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Development of Domestic Solid Waste Management Schemes for Small Urban Communities in Morocco

WASTESUM (LIFE06 TCY/MA/000254)

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Report on the site visits in Greece and Austria

May 2009

Two site visits were organised under the framework of WasteSum project. The visits took place on 25th to 31st of May and the participants had the opportunity to visit a variety of solid waste management treatment and disposal facilities in Austria and Greece. Among the participants were the general secretary, Mr Hardane Mohamed, and the vice president of the Municipality of Azemmour, Mr El Baidouri Mostafa, while FSJ and NTUA were represented by professors and researchers involved in the WasteSum project. The following table presents the people participated in the site visits. This report is devoted to describe the facilities visited.

Athens	Austria
Assobhei Omar (FSJ)	Assobhei Omar (FSJ)
Etahiri Samira (FSJ)	Etahiri Samira (FSJ)
Mountadar Mohammed (FSJ)	Mountadar Mohammed (FSJ)
El Baidouri Mostafa (MA)	El Baidouri Mostafa (MA)
Hardane Mohamed (MA)	Hardane Mohamed (MA)
Kabil El mostafa (FSJ)	Amine Jamal (FSJ)
Rihani Mohammed (FSJ)	Aajjane Ahmed (FSJ)
Maria Loizidou	Maria Loizidou
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Malamis Dimitris	
Thekla Christoforidou	
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Site visits in Greece

During the site visiting in Greece the participants had the opportunity to visit the Integrated Waste Management Plant in Ano Liosia, Attica Region, Greece which incorporates a series of waste management facilities namely an MBT plant combined with a composting plant, a Sanitary Landfill and a Hospital waste incinerator. This facilities are presented below.

MBT plant- Waste Recycling and composting plant in Ano Liosia, Attica region, Greece

The recycling plant is located in Ano Liosia region, in a greater area of 200ha and constitutes one of the most innovative plants for waste treatment, with a daily nominal capacity of:

- 1200tn of municipal waste

- 300tn of biological sludge from the wastewater treatment plant of Athens in psytaloa island. For the time being it receives mixed municipal waste and green waste only and it remains ambiguous whether it will take up the designed quantity of 300tn of sludge per day.
- 130tn of yard waste

The operation of the recycling plant reduces the quantity and hazards of waste ending up to the sanitary landfill after its utilization by the recycling of many useful material iron and aluminium and also by the production of new products (compost and RDF).

On an annual basis the plant is designed to accept 375.000 tns of MSW 40000tns of yard waste or similar material for the control of the porosity of the organic fraction and 85000 tons of biological sludge from the Wastewater treatment plant of Athens in Psytallia island. The recycled products of the plant are, on an annual basis, 10000 tons of compacted ferrous metals, 1500 tons of compacted aluminium metals, 100000tons of compost and 110000 tons of RDF with a total calorific value of 10^6 Gjoules. As by-products, on an annual basis 100000 tons of rejects are produced which are disposed of in the adjacent sanitary landfill.

Plant description

1) Reception of waste: the waste trucks enter the plant, are weighed and directed automatically to the available position of discharge. The waste is unloaded in large holding tanks, which are housed in a covered area and have sufficient capacity for peak loads, and then is fed through grabs in hoppers, from where it is dosed to the mechanical sorting plant. The reception and the subsequent mechanical sorting processes are divided into parallel lines. The reception and mechanical sorting areas are housed in a single closed building equipped with the appropriate deodorization and dust-collection systems. The feeding of sludge, yard waste and other materials for the control of the porosity of the wet fraction, i.e. the organic fraction from which the compost is produced, take place at the same feeding front. The reception and feeding area of the sludge and the other organic materials is the same with the waste reception area. The sludge feeding line is divided into the parallel dosing lines.
2) Mechanical sorting of waste: the separation of the wet and dry fraction, the separation and pressing of ferrous and aluminum metals, as well as the rejects take place inside the mechanical sorting building. The dose waste undergoes initial screening, for the separation of the dry and wet fraction. The dry fraction then undergoes size reduction and, following enrichment in materials with high calorific value, it is presses and baled in order to subsequently distributed as fuel. The wet fraction undergoes size reduction and size separation for the removal of rejects and then, the organic fraction with the appropriate size is mixed with sludge and the porosity-controlling materials. The mixture is the fed to the composting plant. Along the dry fraction processing line, the ferrous and aluminum metals are separated and driven by independent transfer lines to the

corresponding presses for baling, in order to be ready for distribution into the market. The rejects produced at the various intermediate stages of mechanical sorting are collected and transferred and disposed in the adjacent sanitary landfill.

