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1. Fachtagung "Perspektiven von Deponien – Stilllegung und Nachnutzung nach 2005" am 26.-27. September 2005
2. Mischen oder Trennen ? –Grenzen der Technik und Nachweisführung nach ElektroG und VerpackV" am 28.September 2005
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# **Potential Hazards and Reclemation of Uncontrolled Landfills (Altlasten) in Kemalpaşa - Izmir**

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## **Summary**

Kemalpaşa is located 29 km from IZMIR city it has 660 km<sup>2</sup> areas including 35 km river basin on the east-west IZMIR to ANKARA road. Kemalpaşa county has been passing from agricultural ecosystem to industrial ecosystem for long period of time. Today, this situation is still continuing. Industry was constructed on valuable fields and water sources without doing Environmental impact Assessment studies. Therefore, too many things were destroyed, Nowadays Nif Brooks is used as waste water discharge and solid waste receiving media while it was a place to where people were going for picnic and hunting fish for 15 years ago.

Above 170 factories, 200 poultries and 150 cattle farms were constructed with the development of industry since 1970. The population was increased rapidly parallel to industrialization. This event was also happened in one of the most agricultural areas in Kemalpaşa county. It

became nonagricultural area due to rapid industrialization. The water, air and soil pollution caused by industry goes out of Kemalpaşa county lines mixed to Gediz River by Nif Brook and then carried to Aegean sea and polluted it. Polluted soil caused by environmental pollution leads to decrease in the yield and consequently economic loss of farmers.

One of the most important issue in county is absence of perfect completed solid waste projects. The generated wastes, from industries treatment plant sludge and from factories plants toxic - hazardous wastes and domestic wastes disposed arbitrary to land, forest areas and in to Nif Brooks. Solid wastes was collected and disposed without controlling in 67 landfills on 17 ha area.

By investigation the potential of the unorganized landfill sites in Kemalpaşa, not only the present situation is important, the accumulated solid waste amount from the passed years should also be taken in to consideration. So there must related the present landfill position with passed years solid waste amount and also with present situation solid waste generation potential. In this paper, it was aimed to show environmental pollution problem of Kemalpaşa because of arbitrary dispose of solid wastes and to recount starts for sanitation of landfill areas.

**Keywords : contaminated land , soil and water pollution, changing ecosystems, reclamation, remediation ,**

## **Introduction**

Kemalpaşa county has been passing from agriculture economy to industry economic for long period of time. Today, this situation is still continuing. Industry established arbitrary on productive agricultural areas because of advantageous of getting cheap water, electricity and area around Bornova and Kemalpaşa/İZMİR. Industry was constructed on valuable fields and water sources without doing Environmental impact Assessment studies. Therefore, too many things were destructed, Nowadays Nif Brooks is used as waste water discharge and solid waste receiving media while it was a place to where people were going for picnic and hunting fish for 25 years ago.

Above 170 factory, 200 poultry and 150 cattle farm was constructed with the development of industry since 1970. The population was increased rapidly parallel to industrialization. It became nonagricultural area due to rapid industrialization. The water, air and soil pollution caused by industry goes out of Kemalpaşa county lines mixed to Gediz River by Nif Brook and then carried to Aegean sea and polluted it.

Polluted soil caused by environmental pollution leads to decrease in the yield and consequently economic loss of farmers. High agricultural yield of county depends on limited water sources. The industry without infrastructure aspire to already limited water while it is one which both consumed and pollute water.

Kemalpaşa Organized Industrial Region “KOSBİ”, which was planned in 1991 and became functional in 1994, was constructed to prevent unorganized industrial development and to plan and to control industrialization. Today, it has 410 ha area of which 69 % is already used. Fortunately, it is thought as to increase its capacity from 410 ha to 1000 ha with 144 % rising in total area due to high industrialization demand. The border of “KOSBİ” starts from Belkahve and reached to Tetra Pak Nasaş Industry line. Yet the area in increasing area capacity is not along but it was planned to enlarge it around Ankara road (TRAV, 1994). It will be a big problem to supply water to new construction in KOSBİ due to already polluted and unenough water resources. It is compulsory to find new resources beside to reusing and saving water.

