National Technical University of Athens

Municipality of Papagos

"Development and demonstration of an innovative household dryer for the treatment of organic waste"

DRYWASTE (LIFE 08 ENV/GR/000566)

Minutes from the trip to the Germany

Deliverable.6

15/7/2010

National Technical University of Athens

Table of Contents:

1. INTRODUCTION **2**

2. MEMMINGEN LOCATION **2**

2. 1.Wastewater drying facility in (Heimertingen) Memmingen *3*

2.1.1.OVERVIEW 3

2.1.2 PROCESS DESCRIPTION 4

2.1.3.FACILITY MAINTENANCE 7

3. AUGSBURG LOCATION **8**

3.1 Sludge drying facility in Augsburg *9*

3.1.1.OVERVIEW 9

3.1.2.PROCESS DESCRIPTION 9

3.1.3.FACILITY MAINTENANCE 14

Pictures:

PICTURE.1: PICTURE FROM OUR VISIT TO MEMMINGEN-HEIMERTINGEN WASTEWATER TREATMENT PLANT **1**

PICTURE.2 :HEIMERTINGEN **3**

PICTURE.3: HEIMERTINGEN WASTEWATER TREATMENT FACILITY **4**

PICTURE.4:ANAEROBIC DIGESTER FULLY OPERATIONAL INSIDE THE FACILITIES **5**

PICTURE.5: POWER GENERATOR **5**

PICTURE.6: *AUGSBURG* **8**

PICTURE.7: ANAEROBIC DIGESTER **9**

PICTURE.8: *BOX FOR INCOMING SLUDGE* **10**

PICTURE.9: HEAT WATER PIPES **10**

PICTURE.10: *SLUDGE MIXING MECHANISM* **11**

PICTURE.11: *AIR MIXING MECHANISM* **11**

PICTURE.12: *PROGRAMMABLE LOGICAL CONTROL SYSTEM* **12**

PICTURE.13: *AIR REMOVAL CHIMNEY* **12**

PICTURE.14: *SUMP FOR DRIED SLUDGE* **13**

PICTURE.15: *TEMPORARY STORAGE* **13**

PICTURE.16: *HOLE WHERE THE SLUDGE IS BEEN TIPPED OF TO THE TRACKS* **14**

Tables:

TABLE 1.TRIP ATTENDANTS **2**

TABLE 2.:*TECHNICAL DATA* **6**

TABLE 3.:*DRIER EFFICIENCY CHARACTERISTICS* **7**

TABLE 4.:*PLANT OPERATIONAL PARAMETERS* **7**

`

Figures:

FIGURE.1:DRYING PROCESS DESCRIPTION DIAGRAM 6

`

DRYWASTE PROJECT
Minutes from the trip to the Germany

Background

This deliverable reports on the site visits at a wastewater treatment plant in Memmingen-Heimertingen and a wastewater treatment plant in Augsburg in July 2010. The site visit was organized under the framework of Drywaste project, **LIFE 08/ENV/GR/000566.**

Picture.1: Picture from our visit to Memmingen-Heimertingen wastewater treatment plant

1. Introduction

This trip took place in Germany (from 07/07/2010 until 10/07/2010). Two sludge drying facilities were visited, one at (08/07/2010 in Memmingen) and one at (09/07/2010 in Augsburg).

Three (3) researchers from the National Technical University of Athens and Two (2) from Papagos Municipality, attended this trip as reported in **Table.1.** The duration of the trip was 4 days.

Table 1. Trip attendants

Sotiropoulos Aggelos	**NTUA**
Malamis Dimitrios	**NTUA**
Tsaroucha Despoina	**NTUA**
Fasouli Aikaterini	**Papagos Municipality**
Augoustakis Panagiotis	**Papagos Municipality**

2. Memmingen Location

Memmingen is a town in the Bavarian administrative region of Swabia in Germany. It is the central economic, educational and administrative centre in the Danube-Iller region. To the west the town is flanked by the Iller, the river that marks the Baden-Württemberg border. To the north, east and south the town is surrounded by the district of Unterallgäu (Lower Allgäu). With about 42,000 inhabitants, Memmingen is the 5th biggest town in the administrative region of Swabia. (Source: Wikipedia., 2010)

