

Appropriate Filling Techniques of Coasts For Protecting Marine Ecosystems: A Study Case: West Coasts Of Turkey

Hüseyin O\ FGP "

K. Turgut GÜRSEL

Mechanical Engineering Department, Faculty of Engineering, Ege University, 35100 Bornova – Izmir / TÜRKİYE

Corresponding Author*e-mail:** turgut.gursel@ege.edu.tr**Received:** June 27, 2009**Accepted:** August 03, 2009

ABSTRACT

One of the basic seawater pollution sources is filling coastal lines with soil and other solid wastes in order to gain additional land from sea. Coastal municipalities are not environmentally conscious about such filling operations giving harm to sea. These operations also harm sea flora and fauna. Destruction of the sea flora and fauna damage biological self cleaning and renewal processes in the sea environment. This also harms the marine ecosystems in the coastal zones.

In this study, attention to marine pollution, especially pollution of seawater within Turkey's certain gulfs was drawn. Further, certain aspects to be considered in filling operations as well as some appropriate filling techniques for marine ecosystems were briefly described.

Key Words: Ecosystem, coast line filling, filling technique, marine pollution.

INTRODUCTION

Water pollution concentrations of Turkish western coasts are relatively high. A map of western coast lines of Turkey is given in Figure 1. Figure 2 is an example to show a filling operation in the region of Gulluk in Bodrum. Figure 3 and 4 exhibit the degree of pollution in the Gulf of Izmir and Ayvalik. Despite the serious level of pollution, no precaution has been taken to reduce this pollution; furthermore filling of coast lines with excavations and other wastes increases the seriousness of the problem. Pollution control systems and regulations usually are insufficient to improve the situation. No sufficient control operations have been executed in drainage systems (Fig. 4). Roads have been widened by filling the coasts arbitrarily, and constructions such as shelters, concrete bays, breakwater and fishponds have been built without necessary environmental impact evaluations. For example, it is impossible to swim in the Gulf of Izmir. So, neither fishing nor sea natural beauties of the coast line are attractive any more (Fig. 3). Healthy flora are replaced by disgustingly septic and mucus flora. Golden sands on the bottom of Izmir bay are covered by wastes. Many fish species have become extinct.

One of the reasons for the big extent of pollution is the filling of coastal line as can be seen in Fig. 2 showing the filling operation of the Gulf of Gulluk. Sea filling not only damages the nature of coast line, but also harms self-renewing and -cleaning of the sea by its own flora and fauna, and destroys the marine ecosystems in the coastal zones.

As a precaution, coastal municipal governments should stop filling seas to gain land and prevent the expansion of buildings towards the coasts. They should spend more sources on waste treatment plants and other related environmental issues. Although Izmir Municipality made unreasonable investments for so many years in order to clean the Gulf of Izmir, seawater has been polluted due to unclean waters streaming into the sea (Fig. 3, 4). Another example is Ayvalik Municipality; it has been gaining space by filling the sea and throwing wastes and excavations into the sea for so many years. Although many precautions have been taken against the terrible smell prevailing from the sea, wastes from summer vacation houses up to olive fields and pine groves continue to be discharged into it.

Unclean waters are discharged through channels to a place that is 100 meters away from a mussel farm and fisheries (Fig. 4). In this study, reasons of maritime pollution and precautions against it as well as appropriate filling techniques for Turkey's west coasts were investigated.

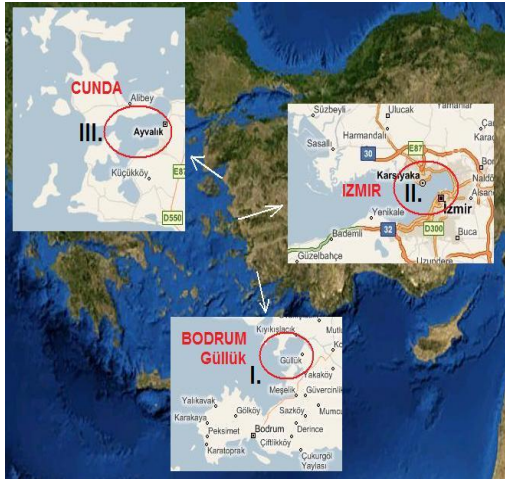


Figure 1. Turkey's west coasts including the Gulf of Gulluk in Bodrum (I), Izmir (II) and Ayvalik (III)

