

AN OVERVIEW OF THE MOST MODERN AND BIGGEST LANDFILL GAS POWER PLANT (BERLIN-SCHWANEBECK) IN EUROPE

E. Erdin , A. Alten, A. Ürüt and G. Şirin

Dokuz Eylul University, Department of Environmental Engineering, Kaynaklar Campus,
35160 Buca-Izmir

Emails: ertugrul.erdin@deu.edu.tr ; akin.alte@deu.edu.tr ; afsaru@ttnet.net.tr ;
gorkem.sirin@deu.edu.tr

ABSTRACT

Schwanebeck landfill site was used as an uncontrolled dumping area before the union of Federal Republic of Germany and Democratic Republic of Germany at 03/10/1990. The solid wastes (SW) are dumped to the pits in sand and gravel mines while East German era. At 1973 the site was begin to use as wild dumping area. After the rehabilitation activities at '90s it has become a modern landfill site. In this paper, some information is given about the landfill gas power plant of this landfill site.

INTRODUCTION

In landfill sites, decomposition of bioorganic and green wastes results in the formation of landfill gas in anaerobic conditions. Approximately 60% of this gas is methane and 40% is carbon dioxide. During decomposition, leachate which may have some volatile compounds is produced. If this leachate is not recirculated into landfill body, there will be a loss in landfill gas production potential.

In domestic solid waste landfill sites, the following parameters should be analyzed in raw leachate; AOX, COD, NH₄-N, electrical conductivity, boron, pH, evaporation residue, ignition residue, sulphate, nitrite, nitrate, chlorine. Some results of leachate analyzes made in landfill sites in North Germany are given in Table 1.

Paths and transformations of carbon in landfills;

- Landfill gas % 92
- Leachate % 2.5
- Permeate % 0.0003
- Chemosynthetic % 0.3
- Residue in landfill % 5.

A comparison of biogas and landfill gas is given in Table 2.

Berlin-Schwanebeck landfill site has a potential to form constant amount of landfill gas for about 10 years. This most modern and biggest landfill gas power plant was designed according to these calculations. 3000-4000 m³ natural gas is used for heating and hot water in a house in a year, while this amount of natural gas is generated in 1.5 hours in this landfill site.

BERLIN-SCHWANEBECK LANDFILL SITE

Area of Berlin-Schwanebeck landfill site is about 52 ha. Current volume of site is 8 Million m³, while the planned final useable volume is 10 Million m³.

In Berlin-Schwanebeck landfill site, waste is compacted as thin layers. Compactors, bulldozers and cranes are used in the construction of landfill site. Number of staff is 28 including drivers, landfill workers, controllers, installers and officials.

Solid wastes, generated in northeast of Berlin, are landfilled in this site. Approximately 8 Million m³ solid wastes have been landfilled forming 25m height. The deep pit, which was sand and gravels mine, was filled with construction wastes in 1960's. Then demolition wastes and domestic solid wastes were dumped into the area. The area was used as central landfill site from 1973 to 1990. After 1990, the area was rehabilitated and its environmental effects were minimized.

All the laws, regulations and facility instruction are obeyed in the landfill site. Life of landfill volume has been lengthened by thin layer compaction technique. While the solid wastes were dumped without any compaction in the past, nowadays they are compacted well, so ground safety is provided. Completed part of landfill is covered with a soil layer then planted. Covering and planting prevent odor, dust and erosion.

Entrance and social facilities were modernized in 1990's. All the wastes are weighted and recorded. The plant has a meteorology station to measure the local conditions. At the entrance, there are many different containers for special wastes.

Before the rehabilitation of landfill site, there were methane and carbon dioxide releases to atmosphere which may cause green house effects. It was prevented by rehabilitation.

Today Schwanebeck landfill site is one the most modern landfill gas power plants in Europe. There is built 117 drilling wells to collect, transport and combust the landfill gas produced under anaerobic conditions. The wells are placed 70 m distant from each other, with a diameter of 25 cm. There will be used perforated HDPE pipes, which are installed to 12-28 m depth. An active collection system, vacuum, is installed to collect the landfill gas from wells for 52 ha landfill area. 400 mbar constant vacuums are applied. The graded interval of vacuum is 200 m³/h – 5000 m³/h. The maximum flowrate achieved is 3000 m³/h. The collected gas quality is controlled continuously and transferred to gas collection stations and than gas compression unit. The water content and suspended solids are removed and landfill gas is purified.