3) Composting: Composting takes place in parallel process lines in an enclosed and deodorized building. The homogenized fraction of organic waste, sludge and porosity controlling material is fed to the composting plant. Composting is the aerobic degradation process induced by bacteria and fungi, in their mesophilic and thermophilic forms, which to a large extent pre-exist in the waste. The material to be composted is spread in layers and is aerated in elongated channels, where it remains and is stabilized for several weeks. The propelling and turiing of the material in the channels take place with specially designed equipment. The parameters controlled during composting in order that the process can have a steady and high efficiency are: The initial composition of the initial feedstock material, the aeration of the substrate, Temperature, Moisture, C/N ratio, pH value. The composing plant is equipped with an appropriate system for the collection of leachate produced from the composted material.
4) Refining maturation: The produced compost undergoes refining a process which separates from the compost foreign admixtures such as glass, hard plastics, grave, plastic film or organic material that reduce its commercial value. The refining is developed in parallel process lines. Initially, size separation of the material takes place followed by further refining in order to achieve desired product quality. The rejects from the various stages are transported for disposal to the sanitary landfill. The compost following refining is led to the maturation area where the material is stacked and remains for four weeks, for the completion of the humification processes. In the maturation area the stacks are moved gradually with front loaders, so that the material that is finally introduced into the market has completed a maturation time of four weeks. Part of the mature compost is packaged and distributed for sale.
5) Environmental protection measures: A wastewater treatment plant operates on site, where the treatment of leachate produced in the various units, as well as sewage, takes place. For the purification of the various air streams, biofilters and/or scrubbers are used, according to the load and volumetric rates of the air stream. Bag filters are used for the removal of dust in the air streams.
6) Other facilities: The systematic maintenance of the vehicles and machinery of the plants takes place in the maintenance building, which is supplied with all the necessary equipment. The spares for the equipment of the plant are stored in the appropriate storage area. The administration building houses the chemistry laboratory the control room and the offices of the administration personnel.

Sanitary Landfill in Ano Liosia, Attica region, Greece

The Ano Liosia sanitary landfill is a modern site for the sanitary disposal of waste with an area of 25ha which almost accepts the total amount of the solid waste produced in Attica which

accounts to 1700.000 tns of MSW per year. The Ano Liosia sanitary landfill has been constructed in stages by the cell method, the sectional operation and immediate restoration of the site, so that every year are restored and returned to the environment 5ha of natural park area.

The sanitary landfill is situated in an area owned by ACMAR to the north of and adjacent to the old Ano liosia Landfill. The designed philosophy of the project followed the most advanced specification, taking into account the demands for planned phase operation and gradual site restoration, the local conditions of surface water runoff, the demands for protection of ground and groundwater and for efficient leachate and landfill gas management, as well as the specifications for environmental monitoring during the operational and post-closure phases of the site.

Lining: The base and sides of the sanitary landfill are lined with a double composite system, consisting of a combination of natural and geosynthetic lining materials. Between the two lining systems, an intermediate drainage layer is installed for the detection, collection and removal of leaks through drainage pipes. The system was chosen for the specific site because of the high permeability of the subsoil and the sensitivity of the groundwater table which is already polluted from the old landfill, industrial activities in the area and sea regression.

Leachate management: The leachate management system was designed in order to (a) maintain a minimal leachate head and to ensure landfill stability, by continuous and uniform drainage of leachate along the whole landfill, (b) to avoid the construction of vertical wells in the waste mass, (c) to ensure inspectability of the leachate collection system and (d) to achieve full treatment of leachate to effluent quality suitable for irrigation or disposal in the surface water collection system.

