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POSSIBILITIES OF USING BIOGAS FROM LANDFILL AND BREWERY AS A RENEWABLE ENERGY SOURCE

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ABSTRACT: Utilization of landfill gas means its aggregation, treatment and burning, caused by decomposition of organic waste. In addition of the possibility of landfill gas utilization for energy, the reducing gas emissions that cause greenhouse effect, the eliminate unpleasant odor and risk of explosion, and the risk assessment of surrounding villages, are also reasons for landfill gas monitoring and using. Beside using landfill gas, the biogas, produced during anaerobic treatment in brewery, which is a proven and energy efficient way of treatment waste water from brewery, can be also used as a renewable energy source. This paper describes the possibility of joint using biogas produced from waste water treatment in brewery and landfill gas from unsanitary landfill. The brewery and landfill are located near the city of Novi Sad, with small distance between them, about 1 km; the construction of plant for joint use of the produced gases can be realistic and economically approved. Economy of appointment system for using landfill gas and biogas from brewery depends from factors such as the amount of generated gas, the availability of users and potential impacts to the environment. Depending on the amount of generated landfill gas, and the amount and composition of gas generated from wastewater treatment plant, different possibilities of common use of energy by produced gases are presented.

KEYWORDS: biogas, landfill gas, brewery, landfill

❖ INTRODUCTION

City of Novi Sad has about 300.000 inhabitants. Based on available data, about 300 tonnes of waste is daily disposed on landfill. Landfill complex covers an area about of 56 ha. The possibility

of expanding the landfill is in direction of the east. Deposited allowed types of waste on landfill are municipal waste, industrial waste without properties of hazardous materials, biodegradable waste (grass, branches, leaves, sawdust, etc.), inert waste, small and large construction waste. Composition of waste, on landfill in Novi Sad is favourable to higher methane generation rate due to significant amount of biodegradable compounds. Composition and quantity of municipal waste generated in the city of Novi Sad is given in the Tab. 1 [1].

There are many factors influencing the landfill gas components and its production level. The most important factors are climate (precipitation, atmospheric pressure, temperature and air humidity), waste age, waste type, and disposition method. Meteorological parameters have significant influence on the intensity of chemical and biological processes which are affecting to the production level, composition and the possibility of landfill gas migration in the deposited waste [2].

Table 1. Structure of municipal waste in city of Novi Sad [1]

Components	Average value [t]		Percentage value [%]
	Daily	Yearly	
Paper	36.5	133323	13.5
Glass	4.0	1460	1.5
Plastic	32.1	11714	11.5
Metal	5.3	1935	1.9
Tire	1.7	621	0.6
Textile	5.9	2154	2.2
Organic waste	178.4	65116	65.8
Other	8.1	2957	3.0
Total	272.0	99280	100.0

Table 2. The composition of landfill gas that is used to form fuel cell projects [3]

Component	Percentage value [%]	
	Range	Average
Methane	35 - 60 %	50 %
Carbon dioxide	35 - 55 %	45%
Nitrogen	0 - 20 %	5%
Oxygen	0 - 2,5 %	< 1 %
Ammonia	No data	No data
Non-methane organic compounds (NMOC)	237 - 14.294 ppmv	2.700 ppmv
Sulphides	1 - 1.700 ppmv	21 ppmv
Water vapor H ₂ O	1 - 10 %	No data
Carbon monoxide	No data	No data

Brewery in Novi Sad is located about 6 km north from the centre of the city. Distance from the closest residential buildings is about 700 m. The capacity of the brewery in Novi Sad is 4.5 million hl of beer for sales per year. The Fig. 1 shows a satellite image of the brewery (numbered with 1) and landfill in Novi Sad (numbered with 2)



Fig. 1. Satellite image of the brewery and landfill in Novi Sad [4]

❖ RESULTS

Key data for the possibility of utilization of landfill gas is the amount of generated landfill gas. The

amounts which were obtained from the research present values from 9 to 14 million m^3/year [5]. The obtained data were acquired with the presumption of stable methane production. Experimental measurement proves the appearance of delay in methane generating in winter period. This amounts show great energy capacity of the Novi Sad landfill, and after fulfilling certain technical requirements (primarily, increasing landfill depth), the application of combined solutions is realistic and feasible.

Adopting the chemical oxygen demand (COD) value of 1.53 kg/hl of beer, and counting with a maximum theoretical methane production (CH_4) of 0.35 m^3 per kg of removed COD, and 80% COD removal efficiency of anaerobic reactors, it is estimated that methane production is 0.43 m^3 CH_4 per hl of beer [6]. Based on the current annual capacity of the brewery, about 4.500 000 hl of beer, we came to the potential amount of generated methane in the treatment of wastewater from the brewery which is about 2 million m^3 per year.

Counting with the values obtained with the assumption of stable generation of methane from the landfill (and implement other conditions) with amount from 9 to 14 million m^3/year , and the potential amount of methane generated in the treatment of wastewater from the brewery which is 2 million m^3 per year for current annual capacity of brewery, we get the average amount of generated methane which is 14 million m^3/year .

Collection of produced biogas from wastewater treatment in the brewery and landfill gas (which also contains a large amounts of methane) from landfill in Novi Sad, which is located at 1 km from the brewery, it can be collected sufficient amount of gas to install some of the efficient plants for energy production.

❖ CONCLUSION

Counting with the values obtained by assuming a stable generation of methane in the landfill (and the fulfillment of other conditions) and the potential amount of generated methane in the treatment of wastewater from the brewery, we get an average amount of generated methane which is about 14 million m^3/year . Energy and economically the most efficient use of biogas generated from the wastewater treatment in brewery and generated landfill gas, would give the use of combined installations regarding combined production of electrical energy and heat. Electrical and heat energy which would be obtained, can be used for the brewery and landfill needs, or can be surrender to the electrical and thermal networks or to be used for the surrounding villages.

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