Memmingen is, with its low encumbrances, from €512 per capita to one of the lowest-encumbranced cities in Germany (Germany-wide more than €1,300). The city had at 2007 a management budget (*Verwaltungshaushalt*) at €94,925,160 and a asset budget (*Vermögenshaushalt*) at €19,490,860. The trade taxes incomes amounted to about €40 million, the income tax assignment at about €20 million. The local rates were last changed in 2003. The city estates about many foundations, whose roots partly go back to the Middle Ages (like the *Unterhospitalstiftung*). (Source: Wikipedia., 2010)

Heimertingen is a municipality in the district of Unterallgäu in Bavaria very close to Memmingen (Picture.2).

`

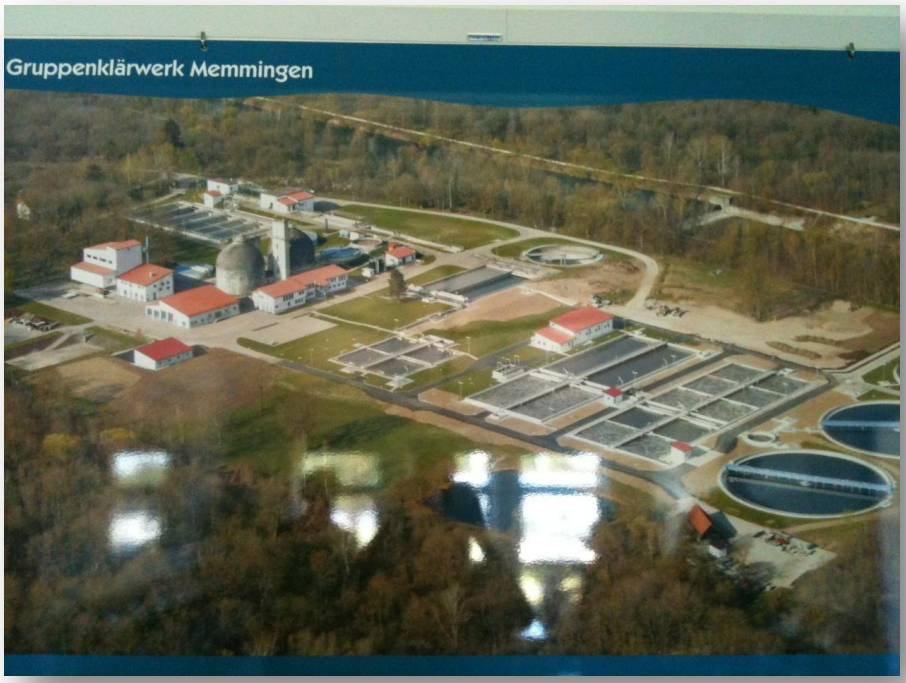
Picture.2 : Heimertingen

2. 1.Wastewater drying facility in (Heimertingen) Memmingen

2.1.1.Overview

Heimertingen wastewater treatment facility (Picture.3), is located in Memmingen approximately 20 minutes drive from the main train station in Memmingen. The facility is covered with very tall trees all around and it is placed in a spot away from residences (the forst residence is located approximately 3 kilometers of the facility).

It is a sewage treatment facility that treats wastewater from the city of Memmingen and suburbs. The facility has a primary treatment tank, a nitrification system, a denitrification system and a phosphorous removal system. The sewage goes to the secondary treatment tank where the separation between the sludge and water takes place. After the separation process ,the sewage sludge is taken to a sludge drier operating inside the facilities.



Picture.3: Heimertingen wastewater treatment facility

The sludge drier is manufactured by the «ANDRITZ GROUP» which is a manufactory company for customized plant, systems and services for hydropower, pulp and paper, steel and other specialized industries (solid/liquid separation, feed and biofuel). The group is headquartered in Graz, Austria and has a staff of approx. 13,400 employees worldwide. It develops and makes its high-tech systems at production, service and sales sites all around the world. (Source: Andritz., 2010).