Landfill gas management: It must be noted that due to the high daily waste input increased production of landfill gas is taking place. For this reason a high recovery system is in operation for the collection and the utilization of the gas. The system includes vertical wells and horizontal collection trenches, in order to achieve active gas collection during the operation of the site. After its collection the landfill gas is pumped and flared in two units with a capacity of 12 MW.

Environmental quality monitoring: Environmental monitoring is conducted in order to ensure that no contaminants may effect public health and the surrounding environment are released from the landfill. The environmental monitoring program in Ano Liosia Landfill includes (a) recording of the appropriate meteorological data and estimation of the hydrological balance of the landfill from the meteorological station installed on site, (b)recording of the quantity and quality of leachate, acquiring data from the installed flow-metres of the inlet well and sampling at the inlet and outlet of the leachate treatment plant, (c) monitoring of the quality of groundwater, with sampling in the groundwater monitoring and reference wells, which are situated respectively, downgradient and upgradient of the hydraulic slope of the groundwater table under the landfill, (d) monitoring of gas migration off the landfill sites, with air sampling

and landfill gas tracing using a handheld analyser in the gas monitoring wells, constructed along the perimeter of the landfill, (e) mapping and continuous calculation of the landfilled waste volume and of the progress of waste settlement, with periodic topographic measurements along a grid in the landfill area.

Hospital waste incinerator in Ano Liosia, Attica region, Greece

The Association of Communities and Municipalities of the Attica Region (ACMAR) has been subsidized by the Greek Ministry for the Environment, Physical Planning and Public Works, with 2 billion GRD for the installation of a special pyrolytic incinerator for hospital waste. The capacity of this incinerator is 30tons per day and is estimated to cover a proportion of the 14.000 tons of medical waste produced in Attica region annually. However the facility operates well below its nominal capacity due to high operational costs.

The participants had also the opportunity to visit various other waste management facilities in Elefsina and Pikermi municipalities including a transfer station, a pilot scale composting facility, a windrow composting facility and a Materials Recovery Facility. More details for the aforementioned sites are given below:

Elefsina Transfer Station

The primary objective in using a transfer station is to reduce the traffic of smaller vehicles to the disposal site, ultimately resulting in reduced transport costs including labor (crews spend less time traveling to the disposal site) and fuel. In addition to lower collection costs, transfer stations offer benefits including reduced maintenance costs for collection vehicles, increased flexibility in the selection of disposal facilities, the opportunity to recover recyclable materials at the transfer site, and the opportunity to process wastes (shred or bale) prior to disposal.

The Elefsina Transfer Station operates five days per week and it is able to handle daily peak loads serving the municipality of Elefsina. The station is equipped with an operating area for waste collection trucks. The direct-discharge station is constructed with two operating floors. A compactor or open-top container is located on the lower level thus enabling users/trucks to enter the upper level and dump wastes into the hoppers attached to containers.

Pilot scale composting facility, Eco-pod in Elefsina municipality, Attica region, Greece

A pilot scale composting facility was visited in the municipality of Elefsina which started to operate in 2008 using a specially designed equipment (by the company L. KABANIS A.E) named eco-pod for the composting of biodegradable organic waste including green waste. Eco-pod technology incorporates the In-vessel forced aeration composting technique using Ag-bag

composting machinery. The Eco-Pod mobile flexible in-vessel system enables the production of compost in 6 to 8 weeks on a non-permanent site.

Windrow Composting facility in Pikermi municipality, Attica region, Greece

A windrow composting facility was visited in Pikermi municipality which treats biodegradable organic waste in a co-composting process for the production of an enriched product from straw residues and horse manure. The feedstock material is formed in piles and the substrate is frequently mechanically agitated to maintain aerobic conditions within the piles. The cross-section of the windrow is triangular while its dimensions are typical of a windrow system. The turning device used, is a self-propelled model specifically designed to straddle the composting pile in order to acquire a homogeneous substrate while maintaining aerobic condition throughout the duration of the composting process within the pile.