One of the most important problems in county is absence of solid waste projects. The product wastes, from industries treatment sludge from plants toxic-hazardous wastes and domestic wastes disposed arbitrary to land, forest areas and in to Nif Brooks. Solid wastes was collected without controlling in 67 unorganized dumping places on 19 ha area due to absence of planned solid waste landfill.

The measurement interval depends on the usage of the groundwater and the pollutants concentration. So the interval can be rendered or rarefied. Determining the organic and inorganic compound group shows us from which industry the pollutant comes from. Therefore this analyze is very important.

## **The Investigation of The Solid Waste Potential**

By investigation the potential of the un organized land fill sites in Kemalpaşa, not only the present situation is important, the accumulated solid waste amount from the passed years should also be taken in to consideration. So there must related the present landfill position with passed years solid waste amount and also with present situation solid waste generation potential.

The daily production of solid waste is examined in two parts;

- 1- Solid waste from settled population
- 2- Solid waste from industries

The total amount of 86,726 kg/day solid waste consists of 3 part; 80,41kg l/day domestic waste, 4,430 kg/day commercial wastes and 1,885 kg/day is slaughterhouse waste. Commercial wastes consist of wastes collected from the shops, bazaar, street and officiate buildings.

143,351 kg/day industrial wastes consist of 3 fractions; 9,704 kg/day from employers, 61,715 kg/day total product waste and 71,932 kg/day total sludge from treatment facilities. The product waste and sludge are consist individual to removed amount and to be disposed amount part.

The 27,000 product waste and 15,696 kg/day sludge amount of wastes are removed and benefit to economy and other amount of wastes are pored to disposel area.

The 34,715 kg/day amount of product wastes are disposed but it's also consist of 2 parts: 2,351 kg/day amount of degradable and 32,364 kg/day amount is non degradable. 56,236 kg/day amount of disposed sludge is also consist 2 part: the amount of 10,395 kg/day is degradable and 45,841 kg/day is non degradable sludge.

The amount of 22,450 kg/day waste has domestic characteristic and it is coming from employers, product and from sludge degradable wastes.

When the 22,450 domestic characteristic waste accumulate with amount of 86,726 population solid waste for obtaining the total 109,176 kg/day domestic solids waste.

When the total 109,176 and 78,205 kg/day amount of total non degradable solid wastes accumulate there are obtaining the amount of 187,381 kg/day total solid waste formation for dispose in Kemalpaşa county.

9 industrial sectors solid waste distribution in Kemalpaşa county. For the 1,249,196 t/year product, there are preparing the amount of 67,625 kg/year total waste. But the 16,980 kg/year part is recover and the other is pour to disposal area.

## **The Distribution of The Industrial Solid Wastes**

This title is investigated under the subtitles of the solid wastes generated from the working stuff, and the solid wastes generated from the activities of the industries.

### **The Solid Wastes Generated From The Working Stuff**

The industries have generated solid wastes since 1974 significantly, and the solid wastes of working stuff is calculated from that date. The generated domestic solid waste of the working stuff is 33,526 m<sup>3</sup> until today, and the rest waste from the biodegradation is 24,868 m<sup>3</sup>.

The calculations are made according to the answers of the questionnaires. The personal domestic solid waste production of the working stuff is found as 0.31 l/capita.day.

### **Manufacturing and Treatment Sludge Wastes**

The sectoral solid waste distribution of the food, metal, mine, chemistry, textile, rubber and plastic, cellulose and paper, and tannery industries are given. 91,348 m<sup>3</sup> of the 253,178 m<sup>3</sup> solid waste from the manufacturing is recovered, rest of it is tipped at landfills. The 27,865 m<sup>3</sup> of the 128,987 m<sup>3</sup> treatment sludge is recovered, rest of it is discharged to the landfills. That shows the 119,213 m<sup>3</sup> of the 382,165 m<sup>3</sup> total solid was recovered, and rest part of 262,952 m<sup>3</sup> is tipped at landfills. If the data above is summarised; the 30% of the biologic wastes decreased by biodegradation and the 20 % of the inert wastes decreased by settlement when the total amount of the solid waste generated at recent years is

955,829 m<sup>3</sup>. Because of that, 198,143 m<sup>3</sup> solid waste volume is observed instead of 692,722 m<sup>3</sup> solid waste indicated, of part by the investigation of uncontrolled landfills. So, 494,579 m<sup>3</sup> solid waste polluted the environment by transportation by surface water and by incineration.