SEAWATER POLLUTION SOURCES

Main causes of sea pollution and destruction of flora and fauna can be summarized as follows [1-4]:

- Throwing all kinds of wastes and excavations into sea directly or indirectly,
- Inappropriate filling of coast lines,
- Discharging sewage from sewage hole and drainage into the sea without treating them (Fig. 4),
- Discharging and/or diffusing toxic, coloring industrial wastes into the sea (Fig. 4),
- Polluting channels with disinfectants, and then sending these into the sea,
- Creation of harmful bacteria population in puddles and dry river beds and spreading them into the sea with rains and running waters, which can infect many living organisms in the sea.
- Discharging house wastes such as acidic, phosphorous cleaning materials, detergent waters and oil wastes, saved in sewage hole into the sea directly or indirectly,
- Damaging the nature of coasts by constructions,
- Preventing natural circulation of seawater and its flow direction by constructions such as fillings, shelter, water-break, marina, fishponds.
- Using the method of net fishing for so many years which scans the bottom of sea,

- Overfishing in coastal regions,
- Overcollecting mussels, mosses, star fish, snails from bottom of seas for many years,
- Collecting stones, sand and pebbles from bottom of seas and bays for building,
- Increase in the number of sea vehicles such as boat, water craft, rowing-boat and yacht. Discharging oily ballast waters from boats and merchant ships into sea [1-3].
- Painting boats and ships with toxic dyes,
- Spreading out toxic micro organisms such as poisonous algae in sea by sea vehicles and streams.

DAMAGES OF COAST LINE FILLING TO SEA

Because of improper coast filling by throwing all kinds of wastes and excavations, and delaying building of coastal facilities or stopping them, the following damages are given to sea [4]:

- Excavations and wastes spread out on the bottom of sea due to many factors such as wind, stream and wave; some of them come back to coasts.
- Water is polluted as a result of spreading out wastes and excavations dissolving/melting in sea. In course of time, they precipitate onto the bottom of the sea and causes deaths of micro organisms, plants and fish larvae. This destroys food resources for many species of fish by covering plants such as algae.
- The buildings as well as unplanned filling constructions on coast lines prevent and/or change direction of natural circulation of seawater. As a result, wastes can not be carried away to open seas via currents; instead they precipitate onto the bottom of the sea. These regions turn into septic areas in course of time and the sea loses its self cleaning mechanism. All these effects endanger or destroy many flora and fauna and their environments, which function as natural refinery plants. Besides food chain are broken for many additional species. The most serious example of this situation can be observed in Izmir bay and Golden Horn (Part of Bosphorus region).
- In general, permissions are not given to constructions closer than 100 meters to coast lines. Coasts should be open to public access and protected against any kind of damages.



Figure 2. Filling operation in the Gulf of Gulluk near Bodrum (I. 1.3) (<http://milliyet.com.tr> , 2008)



Figure 3. Marine pollution in different locations of the Gulf of Izmir

PROTECTION METHODS OF SEAWATER ENVIRONMENT

Basic methods preventing seawater environment can briefly be listed as follows:

- Before toxic, septic industrial wastes reach the sea, they should pass through waste treatment plants. This should be enforced by laws. Companies with major pollution sources should have their own treatment plants or should make agreements with municipal treatment facilities to ensure treatment of their specific wastes [1-4]
- All residential places should be connected to municipal domestic waste treatment facilities through waste drainage systems. Waste water can not be discharged to any water reservoirs unless pollution level is reduced to the minimum levels enforced by laws or regulations.
- Any kind of pollution intake into the rivers and seas should be controlled and prevented. In Turkey, dry running water beds turn into garbage dump areas in summer months.
- Fishing should be forbidden for a certain period in shallow waters and ports.
- Overfishing must be controlled within ten miles distance from coasts. In this range, fishing methods such as fishing with fixed vertical nets and mobile nets scanning sea bottom should be forbidden. Further, concrete blocks should be laid on the bottom of sea to create a safe environment for fish population.
- Over-utilization of sea resources such as mussels, fish etc. should be controlled.
- Nature of coasts must be protected. No permission must be given for buildings such as summer vacation houses, hotels etc. within a distance of 100 meters from coastal lines.
- No permission should be given for constructions such as filling, shelter, water-break, marina, fishponds preventing natural circulation of sea. Beaches should not be opened to traffic.
- If filling is compulsory, it should be constructed to give minimum damage to environment. An environmental impact study should be carried out before a permission given to a construction of this kind.
- No permission should be given for collecting stones, pebbles and sand from coastal areas and sea shell.
- Instead of concrete walls perpendicular to seawater, rocks in different sizes without soil should be discharged up to the sea level (Fig. 5).

- Channels reinforcing circulation of seawater should be opened. For example; in the Gulf of Izmir, if channels 2-4 meters depth, with diameters of 2-3 meters to be opened, it will make a major contribution to carry polluted waters into the open sea. They will also contribute clean waters to reach into the Gulf. In a similar way, in order to keep Ayvalik port clean, channels joining Pasa port and the Sarimsak Sea should be opened under the narrow road connecting Cunda Island to Ayvalik (Fig. 1, 4, 6). These projects will contribute to touristic potential as well.
- Settling pools with medium capacity should be built near by coasts and at brooks opening to seas as given in Figure 7.
- Utilization of plastics should be limited and be replaced with more environmentally friendly materials. A policy of charging for plastic bags in supermarkets could make a major difference in the total amount discharged to the sea environment. Furthermore amount charged for them can be spent to clean bays and seas around the area.
- Public should be informed by written and visual media. One should be conscious of the importance of a clean environment. For example; one should wash up less frequently and use less cleaning materials. Heavy wastes, rubbish, excavation and different oils must not be discharged to drainage system.
- Environmental protection laws should be enforced thoroughly. Fines and prison punishments should be enforced rigidly if necessary.



Figure 4. A polluted channel in Ayvalik

FILLING TECHNIQUES OF COASTS

Main Concerns

Main points to be taken into accounts while filling the coast line should be:

- i. Operating without giving any damage to nature of coasts,
- ii. Projecting coasts in a way without giving any damage to the mechanisms of sea for self renewing,
- iii. Paying attention not to harm or to pollute seawater and sea bottom by filling materials.

Types of Filling

Figures 5-13 shows types of fillings that are selected according to depth and nature of coasts and width of the side to be filled. Let us look at different excavation methods

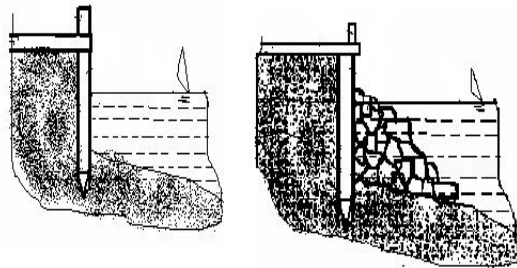


Figure 5. Two different cordon types; unsupported (left) and supported with rocks (right)



Figure 6. Concrete pipe channels for providing natural circulation of seawater

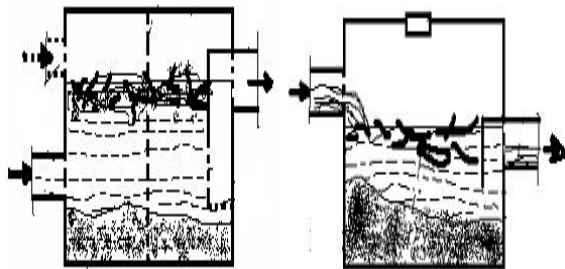


Figure 7. Two different ponds for retention and settling

Excavation without soil

In the wide coasts that are not very deep, the procedure of filling is started with throwing big rock parts without soil into sea. When it reaches over sea level, gap spaces are filled with small stones and pebbles. Then excavation with soil and/or concrete is discharged as seen in Figure 8.

