

## ENVIRONMENTAL PROBLEMS OF IRANIAN LANDFILLS AT SEASIDE OF CASPIAN SEA

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**ABSTRACT:** This paper focuses on methods of solids and contained liquids management and as a case study, and evaluates the proposed landfill design in Langerood, a city in north of Iran close to Caspian Sea. In addition, the methods of waste management and disposal, environmental conditions of transport stations, kinds of waste and other influential managing parameters in this region are analysed and several solutions are presented. The amount of municipal solid waste (MSW) collected in the province of Gulan is about 35,000 tonnes/day. This province involves 4% of the total population of Iran and about 0.9% of the area of Iran, while it produces 1.4% of total MSW of Iran. There is no valuable estimation on the amount of waste generated by industrial units. Approximately 90% of MSW are discharged directly into the rivers. In addition to compostable materials, about 14,000 tonnes paper and cardboard, 9,700 tonnes plastic and 2,500 tonnes glass are annually being entered into the MSW of this province. This paper presents specific and general recommendations to enhance the solid waste management in the study region.

*Keywords: Landfill, Environment, Caspian Sea, Iran*

### 1. INTRODUCTION

Broadly speaking, waste outputs include not only solid and liquid, but also effluent discharges, atmospheric emissions and lost heat. However, this paper will focus on good practice in the management of solids and contained liquids which are discarded by an organization. There are many standards and regulations related to wastes. There are different ideas and strategies regarding the waste constitutes subjected to legal definition [1,2]. For example in the UK definition, the key concept is whether the substance or object is being discarded. In different counties with the same definition, most discarded objects and materials from industrial and commercial premises are further defined as "controlled wastes". These controlled wastes are subjected to a statutory duty of care explained in a code of practice and sets out basic good practice in the storage, handling and transfer of controlled wastes. As controlled waste is subject to regulatory control this should mean that waste arising from industrial and commercial activities are significant environmental aspects [3].

Furthermore, all wastes have the potential to cause environmental impacts if not correctly managed. For example if waste material is spilled or leaks, it may contaminate land, pollute a watercourse, aquifer or cause nuisance. Proper containment of waste is therefore a fundamental management practice. The province of Gulan has several problems in its waste disposal due to its regional situation and distribution of residential, industrial

and commercial units. Valuable forests in all over Gulan except southern part, near Loushan and Mnajil, will lead to lack of landfills in this area. However landfilling is not the best choice for waste management [2]. Today, in addition to insects over the waste disposal areas, much of leachate leaving the disposal area would be considered as an important environmental problem in this province, since this leachate poses a threat to water courses.



Fig. 1 The location of the region studied (Langerood) in the vicinity of the Caspian Sea.



Fig. 2 River Network of Caspian Sea in Lanegrood region

## 2. TYPICAL WASTES

The list below identifies the typical wastes which can be generated. It is clear that understanding the source of these wastes and investigating options for preventive actions are key elements in waste minimization and management. These typical wastes include production residues such as industrial slag, lathe turnings, material off cuts, off-specification products, expired goods and materials, used and unusable products such as spent batteries and spent toner cartridges, damaged objects or materials such as broken equipment and damaged products, residues from pollution abatement processes such as scrubber sludge and spent filter, spilled or leaked materials which are collected but cannot be used, adulterated materials, contaminated materials resulting from the remediation of contaminated land, materials resulting from maintenance and cleaning activities and unwanted materials from buildings that are being demolished or from facilities that are being decommissioned or refurbished. It is important to bear in mind that all activities can generate waste and the waste is not generated just by production and manufacturing processes. The waste generation just in Gulan with the population of 2376000, has increased from 360 to 500 tonnes/day during 1986 to 2000 which 4.5 tonnes of this amount can be considered as hospital waste stream.

## 3. WASTE MANAGEMENT HIERARCHY

Waste management should be flexible. It must conform to the waste management hierarchy, incorporating waste elimination/minimization, waste reduction, material reusing, material recovery (recycling, composting, and incinerating with energy recovery), responsible disposal (landfilling) and incineration without energy recovery [4]. This should be used as an indicative checklist. It is important to note that the best practical environmental option for certain waste streams will depend on environmental aspects and impacts associated with transportation, reprocessing,

treatment or disposal of the waste, legal restriction or requirements on the management of the waste, technical and economic feasibility, stakeholder point of view regarding which options are acceptable and which are unacceptable, including recognized best practice.

