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# ECONOMIC ELEMENTS ON THE STORAGE OF WASTE IN LANDFILLS

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**Abstract:** *Waste deposing is one of the most important problems for a sustainable development of our societies is to find new strategies and places for waste landfill in conformity with environment strategies of European communities.*
*In this paper is shown some models, for determinate the exploitation with optimum fees of the waste deposing on the landfill. The model take in account local condition of warehousing, the existing of sorting technology.*
*We take account of technical and managerial abilities in waste management, a support for an efficient strategy in regard to tariffs, billing and bills collections.*
***Keywords**: waste deposing, tariffs collecting, warehouse, efficiently of costs.*

## 1. INTRODUCTION

In the south-east developing region it observes an important quantity of waste that necessities new space for efficiently storage and for processing. The fees with waste storage and processing are growing from year to year. These costs depend of local condition, existing or not of warehouse technology for waste processing and if existing the possibilities of sorting and valorised.

Like analyse model is adopted for waste the storage in shape of pyramid on flat surface with different storage capacity in function of her high. The characteristics of each storage type are shown in the table no.1. The spends for different models, the costs for equipments, of install plant, logistics and other are considered at the level of April month 2010 and are determined based on average price who was communicated by the firms that cooperating between them.

The functionary spends, for warehouse was classified in three groups [3]:

In the first group is show the spent necessary for the landfill preparing (the area where must be storage the waste).In these spends we find the costs with landfill arrange, reconstruction of „green area„ the terrain compacting, construct of drain systems and warehouse fence, etc.

In the second group is include the spends with the equipments, installations for warehouse construct and for its exploitation (buildings, weighing machine, social installations, access roads, equipments for storage, compacting, levelling, charging, the installations for sorting and processing and fuel warehouse).

In the third group is find the spend with electrical network, water, drain trough for rain water, tubular hole used at periodical control of deep water level and water quality.

## 2. ELEMENTS ON ECOLOGICALLY WAREHOUSE

For European standards, the average household is equipped with a 150 L garbage can. These cans are emptied twice a week. The trucks dump the collected material into the storage bunker. This is an intermediate storage facility that houses enough material to keep the subsequent fermentation process running even if not enough material is delivered. Therefore, the landfill must be constructed in a way to minimize these secondary reactions. The sanitary landfill is a more sophisticated concept in which waste is spread out in thin and separated layers of tamped earth. The stratification slows down vertical reaction processes that might otherwise occur between layers. Horizontal migration is somewhat slower and less troublesome. Nonetheless, reactions within the pile of waste are unavoidable and take place continuously, and have to be constantly monitored. Analyzing both the reaction gases escaping as vapours, and the leakage fluids draining out of the drainage pipes is therefore essential.

Therefore a modern landfill (Figure no 1.) is by far not a pile of dead matter, it remains a living bio-chemical reactor for as long as red ox/reactions and metabolic activities are supported by proper humidity levels on the one hand and decomposable matter on the other. The landfill itself is structured in several ways to meet the standards of the environmental protection agency. The landfill is best situated in an area where clay forms a firm and impermeable bottom stratum. To keep off seepage from ever reaching this stratum and ultimately the groundwater layer, the landfill itself is sealed off at the bottom and the flanks with a multi-layer barrier.

Inside the landfills, at the outer edges, and at the bottom of the landfill, a network of draining pipes are laid to monitor the quality of seepage. Gas pipes incorporated throughout the landfill body, collect the anaerobic fermentation gasses and feed into the main gas tank.

