lagoon, both in suspension and within the bed, and their transport to the shore through the mouths. An expressive representation of the sediment distribution could be obtained presenting sediment dimension d_{50}

distribution with the water depth, which demonstrates that the lagoon could be divided in two areas, northern area and southern area.

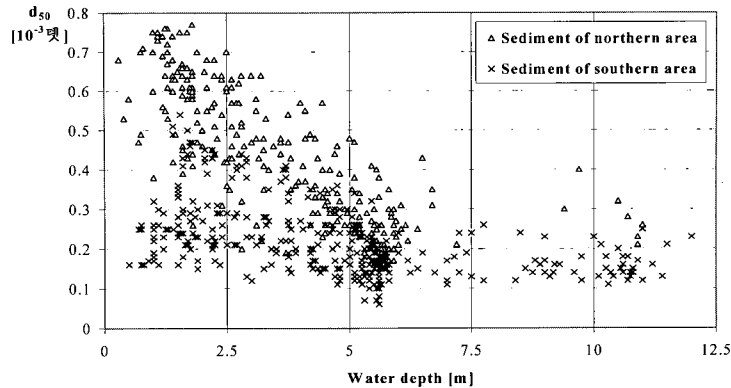


Fig. Diagram water depth – sediment dimension d_{50}

Particularly, the graph shows that in the northern area sediment dimension distribution decreases with increasing depth. The sediment dimension in northern area is altogether always greater than sediment dimension located at the same depth in southern area. In southern area the presence of the anthropic scours determines hydrodynamic conditions giving rise to the sedimentation and a rather uniform distribution of sediment dimension over depth. Such a sediment disposition is coupled with a different oxygen demand in the different areas of the lagoon, as pointed out by the water quality field data analysis that demonstrated that no significant density stratification is present in the lagoon. Also, dissolved oxygen levels have been always higher than 60% of the saturation value during the whole sample period, except for the deepest area of the lagoon where anoxic conditions have been observed.

REFERENCES

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