## **Using as Filling Material**

The widely used filling areas in brook became a dump due to uncontrolled usage of these areas. However these areas can be filled by non toxic, biologically non degradable and suitable to fill can be discharged to these areas. To get a good fulfilled area, necessary provisions must be taken before filling. The material must be weighted before leaving, suitable to filling and must be left to area in an organised plan. In addition, the entrance and exit of area must be continuously controlled. The number 12 area was now a good fulfilled area with a control mechanism. These areas are filled only by marble and floor plate industry treatment plant sludge wastes. It is a monolandfill filled by controlling. The other 65 deponies are now solid waste discharge area. There is 35,000 m<sup>3</sup> filling material and if it is removed from their places and transferred to another places that must be filled, the empty areas will be filled and also unorganised landfill will be recreated.

## **The Construction of New Building on Original Location**

Generally all station, restaurant, factory and resting places are constructed on left and right side of İzmir-Ankara road of Kemalpaşa. Therefore filling is necessary for low level areas compared to road. The filling of two landfills have already been completed. Only one landfill will not create important problems since it filled with suitable method and filling material. However number K11 landfill is filled by hazardous wastes, treatment sludge at marble, floor plate, ceramic, tannery industry and the rubber and excavations. This area will be used for construction of new buildings. It will be covered by concrete and drainage will be placed sides of area to collect rainfall on the top the area. This, the leaches of storm water to landfill will prevent by constructing like to hat technique covering. However it is only one layer point of the event.

The floor layer between landfill and ground water beside to ground water were polluted by leaches. Therefore, although landfill is covered, the floor layer can be polluted due to leaches and decomposition of organic matter in the landfill. In future the level of ground water can increase due to only reason. The floor layer will be saturated with water in this case and some of the pollutant in the base of landfill will dissolve and enter to ground water. As a result it ill cause groundwater pollution. Therefore, although the hat method seems to be partially successful, it has several risks due to future possible problems. It can be completely successful if it is applied to all cover the deponi. Otherwise uncovered wastes will continue to pollute environment. If the other landfills solid waste could be complite and covering with soil, these landfills pollution effect will be prevent.

## **The Effect of Uncontrolled Landfills to the Environmental Areas**

The landfills, which are indicated at Kemalpaşa, are occurred at uncontrolled conditions, so they have effected the soil, water, air and natural life negatively. The leakage and biogas which occur in the landfills by biodegradation of organic materials are combined with rain and polluted the environment for long years. The people meet with this pollution as mentioned below.

### **Effect on Surface Waters**

During the 30 years, the disposal of the solid waste of the town hasn't done under control and properly, and that caused the evaluation of 67 uncontrolled landfills which cover 169,820 m<sup>2</sup> area. The landfills spread out on a wide area and 198,143 m<sup>3</sup> solid waste included by these landfills are free to free with the precipitation and air movement. So, landfills are polluted the surface water and groundwater near their surroundings (Nif Brook and its branches). The pollution is carried by Nif Brook, which like a savage, to the agricultural areas by irrigation. It passes the boundary of the town by Gediz River and arrives the Aegean Sea.

The biodegradation of solid wastes is required for the stabilization of landfill sites. However because of the contact of rainwater, surface

water, and ground water with unstabilized solid wastes, the products of the biodegradation transfer, to the water and pollute the environment. While these waters transport in the nature, they pollute all water sources at their surroundings.

## **Leakage at all Landfill Areas**

The 80% of the precipitation rains in November, December, January, February and March in the town where the approximate precipitation of last 30 years is 659.1 mm/year. At Kemalpaşa, 81.9 days/year precipitates and the lowest precipitation is in August as 19.8 mm. The yearly precipitation is greater than 40 mm. So the leakage problem has a very hazardous perspective. For the calculation of the quantity of the leakage produced from 169,820 m<sup>2</sup> landfill area is utilized from the result of a research done in Germany. At the research, leakage quantity measurement according to the precipitation high is followed in 13 landfill site in Germany. The variation of the quantity of leakage depends the looseness of the landfill. According to the result 20-25 % of the precipitation transforms to the leakage at the landfills which have close solid wastes, and 30-50% of the precipitation transforms to the leakage at the landfills solid waste which have high looseness (ERDİN, 1994).