2.1.2 Process description

Sewage sludge from the Wastewater treatment plant is treated in the following steps after digestion process:

- dewatered by centrifuges to a dry substance content of > 28%
- pumped after dewatering directly into a dosing silo
- pumped from the dosing silo (capacity 50 m^3) directly into the Fluid bed Dryer
- dispersed and dried in the fluid bed to a dry substance content of > 90%
- fed to a product silo (capacity 100 m3) and stored for truck loading

Thermal energy for the drying process is generated by burning Biogas which is produced by an anaerobic digester (Picture.4). operating in the sewage sludge facilities or if necessary oil in a Boiler. Usually from Monday-Friday the energy

is produced by burning biogas and during the weekend or in case some malfunction occurs to the anaerobic digester, a thermal oil method is used.

Picture.4: Anaerobic digester fully operational inside the facilities

The facility is usually closed during the weekend but electronic equipment (sensors) for the monitoring of the drying process operate inside the facility and the staff can access the control system from their houses so if anything goes wrong everybody communicate with each other so that the potential problem is solved with no significant cost.

Thermal oil (Picture.5). will be used as media to transfer the heat to the heat exchanger of the drier. Excess heat from the condensation process is also available to heat up the digesters transferred by a heat exchanger (60/40°C).

Picture.5: Power generator

The installation has different options for the handling of the sludge/product:

- discharge of the mechanical dewatered sludge to containers
- production of partially dried granules with 65 – 90% dry substance
- production of fully dried granules with 90% DS (main product route)

A diagram with the drying process is shown in (Figure.1)

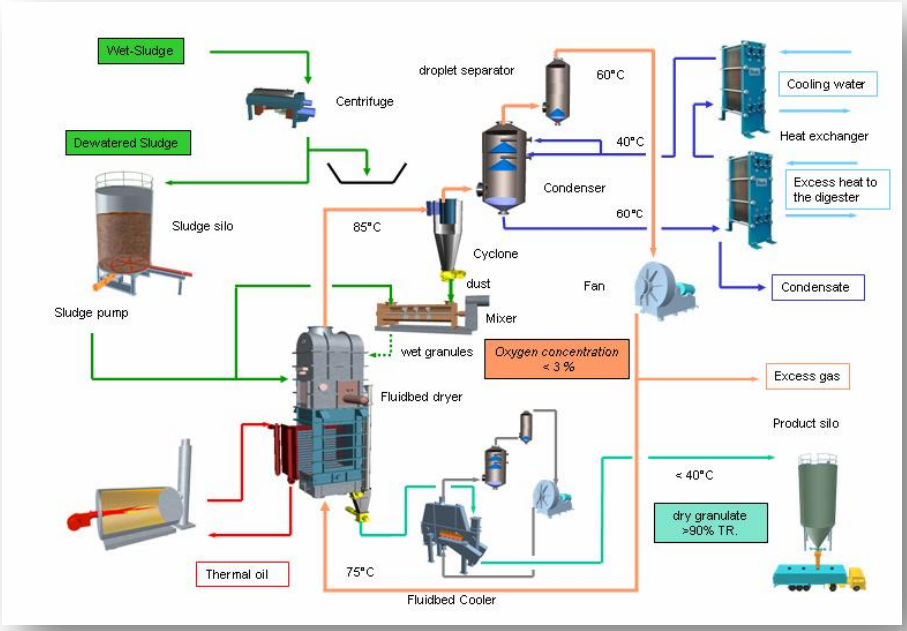


Figure.1: Drying process description diagram

The data concerning the sludge dryer operation are presented in the following tables (2,3,4):

Table 2.:*Technical data*

Technical data	
Mechanical dewatering	Centrifuges
Wet sludge throughput:	20 m^3/h at 4 %DS (600 kg DS/h)
DS content after dewatering:	> 28 % DS

Table 3.:*Drier efficiency characteristics*

Thermal drying	**Fluidbed Dryer**
Sludge throughput:	2'175 kg/h at 28% TS
Water evaporation:	1'480 kg/h
Energy source:	Biogas or Oil
Thermal Energy:	1120 kW
Production of dry granules:	max.15 t/Tag
DS content of the product:	>90 %DS
Size of the granules:	0.5 - 5 mm

Table 4.:*Plant operational parameters*

Plant operation	
Personnel:	1 Operator (dayshift) None (nightshift)
Operation time:	24 h/day, 5 days/week
Availability:	8.000 h/year
Commissioning	December 2003

The plant dries 3500 tons/year of treated sludge and the total cost of the drying facility is approximately 16 000 000 euros while the total sewage treatment plant facility cost is 42 000 000 euros. The final product without the excess moisture and without the polluting odors is transported to incinerators for burning.