According to studies and investigations, following problems have been found in 31 waste disposal sites:

- Adjacent to residential areas (21 sites)
- Inappropriate appearance (16 sites)
- Proximity to ground water and Surface water sources (15 sites)
- Placed in metropolitan area (10 sites)
- Retinue gathering (20 sites)
- Lack of barrier (19 sites)
- Not capable of being extended (14 sites)
- Placed in forests ( 7 sites)
- Placed in rice farms ( 1 site)

It has been estimated that there is 1.3 workers per one thousand residents in Gulan. Moreover in many parts of Gulan, manual wagons are still being used for waste collection.

## 4. WASTE GENERATION IN GULAN

Estimated statistics has shown that the amount of generated waste in average is about 510 gram per capita per day in Gulan. However, there is no data about waste generation in some rural areas in this province. Large amount of the waste generated in Gulan comes from Masooleh. The waste generated in this city is about 1800 gram per capita per day which can be justified due to high capacity of this city for tourism [5].

## 5. WASTE MANAGEMENT PROCESS IN LANGROOD

Careful and detailed projections of the quantities and composition of waste are essential for the planning of efficient and economical waste transport, processing and disposal systems. Therefore waste management process should be divided the following steps:

### 5.1 Identification of the Principal Waste Streams

Estimating waste quantities and composition is typically the first task in any local waste management study. Thus this is the starting point for waste management. A site plan or process flow diagram to map out the use of key materials and the generation of wastes can help this exercise. The following information should be obtained: Quantity of waste over a suitable reference period (e.g. litres, kg, and tonnes per day, week, month or year), Activity producing the waste, Composition of the waste including physical properties (e.g. solid,

sludge, liquid) and chemical properties (e.g. flammable, corrosive and toxic).

## **5.2 Categorization of the Waste**

There are numerous ways that waste can be categorized. However the purpose of classifying the waste should contribute to achieve legal compliance and beneficial environmental and economic outcomes. Factors which lead to various waste classifications are as follows:

### *5.2.1 Compliance with regulatory controls on hazardous waste*

Wastes that contain certain levels of materials with specified hazardous properties are classified as hazardous waste and are subjected to particular controls. It is therefore important to separate this kind of wastes from other non-hazardous wastes.

### *5.2.2 Implications of regulatory obligations on recovery*

Producer responsibility laws are placing obligations on the producers of certain products to recover the products (or equivalent materials) reached to their end-of-life.

### *5.2.3 Implications of economic instruments*

Governments are increasingly using economic instruments to influence public behavioural habit. For example, in some countries, tax is considered on waste for disposal in landfill. Therefore, this option becomes more costly and consequently less attractive. Different types of waste can attract different rates of taxation.

### *5.2.4 BPEO (Best Practicable Environmental Option)*

The waste should be categorized according to the different waste management options. This includes reuse, recovery (recycling, composting, and/or energy recovery) and disposal (landfill or incineration).

It is important to review the categorization of waste according to the new regulations, changes to the scope and level of environmental taxation applied to waste, developments in recovery techniques and developments in markets for reused or recovered materials.

## **5.3 Segregation of the Waste**

Segregation is the practice of separating different waste streams so that the different categories of waste are set apart. This is best done as close to the

source of waste generation as possible to avoid secondary handling (which may involve health and safety risks as well as extra operational costs). Clearly identified collection points should therefore be established for each category of waste stream. Ensuring that certain wastes are not mixed can be important for the following reasons: certain wastes may reach with each other when mixed and lead to an environmental incident, the mixing of small quantities of hazardous waste with non-hazardous waste can make all the waste "hazardous" and thus are subjected to extra regulatory requirements, the mixing of non-inert waste with inert waste will make all the waste non-inert and thus subject to extra landfill tax if inert waste attracts a lower rate of tax, waste for different recovery or disposal routes can be easily identified, more effectively handled and efficiently dispatched to the correct reprocess or disposal facility, data collection including type and quantity of waste is facilitated. This in turn can help with the completion of regulatory documentation, environmental performance monitoring and reporting, and the identification of waste minimization/process efficiency opportunities.

