

European Union Projects The “Eco information” and the “ECOPORTS” projects.

Eco Info application to the impact of port waters pollution on the city of Genoa

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APAT

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General presentation of the site

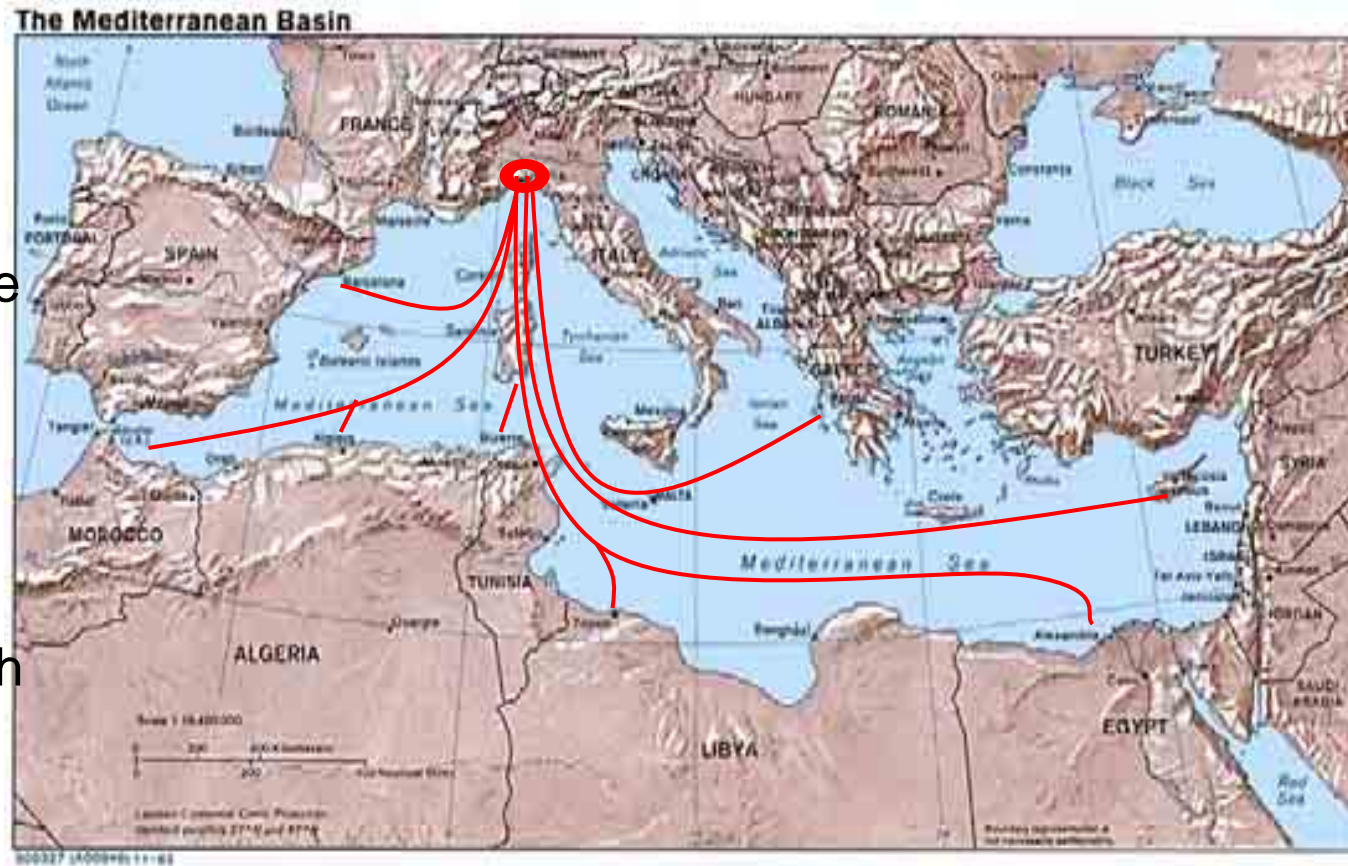
Port surrounded by a mountainous land which degrades very close to the sea or, in some cases, falls straight into it.

Port area extends over about 20 km of coast and covers 5.000.000 m² of marine surface, where the water depth varies from 9 to 15 meters, with a maximum of 50 meters on areas for the discharging operations of oil tankers.