2.1.3.Facility maintenance

The facility's maintenance period is usually once per year for a duration of (1-2) weeks. The sludge is stored in the facility with no significant problems. If during the facility's operation a problem appears, the problematic facility part is isolated while the rest of the parts continue to operate during the recondition process.

`

3. Augsburg Location

Augsburg is a city in the south-west of Bavaria in Germany. It is a College town and home of the Regierungsbezirk Schwaben and the Bezirk Schwaben. Augsburg is an urban district and home to the institutions of the Landkreis Augsburg. It is, as of 2008, the third-largest city in Bavaria with a population exceeding 264,000 citizens. After Trier, Augsburg is Germany's second oldest city.

Augsburg (Picture.6), is a vibrant industrial city. Many global market leaders namely MAN, EADS or KUKA produce high technology products like printing systems, large diesel engines, industrial robots or components for the Airbus A380 and the Ariane carrier rocket. After Munich, Augsburg is considered the high-tech centre for Information and Communication in Bavaria and takes advantage of its lower operating costs, yet close proximity to Munich and potential customers. (Source: Wikipedia., 2010)

Picture.**6:** *Augsburg*

3.1 Sludge drying facility in Augsburg

3.1.1.Overview

Augsburg sludge drying facility, is located in Augsburg approximately 30 minutes drive from the main train station of the region. The facility is 500 meters away from residences while the operator's residence is just outside the facility for 24 hours facility monitoring. It is a sewage drying facility that dries sludge from 4-5 small sewage sludge facilities that operate near the city of Ausburg.

The EDZ-drying method makes effective use of solar heat radiation in a solar house equipped with floor heating and the waste heat available in many locations for instance from block heating stations makes it possible, to produce fuel out of sewage sludge in a cost effective way. The product obtained using the EDZ- drying method is a fuel granulate with > 90% dry substance contents and an energy content between 9 –12 MJ/kg (Å 2.5 - 3.3 kWh/kg).

3.1.2.Process description

In the facility operates a small scale anaerobic digester (Picture.7) (Fermentation Process) which uses grass and woodchips for the production of biogas the burning of which is used for heating the water which is in turn used for the heating of the drying facility.

Picture.7: Anaerobic digester

The sludge is placed into a large box (Picture.8) which is connected to the main drying facility with a pushing floor and then pushed automatically inside the solar house where the drying process takes place.

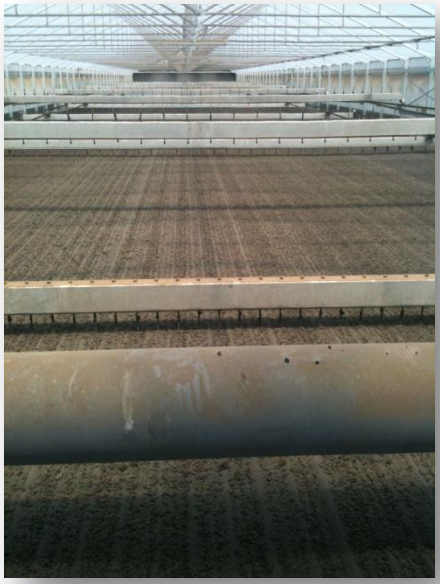
Picture.8: *Box for incoming sludge*

Approximately 120 Water pipes (Picture.9) with the use of the thermal energy produced by the biogas burning process and water, heat the concrete floor at a temperature of about 55°C and produce the final dry organic product.

Picture.9: Heat water pipes
(Lazaretos.,2009)

`

The sludge height inside the solar house is no more than 10cm for the drying process to be effective. It also mixed during the whole process with the use of a special mixing mechanism 'WendeWolf' (Picture.10) for the drying process to be even faster.