Disposal of inseparable wastes in Langood landfills is one of the most important problems in this city. Different kinds of food wastes, paper, plastic, metal, hospital wastes, etc. can be found in the wastes at the first observation. Furthermore in this province, the wastewater from 23 slaughterhouses is being disposed into the rivers while the solid wastes related to these parts enter into municipal wastes.

## **5.4 On Site Controls**

Certain waste management activities may be subjected to permitting or licensing. This may prescribe how these activities are managed, including the responsibilities, procedures, technical controls and training required to ensure that the conditions of the license are met. The following paragraphs outline general good on-site practice:

### *5.4.1 Proper containers*

The types of container should be suitable for its intended waste content so that the waste is properly contained. Compaction may be appropriate for certain wastes so that the volumes of waste are reduced and the use of containers optimized.

### *5.4.2 Proper labelling*

Clear labelling of waste containers and waste collection areas is important to ensure that proper segregation takes place. The labelling should state which wastes are to be placed in the container and may also indicate which wastes must not. Any

particularly hazardous properties that would pose health, safety or environmental risks should be also clearly marked on the container and on adjacent signs.

#### 5.4.3 Security

To prevent the risk of vandalism or unauthorized deposit of waste (e.g. through public access) containers may need to be located in fenced areas and/or be capable of being locked.

#### 5.4.4 Prevention of pollution

The main risks are as a result of the leakage in containment; for example leaks from corroded or damaged containers, or spill during handling. Pollution or littering may also occur due to overflowing of containers or littering of lightweight material due to wind blowing. This emphasizes the need for appropriate primary containment (including covers and locks).

#### 5.4.5 Responsibility, procedures and training

A nominated individual should have overall responsibility for waste management for a given task in certain area. Simple procedure should be applied to waste management operations and all employees should receive training on segregation and relevant storage and handling controls to prevent pollution.

Unfortunately, Langerood with the population of about 146500 has not a proper and scientific waste management. Any kind of wastes, even hazardous wastes are combined together in several points of city.

### 6. TRANSFERRING WASTE TO OFF-SITE FACILITIES

Legal requirements usually control how waste is transferred to third parties and transported to the reprocessing or disposal facilities. In transferring waste to off-site facilities, the nature of waste (e.g. the type of waste, how it is contained, its quantity and a description of any special handling considerations) should be considered. More stringent requirements can be expected for hazardous wastes. Only facilities licensed to take the special waste can accept the waste. Importantly, those facilities which transfer the waste also need to be sure that it will not escape containment in the way to the destination. Again, there should be a nominal person with overall responsibility for waste transfer. Procedures, communication and training should ensure that the relevant waste is being transferred to a registered carrier, securely contained, with appropriate documentation correctly completed, and that it is destined to go to a

properly licensed facility. Optimistically, Only 35% of wastes generated in Lanegrood are being collected automatically. The typical method of waste transportation and disposal are illustrated in figure 3 and figure 8.



Fig. 3 Typical method of waste transportation in Langrood.

### 7. SOLID WASTE MANAGEMENT IN LANGROOD

Langerood with the population of about 146500 is located in the east of Gulan province. The trend of urban residency in Langerood is substantially increasing [6]. The collection service has been provided once a day in Langerood. In this city, people usually place the waste materials by the curbside for pick up. Plastic cans or bags are commonly used as container in solid waste collection. Domestic wastes are usually collected in manual wagons and then will be transferred to temporary sites in the city. In addition to domestic wastes, unfortunately there are substantial amount of wastes coming from hospitals, industry and commercial sources [7]. The waste streams from these units are collected in trucks and transferred to permanent disposal sites.



Fig. 4 Rudimentary leachate drainage system in presented case study

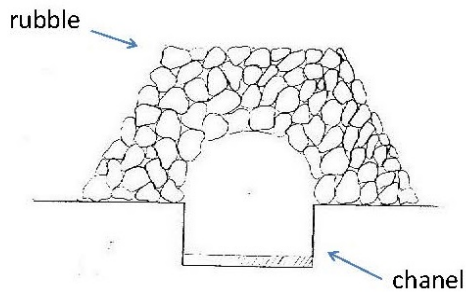


Fig. 5 Typical cross section of leachate drainage system illustrated in Figure 4.