Five seawalls protect the port. Marine activities of port develop about 47 km of length, 30 of which consist of modern quays equipped to receive more than 200 ships of different dimensions. The occidental area of the port consists of a terminal for containers management which occupies an overall surface of about 1.200.000 m². Moreover, located in the same area is the Cristoforo Colombo airport.

For the reasons mentioned above and for its geographical position, the Port is one of most important way of communication between the industrial and commercial systems of north Italy and central Europe with the south Mediterranean and north Africa countries.



Port Activities overview

1. Description of Activities (industrial, commercial, urban)
2. Pollution Sources (related substances and by-products)
3. Consequences
4. Actions taken
5. Monitoring
6. Indicators: Assessment of monitoring results
7. Lessons learnt from the case study

The following activities have been considered:

- Industrial activities: {
Ship repair Terminal
Electric power station
- Commercial activities: {
Oil Terminals
Solid bulk Terminal
- Urban activities: {
Urban waste water discharges
Waste disposal plant

Industrial activities - 1 (Ship repair Terminal)

1) Description of Activities

The terminal is based in a port area covering 425.000 m² and is designed for ship repair, ship sandblasting and painting. It is one of the most important shipyards in the Mediterranean. These yards play an important role in Genoa productivity and have 2.710 m of piers. The activity of ship repairs employs 1.800 workers and distributes orders to approximately 100 medium-small sized companies.

2) Pollution Sources (related substances and by-products)

Such an area, due the high industrial concentration, can result in a source of risk for the quality of marine waters. Large quantities of water containing polluting substances such as hydrocarbons, paint an suspended material are released. Treatment of this waste water before discharging into the sea is very important to prevent the pollution of marine environment.

3) Consequences

Despite the self-purification capacity of the Genoa port waters, some of the port areas are at high environmental vulnerability due to their morphology and to the industrial discharges.

The combination of anthropic, natural and environmental factors affects the quality of waters and marine life in particular areas of the port.

In order to prevent environmental problems to the marine ecological system, the treatment of sand and waste waters resulting from the vessel surface preparation for painting is required. Moreover, the operations carried out in the shipyards result in **acoustic problems** and **atmospheric pollution** by dust and volatile organic compounds (VOC). These substances are easily transported by the wind towards the city, causing several damages to the public health and private properties (deposit of paint on cars, houses, etc.).

4) Actions taken

The goal is to **purify** the waste water resulting from the activities of ship repair, sandblasting and painting carried out on the dry docks.

In particular, the suspension water-sand resulting from the sandblasting operation will be treated in a plant where the water will be separated from the sand by physical separation and also purified from metallic dust and hydrocarbons removed from the surface of the ships.

A store yard will be realised for handling and temporary storing the solid material resulting from the operations mentioned above.

The same area will be utilised to build the waste water depuration plant so that the treated water, discharged into the sea, will meet all the law requirements. The sand recovered, will be sent to the waste disposal plant.

The plant described above will have capacity of treatment of 30 m³/h of water-sand suspension and it is foreseen an investment cost of about 2.250.000 Euro (1997).

Industrial activities - 2 (Electric power station)

1) Description of Activities

The station is fed by coal, develops an electric power of 298 MW_e and consumes 1.210.000 m³/day of sea water for its cooling system.

2) Pollution Sources (related substances and by-products)

The main environmental problem consists in the discharge into the sea of consistent quantities of cooling water, which is warmer than the marine water. The temperature of discharged water varies between 21 (winter) to 35 (summer) °C.

3) Consequences

Few differences between the temperatures of cooling water flowing out the station and the sea water can cause several problems to the life of marine species. The national law 319/76 fixes a maximum temperature of 35 °C for the effluents discharged into the sea. The same law also fixes in 3 °C the maximum increment of sea water temperature beyond 1000 meters far from the effluent discharging point.

4) Actions taken

A collection basin will be realised in order to reduce the temperature of discharged water. Moreover, in order to reduce the quantity of handled coal, Region of Liguria, Province of Genoa, Municipality of Genoa, Port Authority of Genoa and ENEL, stipulated in the 1996 an agreement for the power station reconversion. The agreement foresees the realization of a new plant of solid waste incineration, in order to integrate the electric power production.

Commercial activities - 1 (Oil terminals)

1) Description of Activities

Due to the great amount of crude oil handled, port of Genoa covers an important role on the economy of several European countries.