The minimum leakage of 22,386-27,987 m<sup>3</sup>/year occur during the 81.9 days/year rainy period of Kemalpaşa town. That leakage produced from the landfill sites spread out the surroundings of the town, pollute the surface and ground waters, and soil with its hazardous substances. This pollution have continued for 30 years. For example, the area which the solid wastes and treatment sludge of marble and floor plate firms are tipped, is set up on the land near Nif Brook.

The Nif Brook is the 4th class very pollutant water according to the water pollution Control Regulations Standards. And also the result of the SSM, COD, Cr, Pb, Cd and Zn parameters analysis are much higher than the limiting values (ERAY, 1993). The high Fe, Cr, Pb, and Cd, concentrations indicate that Nif Brook is face to face with a very high industrial pollution. Especially, industrial waste water discharge as the dominant parameter and leakage are mixing and polluted the surface



waters.

## **Groundwater Pollution**

The pollution of the rain water suddenly increases at the time the droplet touches the soil. Organic and inorganic particles, animal and plant wastes, natural and artificial fertilizers solid waste, pesticides and microorganisms are carried along with water to the groundwater. During filtration the quality of water improves depending on the soil type. Nearly all of the suspended solids are removed by filtration organic material degraded and mineral compounds are taken by the plant roots. The dissolved oxygen concentration of the water decreases while the CO<sub>2</sub> concentration increases (TÜRKMAN, 1985). Groundwater are much more sensitive to the pollution then the surface waters. Because any pollution occurred at a point of an aquifer goes very slowly through the point that the water is taken out. By that way, the pollution arriving to the aquifer stays for a long time and it is very difficult to remove. Because of the Kemalpaşa is an industrial and an agricultural town, the environment is polluted by industrial waste waters, solid waste, air emissions, agricultural pesticides, and savage wastes come from the residential area.

The produced wastewater directly effects the surface and groundwater. However, the CN<sup>-</sup> concentration is seen at the groundwater of Kemalpaşa plate, which is unexampled of the industrial pollution. Kemalpaşa groundwater samples were tested including cyanide. The groundwater level of the area rapidly decreased because of the drilling of many water wells and excess pumping of irrigation and industrial usage water, of recent years. This situation is accelerated the mixing of polluted waters to ground water and made the old wells out of order. The most of the results are available according to the Turkish Drinking Water Standards, but some of them are not available (COŞAR, 1994).

Consequently, there isn't saying only unorganised landfills are pollute ground water but there is possible to saying the unorganised landfills pollute the surface and ground water by leaches directly or indirectly.

## **Effecting the Aesthetical View**

Landfills generate an ugly view by the piles at the site and they can damage the beautiful natural views. The treatment of the polluted soil is technically probable, but it is expensive, and can not be appreciated. It is easier to protect the soil from pollution than the treatment of soil.

## **Effects to the Air Quality**

The gases emission can not be prevented at the controlled solid waste disposal systems. However, it can be minimised. But at uncontrolled landfills there is not opportunity to control and minimise the biogas emissions. The gas emissions of the landfills are generated from 3 sources. These are; the biodegradation of solid wastes, incineration of wastes and dust of the landfills.

The gas emissions from biodegradation, dust emissions, and also the incineration emissions are observed at the landfill of Kemalpaşa uncontrolled landfills. According to the result of the questionnaires study, the incineration is presently applied to the landfill to go in volume. It is known that the observed fumes and disgusting smells at Kemalpaşa town are generated from the incineration of landfills. The people are complain about the air pollution occurred from the smells of Nif brook and landfill emissions.

## **Effects to the Alive Life**

The human, animals, and plants named as living, are effected from the environmental pollution mentioned above. The solid wastes of Kemalpaşa have been a very available medium for growing the microorganism and pathogens. The main sources of the insects, which can not be prevented by any kind of chemical fighting, are the landfill sites.