Materials Recovery Facility in Elefsina, Attica region, Greece

The materials recovery facility (MRF) in Elefsina handles source-separated materials and it serves 12 municipalities in west Attica region. The facility is a clean MRF that accepts recyclable mixed materials that have been separated at source from MSW generated by either household or commercial sources (mainly using mixed recyclable materials bins). The materials are sorted to specifications, then baled, shredded, crushed or otherwise prepared for shipment to market. The process followed is described more analytically below:

1st stage: Via a conveyor belt the bulky materials and plastic bags are separated from the rest of the recyclable mixed materials that enter in the facility.

2nd stage: The materials enter in a rotating screening machine which separates the entered material based on their size.

3rd stage the bulking material enters in cabin collection in which optical inspection is taking place for the removal of potential foreign materials and then they are packed.

4th stage the rest of the materials enter into a magnetic separator for the recovery of ferrous materials as well as through an ballistic sieve in which the material is separated base on their weight, shape and size.

5th stage plastics are processed through an optical separator in which they are separated based on their molecular structure.

6th stage all materials enter in and optical inspection cabin for the removal of foreign material.

Site visits in Austria

During their stay in Gratz, Austria the participants had the opportunity to visit a state of the art recycling center, a biological treatment plant and a waste incineration plant. More detailed information related to the aforementioned waste management facilities is given below.

AEVG Recycling centrer

AEVG is the waste disposal company of the City of Graz, responsible for the collection, processing and disposal of the household waste and separated waste in the area of the City of Graz. The AEVG recycling centre is not only the largest collection facility of the City of Graz but also the best known one for the collection of separated, recyclable waste delivered by the residents of Graz. Due to the new waste collection resolution of the City of Graz two separate delivery areas were needed in the recycling centre. More details are provided for the two recycling centers:

The recycling center 1 is chargeable. Against a fee of 4 euros the user can deliver up to 200 kg of waste. Quantities over 200 kg are charged according to a set tariff. This center can recycle the following materials:

- Bulky waste: Mattresses, carpets, furniture
  - Scrap and metal waste (tools, bicycles etc.)
  - Wood (laminated fiber plates, boards etc.)
  - Plastic waste (Styrofoam, foils, tubes etc.).
- Construction and Demolition waste such as porcelain, tiles, glass, fibre glass, concrete, roofing tile, refractory clay, tiles, natural stones etc.
- Green waste such as leaves, grass, branches, green cut, etc.

In the 2nd recycling center electronic devices, packaging materials and hazardous materials can be recycled free of charge. More specifically the following materials can be recycled:

- Electrical and electronic equipment: Television sets, screens etc.; large household appliances e.g. washing machines, ovens, refrigerators etc.; Small electrical and electronics devices such as, computers, printers, radios, vacuum cleaners, mobile phones, keyboards, heaters, electric motors etc.; Cool and air conditioners; Cables (electrical cables)
- Packaging waste: cardboards, boxes, glass etc
- Paper: All kinds of paper (newspapers, pictorial, write papers etc.)
- Hazardous waste: Batteries, lamps, fluorescent tubes; chemical waste, paints, lacquer, wood preservatives, pesticides, caustic solutions; pharmaceutical waste; oil and eating oil; acids, fire extinguishers, ammunition etc