Oil terminal#1 extends over 70.000 m² and can host two oil tankers and three chemical tankers simultaneously. The storage capacity of the terminal is about 17.000 m³ per year of mineral oils and 159.000 m³ of chemical substances.

Oil Terminal#2 extends over an area of 345.000 m², disposes of 211.000 m² of water surface and consists in 5 internal piers. Oil pipelines connect the terminal to Swiss and north Italy oil refineries. In the 1997, the marine traffic on the terminal has been of 533 ships, and 15.6 million of ton of mineral oils. Moreover, 365.752 ton of chemical substances have been handled.

2) Pollution Sources (related substances and by-products)

The activities that can generate a potential water pollution are:

The disposal of the **ballast water** of old ships;

The accidents involving the terminal structures or the ships.

3) Consequences

In order to allow the stability of navigation, tankers can't leave the ports empty. For this reason, after the unloading operations, they are normally filled with sea water (**ballast water**). Once in the port of destination, before to proceed to the loading operations, the ballast water **must** be unloaded (deballasting operation) into temporary storage tanks to be treated and discharged into the sea. Unfortunately, for economical reasons, several tankers throw untreated ballast waters into the sea. A similar problem arises with the **bilge washing waters**, which are often discharged into the sea without to be properly treated.

The port of Genoa is equipped with a plant for the treatment of the greasy waters mentioned above, but sometimes, an incorrect management of this plant can cause some problems of pollution to the looking over waters. Moreover, some problems of air pollution often occur, due to the venting of the tankers during the ballasting operations.

4) Actions taken

All piers have been equipped with loading/unloading arms with automatic interception valves and rapid back off devices for emergency situations. This avoid the spilling of dangerous substances on the water and a consistent safety increase during the handling operations.

In order to avoid oil spill into the sea, the manifolds of the ships and off-shore facilities are connected by special joints which, in case of rupture, are automatically intercepted.

A new plant has been designed in order to handle about 440.000 m³/year of deballasting waters. The estimated investment cost of the plant is about 1.000.000 Euro.

Gases resulting from venting operations of oil tankers, will be collected to a catalytic combustion unit. This will require an estimated investment cost of about 1.050.000 Euro.

Open berth permanence of filled oil tankers has been reduced by an ordinance of local harbour office.

All the areas for crude oil unloading are equipped with sophisticated fire fighting systems. A modern operations centre allows the management of emergency situations.

In case of environmental disaster, the terminal is equipped with all the devices for spilled oil recuperation and storage.

Constant training of operating personnel is programmed. To guarantee high safety standards, ship-owners must certify their Safety Management System (S.M.S.).

Commercial activities - 2 (Solid bulk terminal)

1) Description of Activities

Docks are reserved for handling the following materials:

Coal (landed on the platform), China clay, Sand (ceramics), Sodium chloride, Iron, Pig iron, Pearlite, Magnesite, Fertilizer (landed directly into the train).

The terminal extends over an overall surface of 147.615 m², 12.000 m² of which for storing 80.000 ton of coal reserved to the electric power station.

2) Pollution Sources (related substances and by-products)

The main potential risk of water pollution related to the terminal activities is the dispersion of coal, china clay, sodium chloride and fertilizers during the loading operations.

3) Consequences

Between the bulk materials handled on the terminal, the **coal** is the only one to be first unloaded on the terminal yard, to be then loaded on the railway trucks. These operations cause the dispersion of coal dust on the atmosphere, with consequent damages to the public health. Moreover, during the operation for cleaning the yard, several quantities of coal dust fall on the surrounding surface water, with consequent increase of water pollution.

4) Actions taken

In order to reduce the dispersion of dust in air and into the water, handling of the coal is carried out by means hermetic conveyer belts. Hoppers have been positioned at a maximum height of 60 meters and surfaces of coal bulks are insulated by the treatment with a particular spray.

The regular cleaning of the roads and trucks reduces the dust dispersion (100.000 Euro/year). 300.000 Euro have been invested to buy two special brushing-machines for the store yard clean up.

Moreover, it is also foreseen the following plan of intervention, which involves an investment cost of about 11.000.000 Euro:

- 1) purchasing of handling buckets with hermetic valves
- 2) installation of an automatic loading/unloading system with showering and film covering of bulk material on a surface of 10.000 m².