The waste generated in Langerood is about 60 tonnes per day, whereas the waste streams from hospitals and industry units are 100 kg/day and 600 kg/day respectively [5]. There are 2 dumpers, 1 loader, 1 bulldozer, 1 power shovel and 4 small trucks for collection and transportation of waste in Langerood. Unfortunately Langerood wastes are being discharged into Amirkolayeh pond for a long time. Amirkolayeh pond is one of the most important natural resources of Gulan which is adjacent to the Public Park of Langerood. Discharging wastes into the pond causes adverse effects on the pond as well as smelling problems due to its proximity to residential area (about 500 m) and also pollution in groundwater and surface water sources. Recently, the disposal site has been backfilled and planted just as it can be seen in figure 7. According to improper condition of waste disposal in the pond, Langerood municipality has built a new waste disposal site with the surface area about 14 hectares.

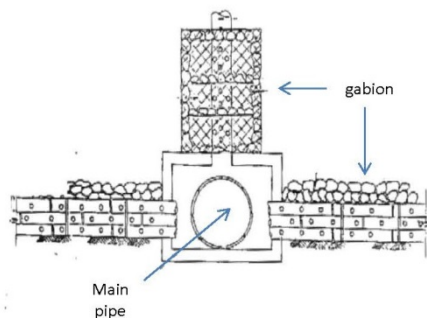


Fig. 6 Inefficient gas collection system illustrated in Fig. 4.

It has been anticipated that this new site will have the capacity of disposal for about 20 years. This site has no gradient approximately but there is a slope of about 12% in south and east-north margins towards the centre of the land. To avoid entering the water into the land, the drainage has been done in

the surrounding parts of the land. Moreover, some additional drainage has been done in waste disposal sites to guide leachate into wastewater treatment plant. The wastewater treatment has not been built yet; therefore the leachate is not treated. The same problem can be seen in gas treatment process. According to the cost evaluation, it has been estimated that the leachate and gas treatment of the waste disposal site cost about 450000 dollars, whereas the wastes are not separated at all [8].



Fig. 7 planting on the waste disposal site of Langerood



Fig. 8 waste disposal process

## 8. CONCLUSION

The amount of municipal solid waste collected is about 35000 tonnes/day in the province of Gulan. This province involves about 4% of the total population of Iran and about 0.9% of the area of Iran, while it produces about 1.4% of total municipal wastes of Iran. It should be noted that the above statistics includes just the amount of waste collected in this province, whereas the collected waste is a partial part of all wastes generated in Gulan.

There are incinerators for burning hospital wastes in only 5 hospitals in all over the province. Since more than 70% of domestic wastes can be considered as organic materials, they provide an appropriate condition for microbes' growth. Moreover about 50% of wastes generating by

industrial units dispose around Rasht and only four factories take their hazardous waste out of Gulan. In such circumstance, there is no valuable estimation about the amount of waste generated by industrial units. Unfortunately about 90% of municipal waste discharge directly into the rivers.

In general, most of the wastes are being disposed in Gulan, whereas several problems have been observed according to special situation of this province such as its topography, presence of groundwater and surface water and forests, and also lack of cleared lands. However Composting is considered as a modern method for waste treatment. In addition to compostable materials, about 14000 tones paper and cardboard, 9700 tones plastic and 2500 tonnes glass are annually being entered into the municipal wastes of this province. It is necessary to review, evaluate and analyse the last systems before any kind of planning for solid waste management and proposing any solution. Since solid waste management should be consistent with other communities' goal, the following principles shall be considered in order to achieve these goals: the options considered during planning and determining instructions and standards should be as feasible, economical and clean as possible, the issues related to funding and trained workers should be considered in planning.

In current condition, it may be better to focus on separating wet and dry wastes at sources instead of complete separation in the first place. Furthermore the number of the residential units and their residences should be determined to identify the best routes for waste collection and transportation. Exchange of views between different municipalities of the province can play an important role in future planning. Leachate which is reached to Zarjoob River from Saravan valley causes some problems for pheasants which Saravan valley is their main habitat and also for fishes and retinues. Therefore actions should be taken seriously to avoid such problems.

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