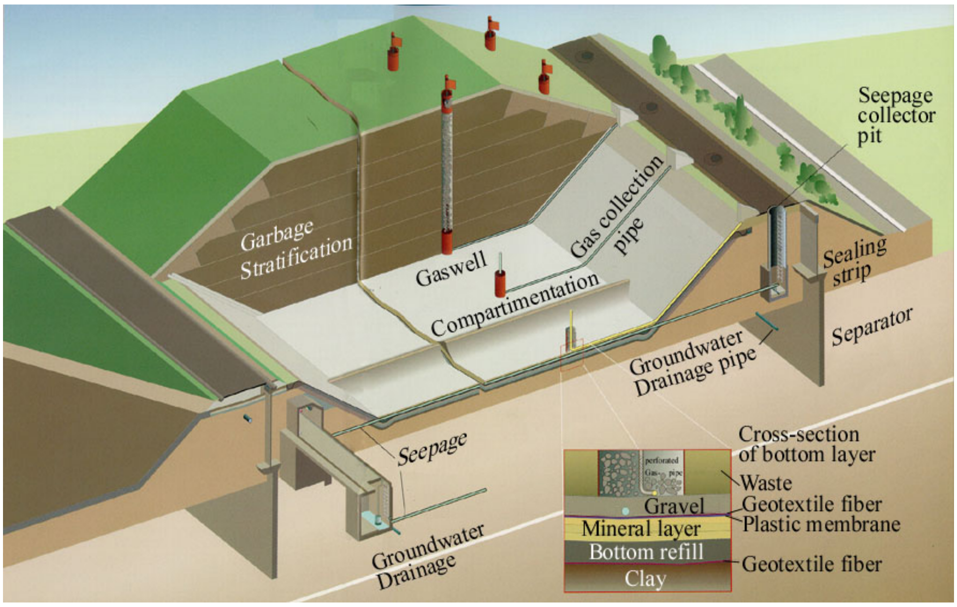


**Fig.1 Section throw modern warehouse [1]**

Along with the gas products of the biomass fermentation (from other sites of the landfill we obtain compost for garden). After the sludge fermentation the drain sequence can be used to generate heat and steam to obtain electrical energy that is used to cover part of the electrical demand of the plant.

Once the landfill reached its upper filling capacity it will be covered with an impermeable synthetic layer (to keep rainwater out), followed by a thick stratum of soil or humus obtained from the biodegradable composting process. Greening is often done by planting fast growing trees or grass on top of it. To monitor the uptake of toxic substances from the landfill matter below, the humus layer, trees, etc. are regularly cut and analysed within the plants on laboratory facilities. In the case of grass, the goat's milk is used to monitor the accumulation of incorporated toxins (bio-monitoring).

The investments expenses for the integrate systems for warehouse are depending of waste quantity, quality and type of processing technology used.

## 3. RESEARCH ON EXPLOITATION COSTS FOR DIVERSE TYPES OF WAREHOUSE

The fee that must to do at small warehouse on a year is very big and it is not profitable to construct this small storage, because the spent with all equipment is bigger. A warehouse about 75 000 tons/year necessities reasonably specifically investments and it is profitable. In this case it must that the pyramidal warehouse high to be higher of 5 m. When the pyramid high is grow upper 5m the calculus specify values, recorded a decrease (the case of simple storage-D1). The investment spent in the variant (D1) is 26-32 (average 30 Euro/t.year), when the capacity is between 75 000 – 225 000 tons/year, high of 15 m. If we choice a warehouse where the waste is crushing and compacting (D2) the decrease is bigger. When the capacity is between 75 000 – 225 000 tons/year, high of 15 m; In the variant D3 for same high and capacity, the spent is 77-84 (average 80) Euro/t.year.

Over capacity of 225000 tons/year, with storage pyramid and high of 25 – 50 m, the investment spent in variant D1 is of 13-29 (average 20 Euro/t.year). In variant D3 over capacity of 225,000 tons/year, the value is between 36-78 Euro/t. year.

In the table no.1 is show some usually types of warehouses (high and capacity of warehouse) used for spend calculus.

**Table no. 1 Types of warehouses [2]**

| Storage type | Warehouse high (m) | | | |
|---|---|---|---|---|
| | 5 m | 15m | 25m | 50m |
| $D_1$ - Storage without crushing and without isolation. | capacity(tones/year) 5 5000/10 000<br>25 000/75 000 | capacity(tones/year)<br>25 000/75 000<br>150 000/225 000 | capacity(tones/year) 75 000/100 000<br>225 000/300 000 | capacity(tones/year) 225 000/300 000<br>375 000/500 000 |
| $D_2$ - Storage with crushing and without isolation | 5 000/10 000<br>25 000/75 000 | 25 000/75 000<br>150 000/225 000 | 75 000/100 000<br>225 000/300 000 | 225 000/300 000<br>375 000/500 000 |
| $D_3$ - Storage with crushing and isolation | 5 000/10 000<br>25 000/75 0000 | 25 000/75 000<br>150 000/225 000 | 75 000/100 000<br>225 000/300 000 | 225 000/300 000<br>375 000/500 000 |

Exploitation expenses at 1 tons waste show that at small capacities and low high of warehouse is take in account variant $D_3$.
Over 75 000 t/year, specifically indicators low stp by step, but comparing with variant $D_1$ are of 1,5 – 2 higher. At pyramid high between 25- 50 m, the value of exploitation expenses in variant $D_1$ is 7 Euro/tons and in variant $D_3$ is about 10 Euro/tons.