The effects of the actions mentioned above will consist in
better air quality,
commercial risk reduction,
economical benefits (reduced loss of goods),
control of the cleaning costs and
control of the contamination of goods during unloading operations (e.g.,
china clay mixed with coal cannot be used for ceramic).

Urban activities -1 (Urban waste water discharges)

1) Description of Activities

The depuration system of Genoa consists of six plants. Further, two plants are in construction. The plants operating at the moment treat an overall flow/rate of about 202.000 m³/day of waste waters. At the moment the system removes 33.000 kg/day of suspended solids and 1.800 kg/day of sediments, working at 92 % of its treatment capacity.

2) Pollution Sources (related substances and by-products)

Due to the high density of urbanization, Genoa produces relevant quantities (about 2.514.000 m³/day) of domestic waste waters particularly rich in organic matters.

3) Consequences

Due to the presence of a seawall, the effluent of the depuration plant can't be discharged off-shore by a proper pipeline and this makes the area at relevant environmental risk.

Worse situation arises in the area where, the presence of several industrial activities, beside the discharge of depuration plant, make of this basin the one at higher environmental risk.

4) Actions taken

The depuration plant will be restructured by the realization of a primary treatment unit. Waters effluent from plants should be discharged at least 1000 meters off-shore at a minimum depth of 30 meters.

The realization of two further depuration plants and a new sewer collector will improve the system efficiency. These plants will guarantee a further treatment of about 49.000 m³/day of waste water, increasing the system capacity.

Particular solution will be studied for the off-shore discharging pipeline that is situated straight in front of the Cristoforo Colombo airport.

Urban activities - 2 (Waste disposal plant)

1) Description of Activities

The waste produced in Genoa and surrounding area are sent to the disposal plant of Scarpino. Only in the 1995, the plant treated about 325.756 ton of waste.

2) Pollution Sources (related substances and by-products)

The waste disposal plant generate an eluate that can pollute the nearest rivers and the soil.

3) Consequences

Several risks for marine environment result from the possible flow of some percolate into the stream

4) Actions taken

In order to avoid possible infiltration of percolate, an insulation layer of polymeric matter is spread on the floor of the plant. Moreover, in order to reduce the punching effect of the waste load, scraped tyres are spread on top of the layer before the waste discharge.

Moreover, Region of Liguria, Province of Genoa, Municipality of Genoa and AMIU, have identified a series of actions to realize a percolate pre-treatment and its subsequent pumping to a depuration plant. Obviously, the plant capacity will be increased in order to process this overload. Moreover, the same plant will be equipped with a deodorization unit and an off-shore discharging pipeline longer than 1 km. The estimated cost of this operation amounts to about 25.000.000 of Euro.

5) Monitoring

Institutionally, ARPAL (Ligurian Regional Agency for the Environment Protection) carries out the activities of inspection and control in order to verify the compliance of the sea water quality and effluents of depuration plants with the legislation requirements.

Monitoring points of port waters have been located close to the discharges of depuration plants and other discharging points of port activities. The location of monitoring points has been also influenced by prevalent marine current (WEST to EST) and wind direction (NE to SE) of Genoa port. Measurements for sea water quality are normally carried out half meter from the sea surface and half meter from the seabed surface respectively.

A part of the determination of ammoniacal nitrogen and faecal coliforms, normally carried out in laboratory, others parameters are accurately measured on site by means multiparametric probes. Measured values (measurement of conductivity, salinity, pH, dissolved oxygen and temperature until a depth of 100 meters) are saved on a data logger and later on processed.

| PARAMETER | COST FOR SINGLE ANALYSIS (EURO) |
|--|---------------------------------|
| <i>Analysis of water</i> | |
| pH | 4.5 |
| Dissolved oxygen | 5 |
| Temperature | 1 |
| Salinity | 4.5 |
| Conductivity | 4.5 |
| COD | 15 |
| BOD₅ | 12.5 |
| Nitrite-nitrogen | 8 |
| Nitrate-nitrogen | 8 |
| Ammoniacal-nitrogen | 8 |
| Total phosphorus | 5 |
| Aromatic hydrocarbon comp. | 40 |
| Halogen hydrocarbon comp. | 40 |
| Heavy metals (Ni, Cr, Cu, etc.) | 15 (each one) |
| Total coliforms | 7.5 |
| Faecal coliforms | 7.5 |
| Faecal streptococci | 7.5 |
| <i>Analysis of sediment</i> | |
| Heavy metal (Ni, Cr, Cu, etc.) | 15 (each one) |
| IPA | 125 |
| PCB | 100 |