The pollution of air, water, and soil sources causes the damage and illness of living. The accumulation of Pb, Cd, Cr, Cu, CN-, Zn, and

excess amounts of N, P, K, Ca, Mg and other pollutants in the soil by the solid waste damage the soil matrix. The air emissions given the SO<sub>4</sub><sup>=</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NH<sub>3</sub>, organic matter, Pb, As, Cd, Cu, Fe, Mn, and other pollutants discharges to the ground and surface waters and destroyed the natural resources.

While the plants absorb the pollutants taken from the soil and irrigation mater, the human and animals which are fed with that plants are effected from the pollution by food chain. Some of the agricultural areas are being yieldles and the plants and trees and than dry. An example which represents this effect is observed in a cherry orchard near the Kemalpaşa Municipality landfill site. The cherry trees dried, because of the irrigation water taken from the dawnflow of an uncontrolled landfill. However, the cherry orchards irrigated by the upflow water of landfill are not effected. So, it can be said that the Kemalpaşa landfill caused the drying of the cherry trees.

There are important uncertainties of the long term effects of the pollutants in the waste. So, the pollutants, which the human can meet at any time of the life, have effects to the sensitive bodies and chills health. Some metals are necessary at low concentrations, but dangerous at high concentrating for health. The effects of than have complexity when more than one pollutant are being together. Because, each of the organic or inorganic pollutants have different side effects. Being the NO<sub>3</sub>-N concentration in drinking water is above 10 mg/l causes methemoglobinemia, which is a lethal blood illness. at the babies smaller than 3 months. That concentration may cause health problems at long term at adults and chills. For example, Pb and Hg effect to the central neural system, Ni and Be effect to the lungs, Cd effects to kidneys, and Antimuan effects hard. Cr, Ni, Zn, and as cause poisonings, lungs illness, and cancerogenic effects.

Fecal pollution is reported at the bacteriological analysis of the ground water samples of Kemalpaşa because of the environmental pollution. And also, it is possible to observe lungs infections at the people living near the landfills, and to meet all kind of illness at the people, who collect metal, plastic, and paper, in the landfill sites (COŞAR, 1994) So, all the landfill sites in Kemalpaşa town are threaded the natural life by

pollution the air, water, and soil body.

## **Capsuling in its place**

Capsuling is used to minimise the emissions from landfill. It is generally last choice in the removal of hazardous solid wastes after all construction methods are considered. Capsuling is made by covering four side of the area to prevent leak out. The method for coverage can be made by metal or concrete. A un-leak out material is injected to the bottom of the landfill by a special method. After that the upper part is covered completely by concrete to make it as a box. This un-leak out method inhibits the relations between in and out of landfill. Rainfall, air and any other things can't go in to landfill, beside to gases on leaches can't go out of it. Since this method can't be applied to biodegradable material containing landfill, leak out of water or gas has already not happened. The capsuled landfill should be covered with sand and permitted to grow of plants and vegetation. However necessary precautions places must be placed to this area. Capsulation can be done on separate local places when capsulation will be applied to some hazardous waste containing landfill of Kemalpaşa, the following titles should be considered firstly. If the volume of hazardous waste in the aimed landfill is too big, and transfer of wastes from this place to organised landfill is more expensive than the capsulation, than it is preferred to capsulate the landfill. On the other hand, in the reverse case, it is better to transfer wastes to an organised landfill. By that way, the area will be completely recreated. There are hazardous waste containing landfills in Kemalpaşa. The presence of biologically degradable matters in there landfills prevents the capsulation of them. And also capsuling method is not economic because of hazardous wastes. So for these places, to hat method and drainage on the sides of area can be placed.