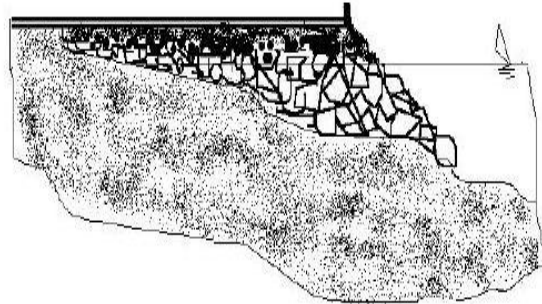


Figure 8. Coastline filling in deep seas by excavation containing rocks and debris

Mixed excavation

In this filling process, firstly, filling area is surrounded by a barrier in order to prevent spreading of mud into the sea. There are different facilities for setting a barrier. Generally sea is filled like in construction of a break-water as described in previous method. Then, procedure goes on with discharging mixed excavation into sea and/or remaining part (Fig. 9). This method is convenient for the fillings in shallow waters with wide area.

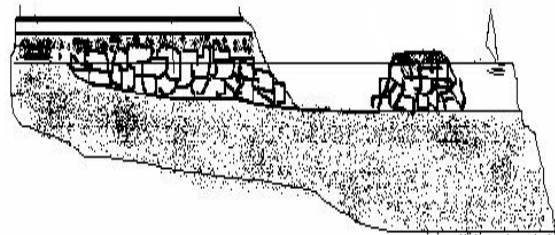


Figure 9. Coastline filling in shallow water by mixed excavation containing soil

Concrete quay

This method can be applied to rather narrow and limited areas, for example, on coast lines of deep seas in order to gain space for vehicle or pedestrian traffic or to open car park (deep, narrow and long filling). These buildings are constructed by covering concrete and asphalt over horizontal steel-concrete beams fixed on steel-concrete stakes (Fig. 10).

Submergible fillings

This method is considered as an alternative for sea buildings such as quay, water-break and fishpond. Fillings consist of types of unconventional ships with two or more buoyancy bodies as given in Figure 10.

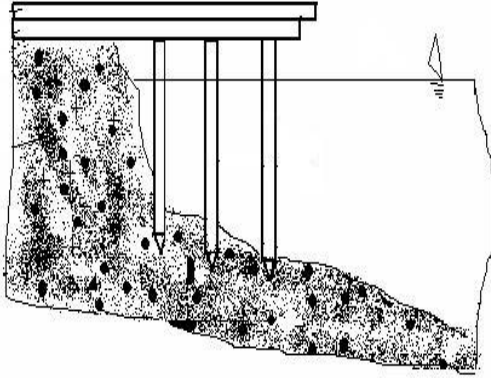


Figure 10 . Coastline filling in deep seas with horizontal steel-concrete beams fixed on reinforced concrete stakes

Concrete pipe channels

Concrete pipe channels for providing circulation of seawater under filling constructions such as shelters, water-breaks and fishponds will enable cleaning and recreating waters and seas, e.g., setting concrete pipe channels onto the sea bottom realizes the circulation of waters (Fig. 6).

CERTAIN ASPECTS IN FILLING PROCESSES

Important aspects and advices in filling processes to be considered can be listed as follows:

The filling materials up to sea level should be composed of big rock parts without soils (Fig. 8, 9).

Stones without soils and pebbles should be placed into gaps between big rock parts over sea level, and then excavation with soils should be discharged on this layer (Fig. 8, 9).

No permission should be given for discharging excavation with soil, rubbish and similar wastes into waters as filling materials.

Filling operation should be completed in a very short time.

Filling operation should be arranged in a way not to block water current (Fig. 6, 7, 11, 12).

In building quay and roads at deep coast lines, filling should be performed with reinforced concrete on stakes fixed at the bottom of sea as seen in Fig. 10 and 12.

Coast lines and wharfs should not be limited by walls perpendicular to sea; walls of wharf generally should be built in dry inner parts of filling (Fig. 13).