6) Indicators: Assessment of monitoring results

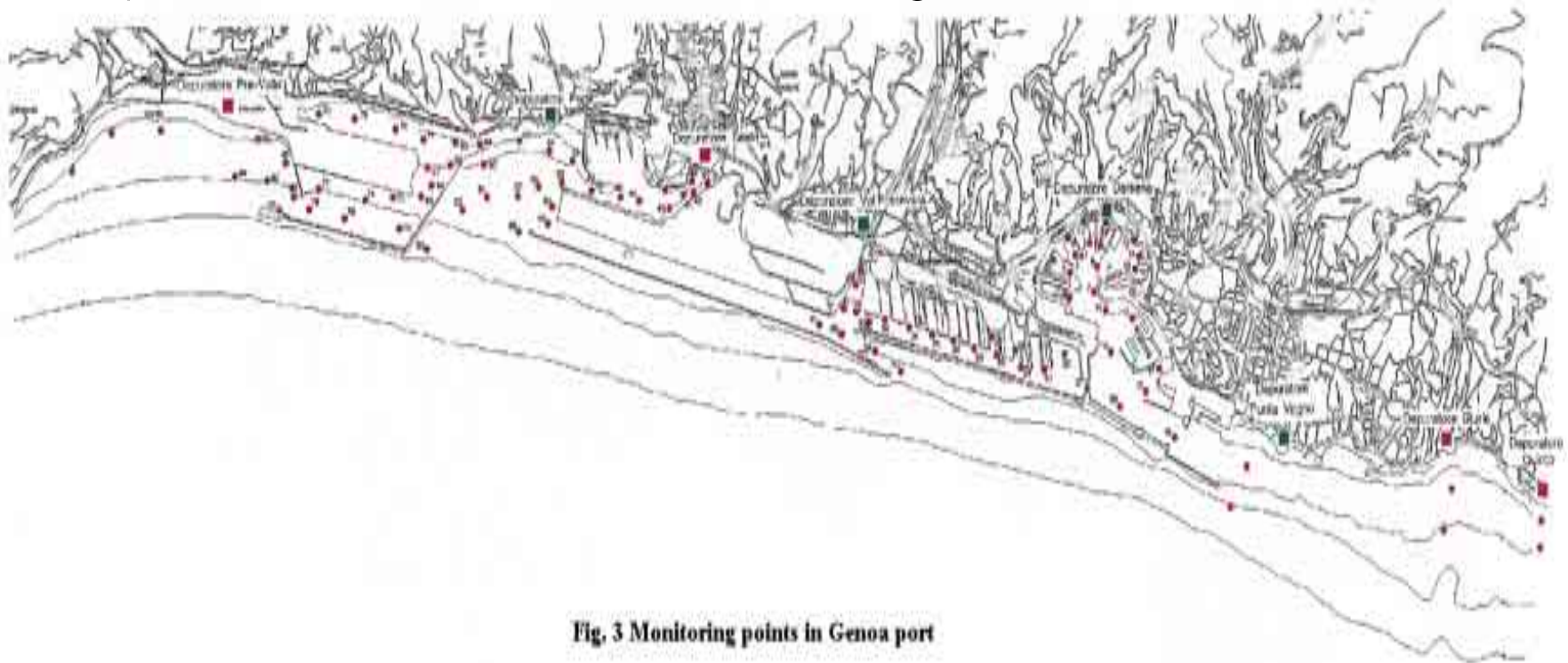
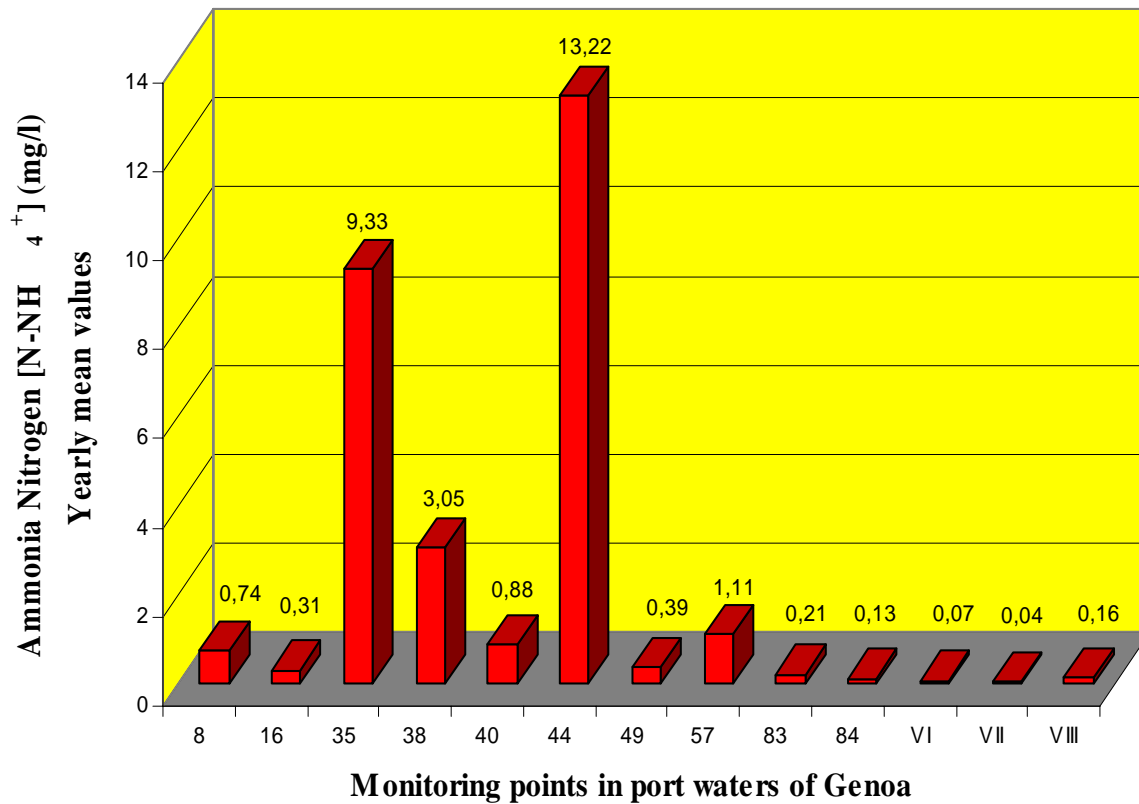