Picture.10: *Sludge mixing mechanism*

Drying is accelerated and condensation formation prevented through guided supply (Picture.11) and exhaust air. The Performance of this mechanism, depends on the air humidity involved. A programmable logical control governs the air exchange and waste heat supply. Optimum drying results are achieved as a result.

Picture.11: *Air mixing mechanism*

A programmable logical control (Picture.12) governs the air exchange and waste heat supply. Optimum drying results are achieved as a result.

Picture.12: *Programmable logical control system*

The excess moisture is being removed through a chimney (Picture.13) which is installed at the top of the solar house where the drying process takes place.

Picture.13: *Air removal chimney*

The sludge keeps moving (from one way of the greenhouse to the other) with the help of the pushing floor until it dries out completely. Then the dried sludge is been disembogue into a sump (Picture.14).

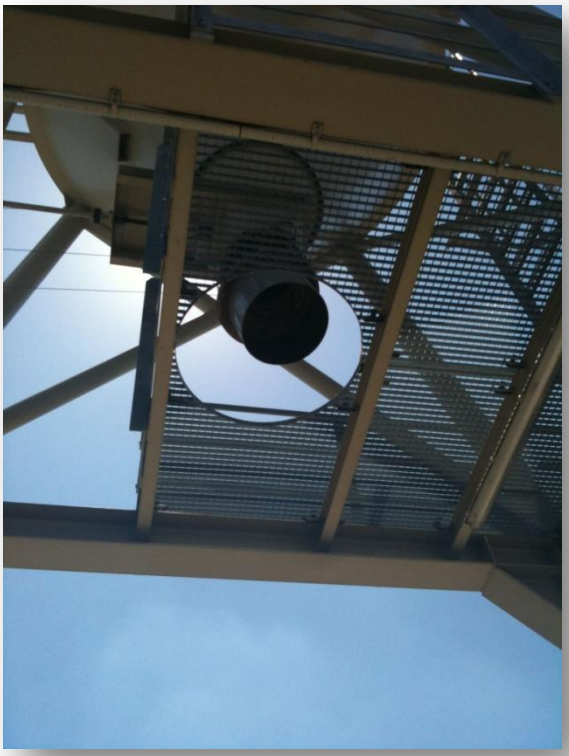
Picture.14: *Sump for dried sludge*

Finally the dried sludge is been transferred automatically to a temporary storage (Picture.15).

picture.15: *Temporary storage*

`

The sludge is been collected by tracks and sold to the market for incineration for a price of about 30 euros/ton.



Picture.16: *Hole where the sludge is been tipped of to the tracks*

It must be mentioned that everything takes place automatically and no personnel is required to carry out the process. Only one person is enough for the management of the whole operation.

The facility needs approximately 30 KWH/ton of water of energy to operate while the performance of it depends on the weather. In the winter approximately 15 ton/day of sludge is been dried while in the summer (when the greenhouse performance is higher) almost 25-30 tons/day of sludge is been processed. Finally, the facility takes about 1000 m^2 of space and its cost is approximately 600.000 euros.

3.1.3.Facility maintenance

The facility's maintenance period is usually once per year for a duration of (1) week. The sludge is stored in the facility with no significant problems as stated by the operator of the facility.

References:

Internet Sources:

Andritz, 2010. Company Profile [Online] Available from: http://www.andritz.com/ANONID0F9F0E6E2C8E1794/about-us/about company-profile.htm

Wikipedia, 2010. Augsburg [Online] Available from: http://en.wikipedia.org/wiki/Augsburg

Wikipedia, 2010. Memmingen [Online] Available from: http://en.wikipedia.org/wiki/Memmingen

The Bavarian Ministry of the Interior, 2010. staedtebaufoerderung [Online] Available from: http://www.stmi.bayern.de/bauen/staedtebaufoerderung/programme/10198/

Bibliografy

Sewage Sludge drying Plant (At the waste water treatment Plant Memmingen), 2010. Memmingen Umwelt-Aktiv, Andritz Memmingen sludge drying facility flyer.

Lazaretos. 2009, Msc thesis, 'Sludge management and biofuel potentiality' Technological Educational Institute of Crete - Branch of Chania, Department of Natural Resources & Enviroment

`

`