Gas household, utilisation of landfill gas and emission reduction on landfills for household waste in Styria

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1. Summary

Anaerobic decomposition of household waste rich in organic matter leads to landfill gas with the main components methane and carbon dioxide, which will escape into the surface of the atmosphere at landfills without a waste disposal system. This will first result in annoyance caused by bad smell and damage to the vegetation. Then there is the risk of formation of explosive gas compounds. Explosive landfill gas causes problems relating to safety technology, in particular at abandoned landfills with subsequent construction work or near residential areas.

The production of landfill gas is a process often lasting for decades. Therefore, it will, from a certain size of the landfill, be possible to utilise the existing energy potential economically under certain conditions. However, the profitability of such a utilisation of landfill gas depends on numerous factors, such as the potential for utilisation, the utilisation period or the distance of the landfill from the consumer.

The present study was limited to a number of operating landfills for household waste that were selected by the "Land Steiermark, Fachabteilung 1c" ("Province of Styria, Specialised Department 1c") as well as to suspicious areas where the result of the landfill history suggested a high production of landfill gas. The required investigations at the landfill operators' and site visits were accompanied by measuremens of the composition of landfill gas at all the sites in 1994.

This means that the present study takes stock of the specific gas emissions and gas household of selected Styrian landfills without claiming completeness. By no means can it be the solution of site specific detailed questions but it is an attempt to derive generic valid statements by linking theoretical bases with concrete investigating and measuring results.

The study is subdivided into the following steps:

- Getting documentation and creating a data base on the literature
- Compiling the required theoretical bases
- Studying and describing the construction stage and gas household of 16 landfill sites in Styria in the form of a cadastral map for landfills
- Results of measurements of landfill gas in 15 landfill sites
- Assessing the emission situation and the possibilities for use

2. Starting Position

At landfills on which household waste was put, the development of landfill gas must be expected, in any case. If the gas formed in the landfill body leaves the landfill as an uncontrolled emission, this may endanger the environment. Landfill gases may be toxic and lead to death due to suffocation. They may damage vegetation and the soil. They are explosive and easily inflammable. They lead to annoyance caused by bad smell and they load the atmosphere. Therefore, problems relating to safety technology may be caused, in particular at abandoned landfills with subsequent construction work or near living areas.

Essential factors influencing the formation of landfill gas are, among other things, the water content, the temperature, the pH value, the content of nutrients and substrates as well as the concentration of toxic substances.

3. Goals

A number of landfills where a high gas production had to be expected and which were selected by the "Land Steiermark, Fachabteilung 1c" ("Province of Styria, Specialised Department 1c") were to be studied as to their gas emissions. Attempts were to be made to link theoretical bases with the concrete investigating and measuring results for the respective landfills

The following landfill sites were incorporated into the study programme: Frohnleiten, Pausendorf - Knittelfeld, Liezen, Allerheiligen - Mürzverband, Frojach - Katsch, Aich - Assach, Karlschacht - Voitsberg, Zattachweg - Weiz, Öd - Markt Hartmannsdorf, Halbenrain, Feldbach, Ritzersdorf I und II - Judenburg, Köglerweg - Graz, Fürstenfeld as well as Kaindorf - Tiefenbach. The landfill volume of the studied sites ranged from appr. 17,800 m³ to appr. 9,400,000 m³, the surface from 8,000 to 130,000 m².

4. Procedure

The first part of the study consisted in compiling the required theoretical bases and in creating a data base of the literature. For this, projects for environmental research, rulings, standards and directives as well as pertaining literature were combined to a relational data base. The theoretical bases served to study the gas formation, the collection of landfill gas, the purification and degasifying methods as well as the utilisation of landfill gas.

The selected landfills were classified according to the composition of their waste, to the size of the landfill, to the annual amount of waste, to the age of the landfill and to the availability of gas collecting systems. A computational model serving to predict landfill gas was created and the model parameters used for this were stated. At the selected sites, gas measurements at the site and profitability deliberations were then performed.

5. Result / Benefits

In general it may be stated that that no correlation between the type of installation, compression (newly poured, compressed, pressed) and methane concentration could be seen. As is shown by the gas predictions, a possible preliminary sorting won't inflence the identified methane concentration either but will rather influence actual gas production.

At landfills on which household waste was put, the development of landfill gas must be expected, in any case. At landfills with waste disposal facilities, a part of the produced gases can be collected according to the achieved degree of collection, which is between 40-60%. Quite a considerable part is left in form of uncontrolled rest emissions and still is a considerable source of emissions. Action required for collecting landfill gas must be designed as to make sure that the remaining residual emissions are still ecologically compatible.

In this context, a value of residual emission that amounts to 4-6 l/m² . h of landfill gas, which corresponds to 70 ppm directly on the surface, should not be exceeded sustainable and considerably. Otherwise sealing measures or the improvement of gas collection should be provided for.

Except for the Landfill Feldbach, methane concentrations in the residual emissions that were calculated on the basis of measurements of landfill gas have, with existing post-use, not led to a risk potential that would make sanitation necessary.

For creating the gas predictions, the model of Tabasaran/Rettenberger was used. This model excels by simple handling and a low number of parameters. This is all the more important as the required input variables only are known badly. In this context, it could be shown that the reference value of 70 ppm of methane gas in the emission did not have to be expected by 2020 at any of the studied landfills that had no degasifying system.

At any rate, the profitability of the utilisation of landfill gas must be assessed separately. General statements are made impossible by different conditions of the sites, different infrastructure and a different price structure. According to the individual landfill operators, a utilisation may be considered from a gas potential of 200 m³/h. As a rule, the landfill gas is used for covering the own needs of the facility for hot water production and the generation of electric energy.