## 4. MODERN COMPOSTING PLANT

The biodegradable Waste can be transformed in compost and biogas in a specifically plant like in the figure no.2. For the first the waste material is sorting and then milling in a shredder (hammer mill) in small pieces. Then, the small pieces of organic waste are mixing in a revolving rotting drum.

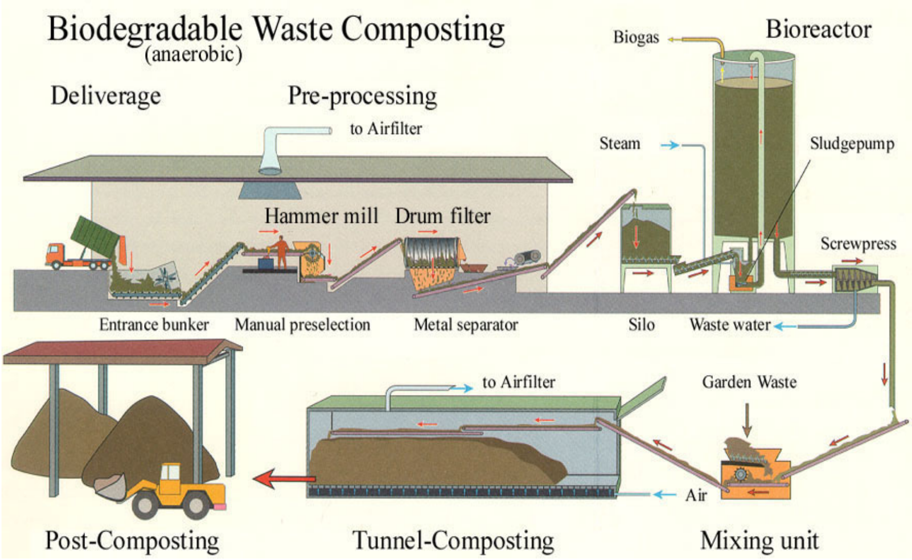


**Fig.2 Equipment succession for biodegradable waste composting [5]**

Constant aeration, at a preset temperature of 50°C, not only speeds up the microbial decomposition process, but also kills many pathogenic bacterial strains and protozoon life forms. Into a bioreactor the waste is transformed in biogas. Before driving the pre-processed material into the landfill, it undergoes an indoor post-fermentation process. To prolong the mineralization process, the semi-fermented material is stored for 3-4 weeks in the rotting hall. The rotting material is stored and turned over in regular intervals - the microbial metabolism still generates enough heat (about 50-70°C) to complete "sterilization" of the rotting matter. To keep fouling smells from escaping into the environment, special floor-bound ventilation slits suck in the gaseous by-products and pass it through charcoal filters.

The draining watery reaction liquids are likewise collected and conveyed to the wastewater treatment plant. To maintain the minimum temperature required for this process, heat-exchanger feedback process heat of the exhaust air stream into the rotting hall, thus increasing the overall efficiency. Both drum- and hall-fermentation are steps to further reduce the waste's volume and thus to save landfill space.

Fermentation has another advantage as it reduces both the noxes level and the long-term metabolic activity of the material; i.e. fermentation within the rubbish pile while stored at the landfill. One can speak her of semi-mineralized waste, a form of waste which is bio-chemically less reactive than untreated residual waste. These quasi mineralized substances are no longer involved in metabolic processes (ideally, any material discharge into a landfill should be biologically and chemically inert). By the time the amount of noxes has fallen below 5%, the total volume of the rotting material has decreased drastically. At this stage at least 30% volumetric reduction is achieved (referring to the initial volumetric dimensions), while about 80% of the all over biogenic content has been decomposed.

The rotten matter is then loaded onto trucks, weighed, transported, deposited and compressed at the assigned location within the landfill. Further microbial activity within the dumping site is unavoidable as cross-reactions among the various kinds of ingredients are ongoing as long as the right conditions are there. Stopping this conditions by reducing water and nutrient content of the waste material would be simply too expensive.

## 5. ECONOMICAL ANALYSE FOR COMPOST PRODUCED

For the two examples all the expenses was calculate at the level of 2010.