LANDFILL GAS AND POWER PLANT

In order to collect the landfill gas, while solid wastes are buried, wells are built in landfill. In Berlin-Schwanebeck landfill site, there are 117 wells and 400 mbar constant vacuums are applied to collect the landfill gas. The collected gas is transferred to gas collection stations. Important parameters O₂, CO₂, CH₄ and N₂ are measured at collection stations.

While applying vacuums to wells, pressure must be adjusted to collect the landfill gas around the well. If

excess pressure is applied, ambient air may enter the landfill body and cause aerobic conditions which may result in decreasing of methane generation and even stopping.

It is assumed that the Berlin Schwanebeck landfill will produce landfill gas for 10 years, approximately with 2500 – 3000 m³/h flowrate. 1 m³ natural gas has the same calorific value of 1 m³ landfill gas. In Berlin for hot water and heating purposes 3000-4000 m³ natural gas consumed yearly for a house, which is produced in Schwanebeck for 1.5 hours. Flow scheme of landfill gas in Berlin-Schwanebeck landfill site is given in Figure 1. [1]

Power plant is a heat-power plant, which has 6 modules, 16 cylinder Otto-Gaz gas combustion engines, operating under low blend technique. 4 of the engines have a power of 626 kW (850PS), where 2 of them have 1240 kW (1700 PS) power. The heat energy is converted to mechanical and than electrical energy, namely 5000 kW/h.

The %99.5 of electrical energy produced is send to high voltage (20 kV) transmission lines, so to the national network. The rest is consumed at landfill. The plant serves for 32000 people or in other words 8000 dwellings. The energy is sold as renewable energy price. Generation of electricity is given in Figure 2. [2]

Combustion engines will not only produce power (mechanical) energy but also heat energy. The amount

of heat energy produced is 1.3 times of electrical energy produced: 6500 kW. A minor amount of heat energy is utilized in Schwanebeck as hot water and heating purposes. The rest is send to Berlin – Buch heat-power plant with a 3.5 km transmission line.

CONCLUSION

Berlin Schwanebeck landfill site was a wild dumping area prior to union of East and West Germany. It became most modern and biggest facility in Europe after the projects and investments in 1990's.

Nowadays landfill gas forming in the site is collected under quality control. Collected gas is processed and then electricity is produced. 32000 people or in other words 8000 dwellings uses most of electricity produced.

REFERENCES

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2. Anonym, 2002. Entsorgung mit Zukunft Abfallwirtschaft. BSR. Berlin.
3. Personal interviews, 1999. Made by E. Erdin in Germany.

Table 1. The following values were obtained as a result of leachate analyzes made in landfill sites in North Germany [3]

Parameters	Unit	Limit value	Landfill A	Landfill B	Landfill C
COD	mgO ₂ /l	400	2500-3500	3000-4000	800-2000
BOD ₅	mgO ₂ /l		200-350	200-500	300-800
Chlorine	mg/l		2000-3000	1500-2500	900
Filterable matters	mg/l	20	**	10-100	**
Total N	mg/l		1200-1900	1200-1500	200-300
NH ₄ -N	mg/l	155	1000-1700	700-1300	200-300
Lead	µg/l	500	**	30-50	<40
Cadmium	µg/l	100	**	1-2	20
Chromium	µg/l	500	**	200-600	20
Copper	µg/l	500	**	20-50	50
Nickel	µg/l	500	**	100-300	240
Mercury	µg/l	50	**	0,2-0,3	4
AOX	µg/l	500	**	1200-2000	760
Zinc	µg/l	2000	**	100-300	340

Table 2. Comparison of biogas and landfill gas [3]

Components of gas	Unit	Biogas from farms	Domestic wastewater treatment plant	Domestic solid waste landfill gas
Methane	%	60-70	55-65	45-55
CO ₂	%	30-40	different	30-40
Nitrogen	%	< 1	<1	5-15
H ₂ S	ppm	10-2000	10-40	50-300