## **Transfer to Sanitary Landfills**

The Sanitary landfills are suitable solid waste storage places where all the environmental effects are considered, all kind of hazardous and non hazardous waste can be left and all the control mechanisms are taken. The construction of on sanitary landfill in Kemalpaşa will function as both collection of usual wastes and a place to where wastes of

unorganised wastes will be transferred. As a result the old area will be recreated. Therefore, it is necessary to carry the wastes from landfills. These deponies, some of which close to Nif River or on the agricultural areas, pollute both groundwater, surface water and soil. That's way, they must immediately removed. Actually, these areas are planed as recreation areas in the master plan. If they don't removed today, more problem will be seen and new recreation areas will be used for solid waste left. By tat way, 39,000 m<sup>2</sup> area will be gained for different purposes while 35,500 m<sup>3</sup> solid waste is transferred. The other small wastes containing places present on the sides of roods and small river or in the county. They don't have too much damage to environment. It is sufficient to cover them by soil or to medicate them. However, to leave the wastes arbitrary in countries must be forbidolen to prevent wide spread of this behavior beside to increasing number of these small of places. Otherwise small area will be big, uncontrollable and problematic big unorganized deponies.

## **Use of Recreated Areas**

Around 62,200 m<sup>2</sup> empty area can be obtained if their wastes are collected or transferred to a landfill. The empty areas can be used for agricultural purposes after improving these floors and covering them with productive soil. They can be open to vegetation. Also in condition, kindergartens, spoor complexes, parks and buildings can be constructed on these areas.

## **Conclusions**

Together with the other environmental problems solid waste problem has gained importance in Kemalpaşa. Solution of this problem is only possible by, starting with a clean technology to the final deposition quality applying an integrated solid waste management.

Similar to the many countres, solid waste management concept is rather weak in Turkey. But, since deposition is the first method in solid waste disposal, construction sanitary landfill sites is very important. This will also from an important step in reaching integrated solid waste management.

Questionnaire studies were done by 130 firms but among these only 92 of them were found to be correct and these and six municipality questionnaires were used in the study. As a result of this questionnaire study the aspects given below were determined. Uncontrolled industrialization and urbanization is continuing on in the district without any preventions for environmental pollution and there are totally 67 uncontrolled landfills of which 21 of them are large.

For the past years, it was determined that solid wastes were being incinerated under uncontrolled conditions and also solid waste were left to biologically decompose in the open areas. As a result of these happening it was calculated that approximately 29,447 nm<sup>3</sup> of waste gas was given to the atmosphere which effected the air quality of the area negatively is unavoidable.

## **Discussions and Recommendations**

As it was stated before, the purpose of this study was determining the existing situation in Kemalpaşa district in terms of environmental pollution caused by solid wastes produced. In order to enlarge the scope of the study analytical investigations should also be performed as the second and the third steps. This way it will be possible to determine the source and extent of surface and groundwater pollution. Then it will be more appropriate to propose a certain improvement method.

In Kemalpaşa, industrialization and urbanization were both developed in an uncontrolled manner. The pollution problems as a result of this development were very intense. For example in Kemalpaşa, a food industry which has waste gas emissions functions next to a chemical industry. If an environmental impact study had been done previously, these two different factories would not be placed next to each other.

Kemalpaşa Organized Industrial District (KOSBİ), which began functioning in 1994 will enlarge its areas, if possible to 1,000 ha by an addition of 590 ha to its already existing area. This will cause industrialization in the region to increase plus 2.5 times which will cause 2.5 times more pollution problems. This may be very dangerous for

Kemalpaşa from environmental point of view. But as a result of it is supposed that the Organized Industrial District, industrialization will continue on in a controlled manner and the industries will be careful in choosing environmentally friendly technologies.

The uncontrolled landfill sites in Kemalpaşa region should be improved as soon as possible and a sanitary landfill site should be formed. Of course site selection for a sanitary landfill is not something that could be done by 2 or 3 people. This kind of a decision should be given after an environmental impact report prepares by a group of scientists. The "Solid Waste Control Regulation" in acted in 14th May 1991 in the official newspaper number 20814, gives the official measures to be taken for solid wastes in Turkey. So it is very important to take the advice of various experts in this area in order to find the best solution.

As a result of all these aspects, the most appropriate and economic solution for the solid wastes of Kemalpaşa was found to be sanitary landfill. But in order to increase the operation period of this sanitary landfill, recycling technologies should be improved for solid wastes also they should be separated at their sources, and environmentally friendly technologies should be chosen by the industries which minimize wastes while maximize production.

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