Fig. 3 Monitoring points in Genoa port

In November 1997, a monitoring map of the area was designed, identifying 85 monitoring points to give a statistical representation of the areas. The results allowed the screening of most significant parameters to keep under control. The following tables figures show the monthly and yearly mean values of monitoring survey carried out on port waters from November 1997 to November 1998.

| Monitoring points of Fig. 3 | | | | | | | | | | | | | |
|-----------------------------|------|------|-------|------|------|-------|------|------|------|------|------|------|------|
| | 8 | 16 | 35 | 38 | 40 | 44 | 49 | 57 | 83 | 84 | VI | VII | VIII |
| Nov. 97 | 0.71 | 0.15 | 10.3 | 2.5 | 1.37 | 5.7 | 0.59 | 1.23 | 0.36 | 0 | 0.24 | 0.17 | 0.49 |
| Dec. 97 | 1.47 | 0.9 | 17.3 | 4.08 | 1 | 65 | 0.32 | 0.22 | 0.1 | | 0.13 | 0 | 0.21 |
| Jan. 98 | 0.18 | 0 | 15.1 | 1.55 | 2.19 | 1.03 | 0.02 | 0.01 | 0.09 | 0 | | | |
| Feb. 98 | | 0.74 | 12.3 | 4.73 | 0.52 | 3.1 | 0.93 | 4.15 | 0.31 | 0 | 0 | 0.17 | 0.08 |
| Mar. 98 | 0.16 | 0.15 | 9.98 | 7.46 | 1.04 | 20.85 | 1.52 | 2.25 | 0.53 | 0.21 | 0.14 | 0.04 | 0.22 |
| Apr. 98 | 2.39 | 0 | 0.95 | 0.06 | 0.04 | 0.89 | 0.3 | 0.88 | 0.02 | 0 | 0.06 | 0.03 | 0.03 |
| May 98 | 0.5 | 0.92 | 0.62 | 2.72 | 0.17 | 11.2 | 0.14 | 0.96 | 0.11 | 0.1 | 0.12 | 0 | 0.03 |
| Jun. 98 | 1.87 | 0.54 | 13.55 | 5.5 | 2.28 | 32.05 | 0.4 | 1.73 | 0.9 | 1.07 | 0 | | |
| Jul. 98 | 0.31 | 0.19 | 21.6 | 5.5 | 2.3 | 11.92 | 0 | 1.82 | 0.06 | 0 | 0 | 0 | 0 |
| Aug. 98 | 0.4 | 0.02 | 2.72 | 1.23 | 0.49 | 2 | 0 | 0.17 | 0.02 | 0.01 | 0 | 0 | 0.16 |
| Sep. 98 | 0.56 | 0.08 | 5.7 | 3.81 | 0.09 | | | 0.55 | | | | | |
| Oct. 98 | 0.1 | 0.03 | 5.9 | 0.04 | 0 | 1.96 | 0 | 0.11 | 0.01 | 0 | 0.1 | 0 | 0.21 |
| Nov. 98 | 0.22 | 0.25 | 5.23 | 0.53 | 0 | 2.9 | 0.47 | 0.34 | 0 | 0 | 0 | 0 | 0.12 |