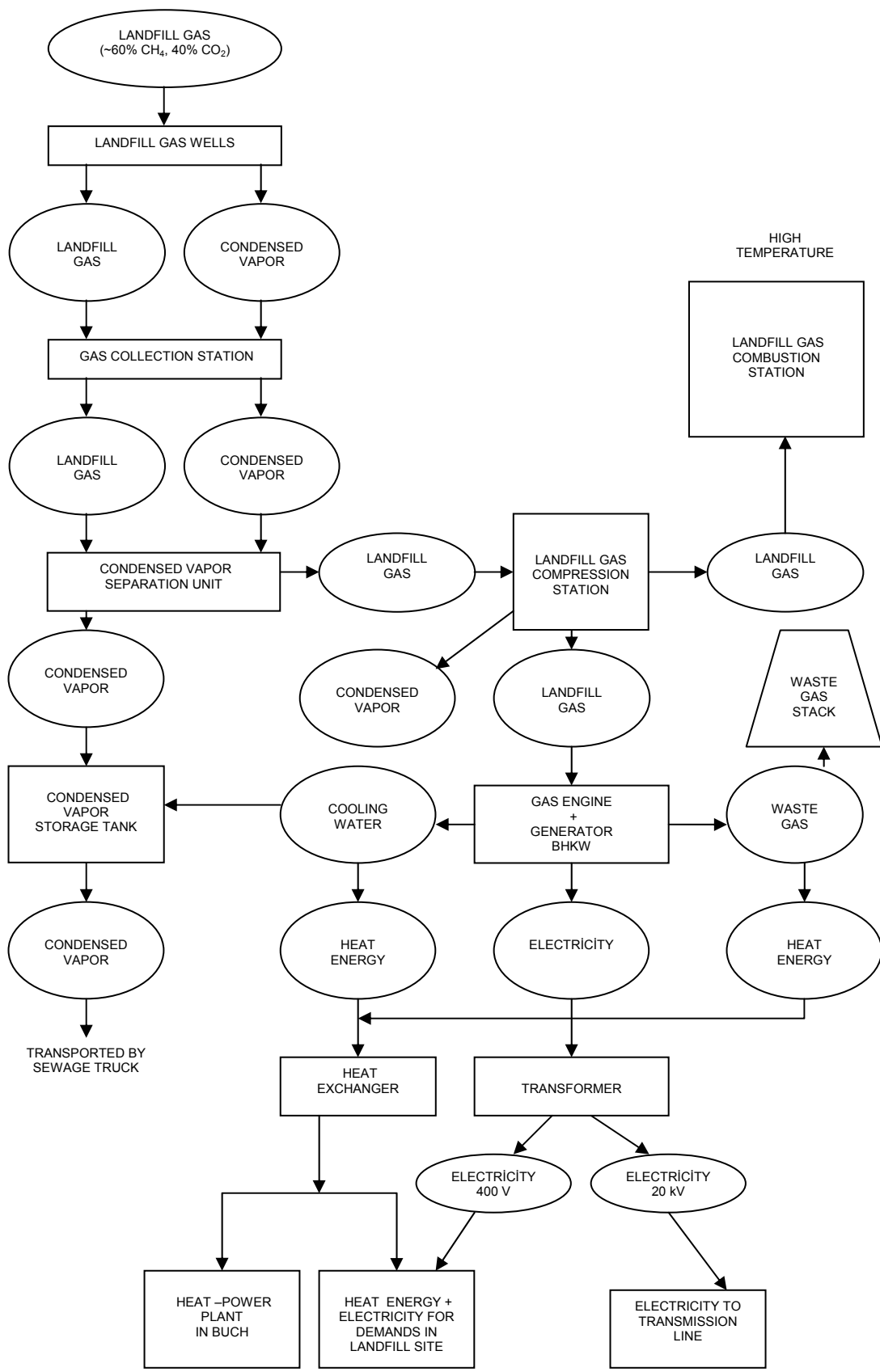


Fig. 1. Flow scheme of landfill gas in Berlin-Schwanebeck landfill site [1]

