The Study on the Estimation of Greenhouse Gas Emission from Landfill Facilities

Chan-Jin Park
School of Urban & Environmental Engineering
University of Incheon
Incheon, Korea
e-mail: cjpark@incheon.ac.kr

Abstract—The estimation of greenhouse gas emission from landfill facilities was investigated using the monitoring of greenhouse gases & applying the methods of IPCC 2006 comparatively. The tendency of major components such as methane and carbon dioxide gas with the elapse of time were analyzed and the minimization of gas emission were studied to decrease the global warming effect of landfill gas emission from the landfill facilities.

Keywords- global warming, greenhouse gas, landfill

I. Introduction

The recent extra-ordinary changes of weather in the earth have been the main issues of every country in the world. The world-wide global warming would be the most urgent problem which must be solved for better life of our living.

Use of fossil fuels are the main source of greenhouse gas such as carbon dioxide gas & nitrous oxides. Freon gas has been used for wide applications in chemistry & electronic devices but nowadays it is prohibited for strong effect of greenhouse effect. Recently methane gas from landfill facilities & grass-eating animals has been worried about due to the strong GWP (Global Warming Potentials) of methane gas. In this study the methods of estimation for greenhouse gas emission from the landfill facilities was investigated.

II. Experimental

Major components of landfill gas are methane, carbon dioxide gas, non-methane Volatile Organic Compounds, nitrous oxides & carbon monoxide. The degradation of wastes in landfill sites are primarily due to physical, chemical and biological processes, & major greenhouse gases are methane and carbon dioxide gas.

In this study, the methods of monitoring landfill gas in Incheon area which can be calculated to the amount of greenhouse gas during the given time, & the other methods of IPCC 2006 manuals[1]. Table 1 shows the global warming potential of each components.

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<th>Components of LFG</th>
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The amount of landfill gas generation estimation is affected by various factors & degradation of wastes is supposed to first order reaction. From the IPCC 2006 manual, the main methods of estimation is classified as Tier1, Tier2 & Tier3 category. And several famous models are IPCC Reference Method, Scholl Canyon Model & Methane Emission from Landfill Method, etc. In this study IPCC 2006 and direct monitoring methods were adopted to calculate the emission of greenhouse gases.

III. Results & Discussions

The generation of landfill gas is classified to four steps which can be expressed as the aerobic process initially to final anaerobic process. After one or two years from landfill, the amount of methane and carbon dioxide gas becomes nearly constant. The generation time of greenhouse gas is estimated as from five to twenty years. The methane gas in landfill gas must be treated due to strong greenhouse effect to the incineration facilities and after that thermal energy is utilized as the generation of electrical power which can be classified as the Clean Development Mechanism.
Landfill gas has been monitored continuously in the Incheon area such as Table 2, and the concentration of methane gas is about 37.1% to 63.5% with annual average values.

Methane has shown the highest value of 63.5% in the year of 2000 and after that the value has decreased until 2004 & then increased gradually. Carbon dioxide gas from the landfill emission is approximately the concentration range of 13.3% to 47.1% and it has decreased until the year of 2006, but it has the tendency of over-all increase. In Incheon area the landfill gas is sent to the landfill gas utilization facility and used to generate electric power. The collected gas flow rate is 544 m$^3$/min. & the 20.1% was the incinerated portion, 79.2% was electrical generation & the other was the portion of refrigeration or heating.

The Fig.1 in the right section shows the tendency of utilization for landfill gas[2]. The scope of utilization is the air conditioning, electric power generation and direct flaring. The landfill gas is generated from the very complicated degradation process, therefore it is affected from various factors [3,4,5]. From the IPCC 2006 guidelines, the important factors for the estimation of greenhouse gas are the amount of annual waste landfill, the amount of potential methane gas and the rate constant of the methane generation.

The landfill gas are the causes of odors & air pollution and the methane gas consists of more than 50% of landfill gas and global warming potential is high comparatively. The landfill facilities in Incheon collects landfill gas compulsory and utilize as electrical power that almost all methane gas are reused as energy.

The IPCC 2006 guideline shows the FOD(First Order Decay) model which is based on the exponential factor describing the ratio of degradable components going to methane and carbon dioxide gas. The major input data are degradable organic compounds in the landfill portions. Various kinds of waste category & the information of landfill with the variety of waste composition or the default values of degradable organic carbon can be used. The major input data are degradable organic compounds, the weight of landfill, the degradable organic carbon ratio, the amount of methane generated in the year, volumetric ratio of methane in landfill gas & the ratio of recovery and oxidation.

![Fig 1. Tendency of utilization for landfill gas](image1)

![Fig 2. Estimated CH4 emission with direct measuring method](image2)

The waste in the landfill site is buried with the scale of landfill, the amount & the method of landfill and the operation continues over ten to fifteen years. And the characteristics of buried wastes change with the conditions of exposure. This means that methane comes out differently with the time passage. In the guideline of IPCC 2006, many kinds of methane correction factors were suggested, but in Korea both anaerobic & semi-aerobic processes would be considered. The landfill facilities in the future would be designed to reduce the greenhouse gases.

In the management law of waste landfill gas, the generated gases in the landfill of organic wastes must be collected to incinerate or to generate electric power and reuse fuels. On the other hand, horizontal and vertical gas exhausting pipes must be installed to make the collection of gases. As explained earlier, Direct measuring methods & methods in the IPPC 2006 guideline was applied to calculate methane gas in the landfill facilities, & the results of direct measuring methods were depicted in Fig.2. This tendency showed the slight differences from the IPPC 2006 guideline to explain the overall phenomena of greenhouse gas emission.

IV. Conclusions

Greenhouse gases from the landfill facilities in general have the characteristics of continuous & much amount of methane and carbon dioxide gas. Therefore the continuous investigation of optimum management for the greenhouse gas must be developed. This study would have positive effect on the reduction of odor emission. Therefore continuous study will be done for the CDM of greenhouse gases in Korea to reduce the emission of greenhouse gases.

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REFERENCES