Big rock parts should be placed in front of coast line walls perpendicular to sea bottom (Fig. 5). By means of this method, sheltering many micro organisms, mosses and other life forms on and between rocks is possible. Additionally it considerably reduces the energy of waves hitting coasts, and thus the service life of coast line walls extends.

Prepared projects for filling operations must be certified by related authorities, and coastal municipal governments must execute them without exceptions.

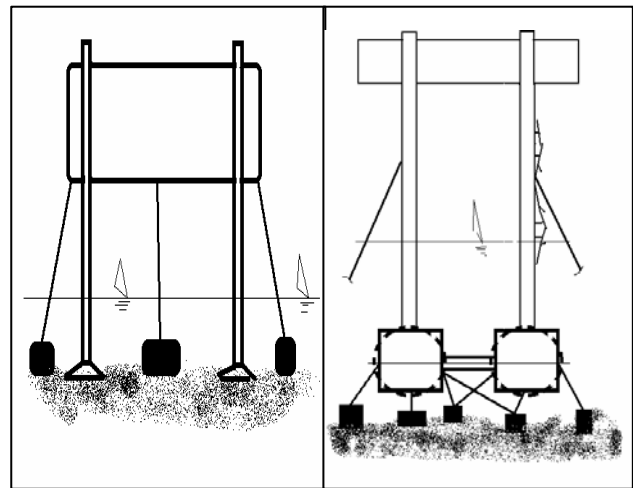


Figure 11 . Types of submergible fillings; legged shelter (left), floating shelter (right)

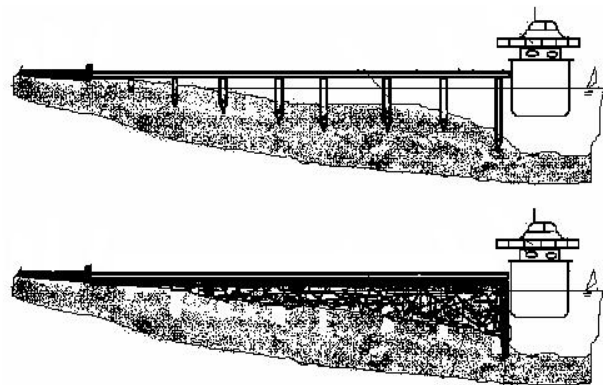


Figure 12 . Two quay types; appropriate construction (above) and inappropriate one (below)

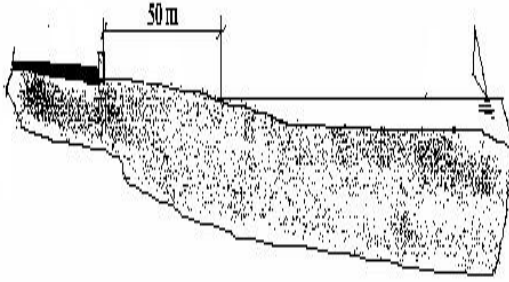


Figure 13. An appropriate construction of cordon and share which is suitable for natural structure of sandy coasts

RESULTS AND CONCLUSION

From this study, following conclusions may be drawn:

The coasts of Turkey are continuously being polluted. In some of its ports, the extent of pollution has reached a critical level. It is impossible to swim in certain coast lines, and neither fishing nor sea vies are attractive any more.

The main reasons and factors of marine pollution listed in this study should be eliminated in order to clean seas. Otherwise high-cost projects carried out can not meet the expectations. The Gulf of Izmir is tried to be cleaned while the sea is polluted by unclean sewage as well as buildings and especially fillings destroying natural balances of the sea at the same time.

One of the reasons for pollution of seawater is the filling of coast lines with rubbish and excavations. Coastal municipal governments are not environmentally conscious in such filling operations giving harm to the life forms in the seas which function as living renewal mechanism. So these operations also destroy the marine ecosystems of the coastal zones considerably. Hence related authorities should control these projects closely and enforce requirements of environmental laws as necessary.

Coastal municipal governments especially in touristy resorts should concern systems of the waste water drainage and treatment systems. If seas are polluted completely, these resorts will lose its touristy attraction, and then incomes and jobs will be lost. What make these resorts attractive are clean beaches, natural scenery and sea foods, and these should be protected.

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