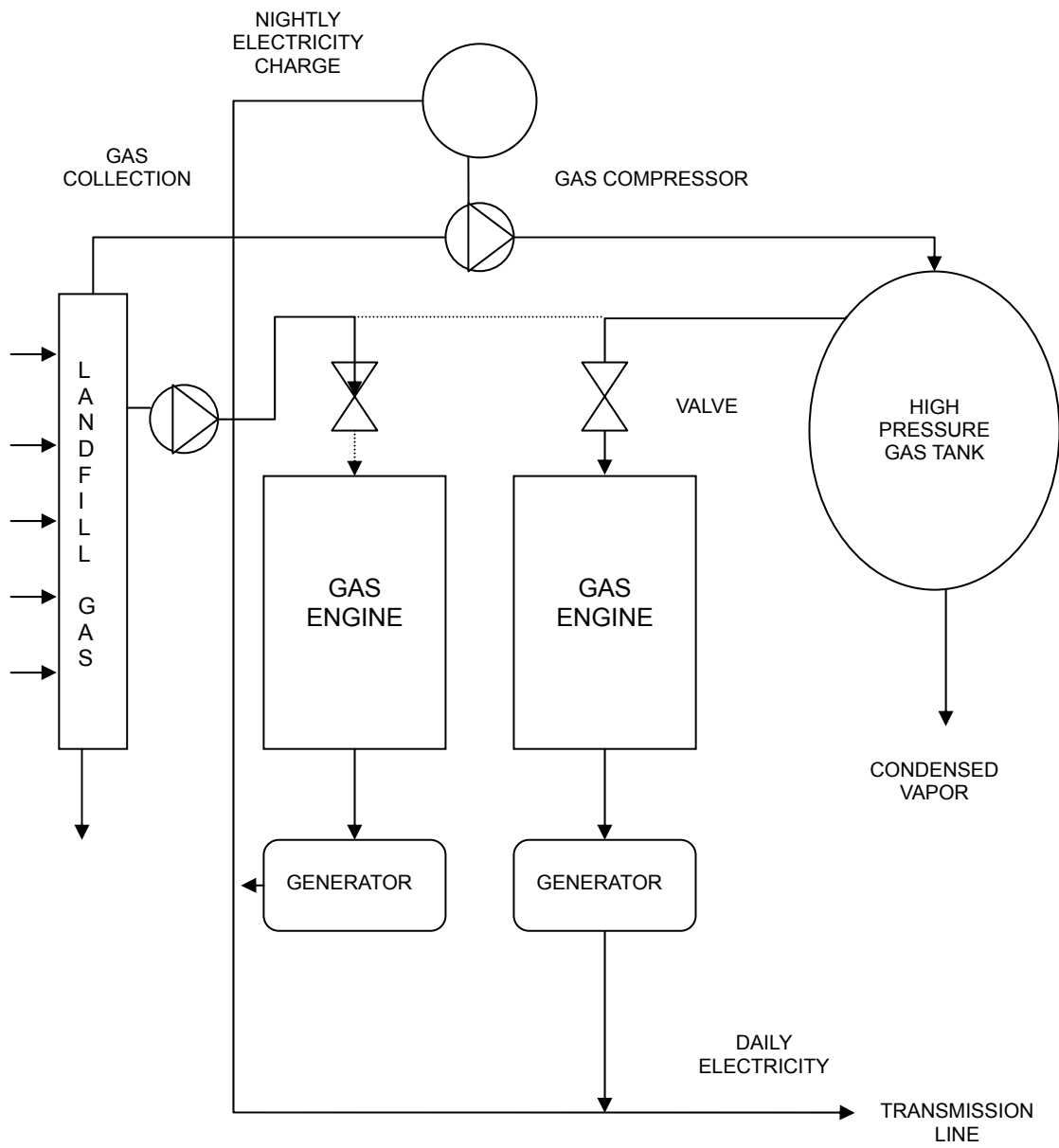


Fig. 2. Generation of electricity gas in Berlin-Schwanebeck landfill site [2]