After the quality of produced compost and the capacity plant, these were divided in 4groups and each group subdivided in other 4 subgroup like:

| | |
|---|---|
| I - first group | 15 000 tons/year; |
| II - second group | 30 000 tons/year; |
| III - third group | 60 000 tons/year; |
| IV - four group | 120 000 tons/year. |

The compost obtained is divide in four quality groups are:

1 - fresh compost brutish;
2 - mature compost brutish;
3 - fresh compost fine;
4 - mature compost fine.

After this classification we can say that optimum capacity processing plant, was between 15,000 tons/year to 120,000 tons/year for obtain mature compost.

For optimum calculates was `create the next group of expenses:

**Table no. 2 Group of expenses [4]**

| The quality of compost | Types of spends |
|---|---|
| 1 - fresh brutish | P; $M_p$; $A_{ins}$; $O_c$; |
| 2 - mature brutish | P; $M_p$; $A_{ins}$; $O_c$; $M_{post}$ |
| 3 - fresh fine | P; $M_p$; $A_{ins}$; $O_c$; $T_p$; $U_e$; |
| 4 - mature fine | P; $M_p$; $A_{ins}$; $O_c$; $M_{post}$; $T_p$; $U_e$; |

Where:

P - preparing the waste for transforming in basics materials, biogas and compost;

$M_p$ - initial waste milling;

$T_p$ - tower of waste mature for subsequent treatment;

$U_e$ - diverse equipments for parameters measuring and transport • installations for crushing of brutish fresh compost (shredder), sieve installation and different types of transporters (figure no.2);

$M_{post}$ - subsequent mature: • composting landfill; • transport systems- conveyer for materials; • construct and treatment of mature prism.

$A_{ins}$ - other machines and equipments: • weighing machine; • winch and cranes; • feeding bunker; • dust removal equipment; • electrical power supply; • evacuated installations for residues, installation for extract ferrous materials.

$O_c$ - constructions: • plant for preparing, processing and subsequence treatment; • spaces for storage; • administrative and social building; • roads; • installation for water supply; • sewerage for thread water.

In the table no. 3 is shown the specifically values of investment in function of plant size for transform organic waste in compost.

**Table no. 3 Expenses for the compost plant [4]**

| Compost Plant Size ($x10^3$tons/year) | Expenses (Euro/tons) | | | | | | |
|---|---|---|---|---|---|---|---|
| | P | $M_p$ | $T_p$ | $M_{po}$ | $A_{ins}$ | $O_c$ | $U_e$ |
| 15 | 80 | 50 | 50 | 25 | 45 | 100 | 22 |
| 30 | 65 | 50 | 42 | 25 | 38 | 82 | 18 |
| 60 | 55 | 50 | 37 | 25 | 33 | 70 | 15 |
| 120 | 50 | 50 | 35 | 25 | 30 | 64 | 13 |

The income, after the specialised plant, sale the compost was in average about 10 – 20 Euro/tons. In the final the choice is of the specialists, because it must take the decision between an integrate plant to produced biogas and compost and to built a warehouse on a deactivate field maybe with low costs but with the inevitable environment damage.

## 6. CONCLUSIONS

An important task in the general systematization plans to settlements is the development, within urban and rural development plans, the details of the evacuation of waste.

Concerning the exploitation costs on tons of waste we can said that at small costs is when the warehouse have a low high and big capacity (about 225,000 t/year) and by comparing under 225,000 t/year, the exploitations spends are of 1,5 – 2 higher. If we transform the organic waste in compost, into a plant with capacity of $120x10^3$ tons/year is most efficiently that we made this technological operation in a plant with capacity of $15x10^3$ tons/year.

The specific local conditions should be examined very carefully, the situation of ground water, flooding possible sources spa water treatment, sewage disposal and neutralization degree of pollution of the atmosphere, places of rest and treatment of protected land, of the uncultivated, based on statistics from different organs and meteorological services, water, sanitation, construction , transport, etc. have separately studied carefully the possibilities of turning waste requirements in this area (turning compost, the heat produced when combustion waste recovery possibilities of types of waste arising during treatment, as raw materials side).

Also all other waste should be considered another source (industrial, agricultural, construction, hospital, etc..) that may occur in the territory for which the warehouse design, possibilities for treatment and neutralization of their joint waste (waste balance).

In justified cases, in advance must be more detailed qualitative and quantitative analysis of them. Trends expected to be determined during design changes.

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