Monitoring of Ammonia Nitrogen [N-NH₄⁺ (mg/l)] in port area



| Parameter | Max. concentration (r.l. 43/95) | Max. concentration (n.l. 319/76) |
|---------------------|------------------------------------|--------------------------------------|
| BOD ₅ | 80 mg/l | 40 mg/l |
| COD | 200 mg/l | 160 mg/l |
| Ammonia nitrogen | -- ⁽¹⁾ | 15 mg/l NH ₄ ⁺ |
| Nitrous nitrogen | -- ⁽¹⁾ | 0.6 mg/l N |
| Nitric nitrogen | -- ⁽¹⁾ | 20 mg/l N |
| Total phosphorus | -- ⁽¹⁾ | 10 mg/l P |
| Total coliforms | -- ⁽¹⁾ | 20000 MPN/100 ml |
| Faecal coliforms | -- ⁽¹⁾ | 12000 MPN/100 ml |
| Faecal streptococci | -- ⁽¹⁾ | 2000 MPN/100 ml |

1) For effluents of depuration plants, the regional law doesn't requires the control of this parameter.

Other environmental aspects to be considered

Morphologic situation of the port

The port of Genoa extends over very large basins which, due to their morphologic characteristics, have a low circulation of sea water and, consequently, low exchange of oxygen.

The discharges of industrial and/or waste water in these areas cause relevant damages to the quality of marine environment.

Streams

Besides the industrial and urban waste waters from activities carried out in the port, relevant quantities of polluting substances deriving from inland industries are transported to the sea by several streams flowing into the area of Genoa port.

7) Lessons learnt from the case study

- Environmental impact of human activities carried-out in port areas must be assessed by taking account of the **global effect** produced from the single source of pollution.
- Planning of the investments
- Follow and evaluate the actions
- Have objective information to incite the ports managers to research good solutions in order to **eliminate the pollution at its sources**.
- Plan the environmental littoral development, globally and locally, improving the knowledge about the area and protect the area with quality objectives.
- Need for procedures of environmental and safety management

- Need for research improvement, starting from a careful analysis of ports and their surrounding infrastructures.
- Consistency in monitoring the parameters and indexes specified in previous sections.
- Need to keep under control the concentration of dissolved oxygen in port waters; it is recommended that this value never fall below 5 mg/l.
- A careful examination of benthic communities, at least once per year, is recommended to identify quality modifications in marine environment.
- Need for continuous monitoring of toxic heavy metals concentration on seabed.
- Need for improvement of urban depuration plant efficiency

Public information

In order to inform Genoa citizens on monitoring activities and related results, Port Authority of Genoa organizes periodical meetings and daily stages open and free to the public participation.

All costs (printing and distribution of illustrated material, teachers and experts fees, exhibit sessions, poster sessions, refreshments, etc.) are normally supported by the Port Authority of Genoa

Moreover, Port Authority of Genoa often utilize the local press for the publication of environmental data. The Authority is also equipped with an Internet site where is possible to find many information concerning the general environmental situation of the port or particular information as, for example, the quality of port waters.