Impact of a coastal disposal site for inert wastes on the physical marine environment : the Riva Ligure case

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The disposal of inert material derived from large civil engineering works together with the need to recover new areas of coast for tourism, port and related services has often lead to the choice of coarsal areas for waste disposal and thus to a series of ambiental problems.

In this work, the Riva Ligure (Imperia-Italy) waste disposal site is analysed for its impact on the underlying sediments and the surrounding water mass.

The disposal site is located between the mouth of the Argentina stream and the urban centre of Riva Ligure, at the centre of the physiografic unit bound to the west by Capo Verde promontory and to the east by Punta Santo Stefano. The material in the site comes almost exclusively from the digging of tunnels (Capo Negro and Santo Stefano) for the new Genoa-Ventimiglia railway line. Waste for a total volume of 126,000 m^3 were discharged into the sea between March 1988 and December 1989.

The dynamics of diffusion of the dumped material has been studied from the wave refraction and it is seen that the area of coast involved is mostly protected by the reigning wave motion (SW) but not against the less frequent but more violent Libeccio storms.

The study of coastal transport (CERC, 1973) has shown a general component north-eastwards but very low in comparison with the maxima found in the area. The HATTORI and KAWAMATA (1980) index-measuring method utilized for assessment of transversal transport has shown that waves incide orthogonally to the coast causing erosive phenomena but infrequently.

Analysis carried out on the water mass (temperature, salinity, density, nutrients, suspended matter) outlined three different patterns of coastal circulation (from north-west, east and south-west) depending on wind and sea conditions. The distribution of hydrological parameters (T, S, 6-t) has shown that thermal and haline variations depend not only on dispersion into the sea of freshwater but also on the mixing processes linked to the surrounding meteomarine conditions. The concentrations of nutrients are low and conditionated by the freshwater input. Within the nutrients, nitrites are absents or in very reduced concentrations. On the contrary, nitrates, silicates, ammonia and phosphates show highest concentrations near the mouth of Argentina stream (maximum values : 16.2 µmol/l, 35.5 µmol/l, 3.62 µmol/l, 0.29 ,µmol/l respectively). The concentrations of these latter nutrients decrease offshore (mean values: 0.3 µmol/l, 1.7 µmol/l, 0.6 µmol/l, 0.08 µmol/l respectively). The suspended particle distribution is also linked to fluvial inputs, to the nearness to or distance from the dump, and to wave action. The highest concentrations were found near the surface, close to the main stream outlets (2.5 mg/l on average) and to the dump area (5mg/1 on average). The diffusion of the suspended particles seems to be related to different pressure regimes which determine the concentration and dispersion of the particles within the surface layer (above 5 m depth). Since the prevailing winds in the zone are from the first quadrant, on average the dispersion is to the SW. Except for the stations near the tidal zone, suspended particle concentrations are generally low throughout the column (0.4 mg/1) .

The textural distribution of sediments and the analysis of granulometric data highlight the progression of sands over pelitic sands, besides confirming the general dispersion of mobile bottom sediments eastwards. Moreover, the presence of areas of accumulation near the dump characterised by a higher level of pelite than the surrounding sediments is to be noted. This phenomen is due to the gradual effects of wave motion on the front of the waste disposal site and to the release of fine materials deriving from movement and dumping operations in the waste deposit. In particular, it was noted that material of medium and coarse sand dimensions tends to move in a direction subparallel to the coast as far as the 4 m isobath, whereas fine and very fine sand moves between the 4 and 15 m isobaths. Thus, one can say that the waste deposit contributes to the mobile bottom sediments supplying material of different granulometry. The coarser part of this material forms a layer in shallow waters, while very thin sand and pelite partly deposit close to the waste dump and partly move to the open sea settling at greater depths (to the 15 m isobath and beyond) mixing perfectly with the natural river and sea sediments present there.

Mineralogic, petrographic and geochemical analyses, carried out to distinguish material of the dump from sea and river sediments, generally confirmed the remarkably homogeneous composition.

Studies on the benthic population carried out during dumping operations highlighted the presence of biocoenoses typical of fine sediments in the waste disposal area. However, the proximity of the mouth of Argentina stream does not allow to distinguish the effect due to the waste disposal from that due to the stream itself (RELINI, pers.comm).

The results of the present study lead to the conclusion that the dump being examined does not substantially alter the mineralogic-granulometric parameters of the sea bottom and physico-chemical parameters of the surrounding water mass. Only during the rare sea floods is the exposed front of the dump eroded, with the consequent transfer of heterogeneous material into the sea. The particular geographical position of the dump within the physiographic unit and the coastal dynamics in this part of the sea suggest that, at the end of the discharge process, material from the waste deposit will rapidly become incorporated into the natural sediments.

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