

# Sewage Treatment and Disposal Strategies in Greece

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Greece lies on the NE part of the Mediterranean Sea, a closed sea with a very low rate of renovation of its waters. The length and the shape of its coasts, the geographic distribution of the population and the economic activities, as well as the relief of its terrain, have created many problems relating to the pollution of the coasts and the sea.

## Factors favoring coastal and sea pollution in Greece

We can distinguish two categories of factors which favor coast and sea pollution. The first category includes those which are independent of human interference and the second one those that depend on human activities. The first category includes physical factors, such as the very low rate of water renovation of the Mediterranean sea, the big length of the coasts in Greece ( more than 15000 km, including the islands ), the shape of the coastline ( many small gulfs ), the relief of the terrain (many narrow plains lying close to the sea ), the small length and low volume of the water of the rivers and the geographical location which obliges it to be the last country that is flowing through rivers coming from northern countries.

The second category includes factors related to human activities. The existence of these activities especially in regions close to the coasts ( urban, industrial, touristic areas etc ), as well as the fact that many gulfs are the recipients of polluted water resources ( pollution due to municipal, agricultural or industrial activities ) have created the necessity of immediately introducing environmental management in the country.

## Existing situation

The major pollution problems exist in closed gulfs, in which many activities have been gathered. Characteristic examples are: Saronicos gulf, which is the recipient of the sewage of Athens greater area, with a population of more than 4,0 mil.inh., Thermaikos gulf, which is the recipient of Salonika greater area (pop. 1,0 mil.inh.), Pagassitikos gulf, in which not only municipal sewage but also agricultural pollutants coming from a big plain are discharged, Amvrakikos gulf, a shallow and closed gulf which is the recipient of two important rivers, N. and S. Evoikos gulfs, with many municipal and industrial activities etc. The situation is different in each case and depends on the total pollution load and the specific features of each gulf. It is obvious that the degree of the pollution has immediate influence on the development of the region.

## Strategy for facing the problem

The target is to find the optimum solution, in order to the development of the regions be continued and the environment not only not be deteriorated but be improved. For these reasons, in the last few years, special studies are carried out, in which, for each region, problems are listed and solutions are proposed. These studies form the general planning and the basis for future interference.

The general layout of these studies includes the following data and procedure

- a) Description of the physical environment.  
In this unity geological, hydrogeological and climatological data, as well as data for the surface waters and the ground water, the coasts, the sea, the flora and the fauna are included.
- b) Structure of local economy, where the existing situation is described and estimation for the future is made, for the different sectors of the economy, with specific emphasis to the factors governing in the region (i.e. industry, touristic development, resort areas etc.).
- c) Existing situation of the water supply and sewerage systems.
- d) Estimation of the population, where an analysis of the trends for the population is given ( permanent and non-permanent population ), taking into account its connection with the estimations of urban designs.
- e) Description of the pollution sources and estimation of their loads, examination of the possible recipients, taking into account the existing legislation and the assimilative capacity of the recipients ( rivers, sea, underground etc.). Examination of the possibility of reusing the sewage, as well as combinations of more than one solutions.
- f) Based on the above mentioned data, a preliminary dimensioning of the collection, transport, treatment and disposal works is made. Treatment and disposal of sludge are also included. The criteria for the selection of the treatment method include the existence of seasonal and weekly variations of the flows and the loads, the estimated increase of the population, possible treatment of septage, the simplicity of the works, the availability of personnel etc.
- g) The impact of the disposal of the sewage in the sea is carefully examined. The study is based on oceanographic studies, which include the listing of different parameters of the sea environment during the seasons of the year. These parameters include physical characteristics (temperature, salinity, density, DO, Ph ), nutrients, biological elements (plankton, benthos ), geologic data, data for currents, winds, waves, tides, heavy metals etc. Based on these data an estimation of the water quality is made. The relevant study is carried out using either mathematical models or simpler methods, depending on the special characteristics of each case.

For the alternative solutions the impact of pollution to the recipient is estimated by determining the critical parameters as oxygen, phytoplankton, transparency, nutrients etc. The removal of viruses and coliforms is also examined.

## Examples

Saronikos gulf :primary treatment + submarine outfall. Future extension to biological treatment.  
Amvrakikos gulf :secondary treatment + sea outfall and tertiary treatment for inland areas discharging in rivers.  
S. Evoikos gulf :secondary treatment + sea outfall.  
Pagassitikos gulf:primary treatment + submarine outfall (future extension to biological treatment).  
Thermaikos gulf :secondary treatment.

## Costs

The construction cost of treatment and disposal works depends on the degree of the treatment, the population served, the local conditions etc.

Some typical figures are given below:

For equ. population 50.000 inh.: US \$ 25 - 40 / inh.

For equ. population 10.000 inh.: US \$ 50 - 70 / inh.

For equ. population 2.000 inh.: US \$ 75 -125 / inh.

## Conclusions

These studies without giving any details on the collection, treatment and disposal of liquid wastes, are considered to be a good tool for a further general policy, because they provide cost data, they list the existing situation of the recipients and they give future estimation for many alternative schemes of treatment and disposal.

In this way they constitute a very good tool to the decision makers, in order to program the construction of the works and to propose measures, after comparative evaluation in different regions of the country.