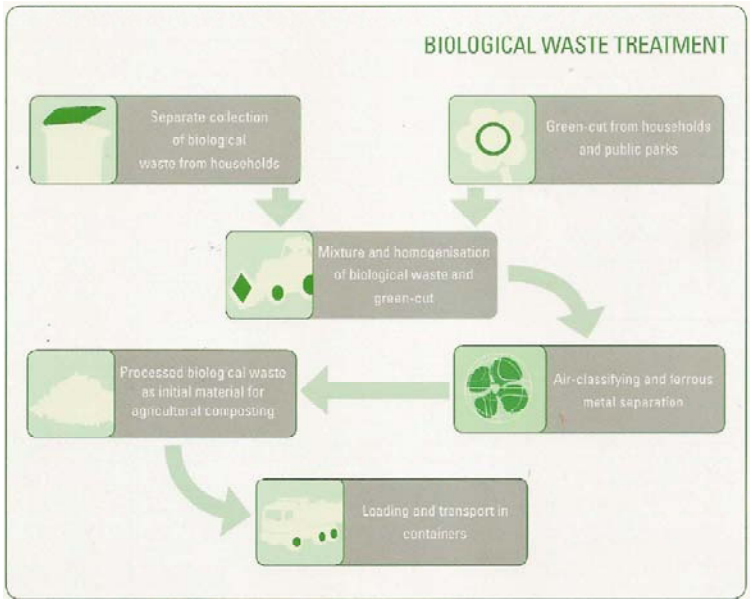
AEVG Recycling center characteristics

Number of users of the recycling centre		Quantity (Selection)			
During the week:	500	Scrap:	5,600 t	Plastic:	150 t
Saturdays:	1,100	Bulky waste:	4,500 t	Total quantity:	24,450 t
Sundays:	1,300	Hazardous waste:	350 t		
Entries/deliveries/year:	250,000	Paper and cardboard:	760 t		
Average quantity/user:	87 kilos	Glass:	120 t		

AEVG Biological Waste Treatment Plant

At the processing plant for biological waste at AEVG's site the biological waste is being mixed and homogenized with shredded green-cut (green-cut from private households and public parks) and special material is added for odour control. An air classifyer and a ferrous metal separator

then mechanically filter out non-biological and disturbing material such as plastic bags or metal. This kind of processing guarantees optimal material for further composting. All processed material is loaded into containers and transported to the farmers in the surroundings of Graz. The composting itself is de-centralized in co-operation with 18 Styrian farmers which use the produced compost. The process is illustrated in the following figure.



Flow diagram of the biological treatment process in AEVG biological treatment plant

AEVG sewage sludge treatment plant

AEVG runs a sewage sludge treatment plant in Gossendor the site of the sewage treatment plant of the City of Graz AEVG is responsible for the further treatment of the sewage sludge from the sewage treatment plant in Graz, i.e. the communal sewage treatment plant. The plant processes the generated wastewater of about 500,000 inhabitants. More than 100,000 tons of wet sludge with a dry substance of about 4% are treated. AEVG's facility is right next to the sewage treatment plant and basically consists of a de-hydrating and a drying facility. AEVG's task is the mechanical de-hydration of the sewage sludge with screen belt presses. De-hydrated to about 25-30% this sewage sludge is then dried by heat. The final product is 6,000 tons of sewage sludge granulate with a dry substance of about 90% and a heating value of about 9,000 kJ/kg.

AEVG sewage sludge treatment plant characteristics

Procedures	Quantities
▲ 72,000 tons of residual waste	▲ 147,000 m^3 of wet sludge
▲ De-hydration by 4 travelling screen presses	▲ 6,000 tons of sewage sludge granulate
▲ Drying to 90% dry substances	
▲ Loading on containers	
▲ Thermal utilization	

Waste/RDF incineration plant – Niklasdorf

Since January 1 2004, TRV ("Thermal residual waste recovery") Niklasdorf, which is run by Fa. Energie- und Abfallverwertungsgesellschaft m.b.H (ENAGES), has been operating in Styria, Gratz as fluidized bed firing plant with an annual capacity of just under 100,000 t. In this plant, residual materials generated during the treatment of municipal, commercial, and industrial waste and sewage sludge are recovered thermally. During the waste incineration in the Niklasdorf facility, steam and electricity are generated in a 25 MW fluidized bed vessel, which is used by the directly connected paper mill Brigl & Bergmeister. By release of process heat, the thermal recovery plant achieves efficiency factors between 75% and 85%. More information on the characteristics of the incinerator plant are given in the following table.

Waste/RDF incineration plant – Niklasdorf - characteristics

KEY DATA	
CUSTOMER:	
Siemens AG Österreich for ENAGES	
Niklasdorf / Austria	StartUp 2004
TECHNOLOGY:	
Bubbling fluidised bed boiler, flue gas cleaning, waste treatment	
Steam output:	48 t/h
Steam pressure:	44 bar
Steam temperature:	400 °C
Fuel:	RDF, waste wood, rejects, sludge
Calorific value:	8 – 18 MJ/kg