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RESEARCH ARTICLE

ASSESSMENT OF GREENHOUSE GASES FROM ORGANIC FRACTION OF MUNICIPAL SOLID WASTE OF KURNOOL CITY, ANDHRA PRADESH, INDIA

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ABSTRACT

The major Greenhouse gases are carbon dioxide, methane and nitrous oxide which emit from the decomposition of biodegradable organic matter by anaerobic bacteria. The emission of these gases from decomposable organic fraction of municipal solid waste also contributes significantly to the global warming. The contribution of methane to global warming is 21 times higher than carbon dioxide. In developing countries the MSW has high decomposable organic matter. This would be the potential source for the GHG's. Most of the Municipalities in India the MSW is being indiscriminately disposed at the dumping sites. This leads to emission of GHG gases, foul smell, birds and rodents menace, ground and surface water pollution. In the present case study the emission of GHG gas from organic fraction of MSW of Kurnool city has been estimated. At present every day 210 metric tons of MSW is collected which contains 49.70 metric tons of decomposable organic matter. This amounts to 23.66% of fraction of decomposable organic matter. Applying CMD Tool it is estimated that 76,650 tones of GHG CO_2 equivalents of GHG's per year.

INTRODUCTION

Because of rapid population growth, increase in standard of living and quality of life the MSW generated contains large proportion of biodegradable organic fraction which includes paper, cloth, food waste, vegetable waste, yard trimming etc. When such waste is disposed in the dumping yards and landfills, the organic material undergoes biological degradation by anaerobic bacteria into methane and carbon dioxide (Weiland, 2010 and Pognani, 2009). This methane released into the atmosphere contributes significantly to global warming. These emissions need to be estimated and reported in natural greenhouse gas inventories under the United Nations Framework Convention on Climate Change (UNFCCC). The CO_2 produced need not be reported in national inventory. In India most of the municipalities dispose off the MSW in non-scientific manner in dumping yards. They have to follow the MSW handling Rule (Solid Waste, 2000). The average composition of gases obtained from OFMSW is 50% methane, 45% CO_2, 5% nitrogen oxides and <1%hydrogen sulphide[4]. In the present case study an attempt is made to quantify the methane gas emitted from dumping yard of Kurnool city following CMD tool (Peaey, 1985) and remedial measures to decrease global warming.

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MATERIALS AND METHODS

The MSW is collected from households, Commercial Establishments, vegetable markets, hotels etc. It is being transferred to community dust bins and tricycles from there it is being transported to the transit point by various transport vehicles like mini lorries, tractors etc, from where the MSW is being transported to the dumping site by means of Tippers. Dumper placers will carry MSW collected directly to the Dumping yard Gargeyapuram which is 12km from the city (Fig.1).

Calculation of total amount of MSW per day: The number of trips made by the tippers and Dumper Placers is arrived at by taking the average over a period of 15 days. The data is provided by the Kurnool Municipal Corporation. The tippers and Dumper placers are weighed in the weigh Bridge with and without MSW. On an average 210MT of MSW is being transported to the dumping site per day.

Estimation of MSW from dump yard : The sampling is made from the dumping yard by standard procedures and as per MSW Management and Handling Rules, 2001, MoEF (www.mnef.nic.in and Ramachar, 2016), 200kg of MSW is collected from various points from the dumping site. The representative sample from the dumping yard is segregated. The segregated samples were cut to uniform size and their moisture content has been determined in the Hot air oven. The related pictures is shown in the Figures 2 to 4. The results are presented in Table 1.

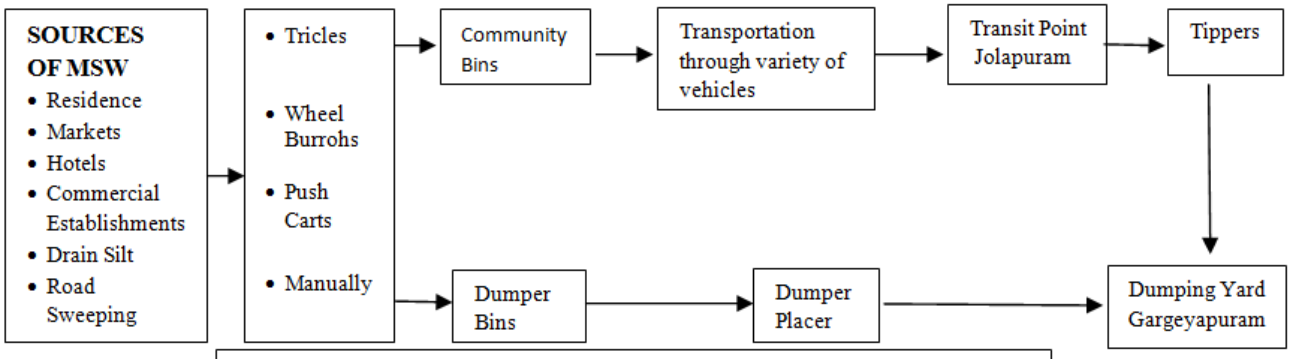

Fig. 1: Existing MSW management system in Kurnool City

Picture showing transporting the MSW to the dumping site

Fig. 2. Picture showing segregation of MSW

Fig. 3. Weighing of segregated MSW

Fig. 4. Hot Air Oven

Table 1. Moisture content of decomposable components from the dump yard

S.No.	Description of the Item	% By weight	% Moisture	Weight of dry component (in 210MT of MSW) MT
1	Paper & card board	11.90	18.0	20.50
2	Textile	8.95	26.0	13.92
3	leaves, yard trimmings, vegetable & Food	40.0	82.0	15.28
Total dry weight				49.70

GHG emission from SWDS in tCO_{2e}

$$= \varphi_y \cdot (1 - f_y) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF_y \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j (y-x)} \cdot \left(1 - e^{-k_j}\right)$$

Waste per day = 210 tons
Waste per year= 76,650 tons (365 days in one year)
The GHG emission from the MSW for first year is calculated below;

Acronym		Values	Explanation
Φy	=	0.8	Model correction factor to account for model uncertainties for year y – *Default value*
Fy	=	0	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH4}	=	21	GWP for CH_4 – *Default value*
OX	=	0.1	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) – *Default value*
F	=	0.5	Fraction of methane in the SWDS gas (volume fraction) – *Default value*
DOC fy	=	0.5	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction) – *Default value*
MCFy	=	0.8	Methane correction factor for year y – *Default value*
Wj,x	=	76,650 Tons	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t) –Measured value
DOCj	=	23.66%	Fraction of degradable organic carbon in the waste type j (weight fraction)
Kj	=	0.4	Decay rate for the waste type j (1 / yr) – *Default value*
X	=	1	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y).
Y	=	1	Year of the period for which methane emissions are calculated (y is a consecutive period of 12 months)
GHG emission =		27,128	GHG emission in tons of CO_2 equivalent (For year)

RESULTS AND DICUSSION

The dry decomposable organic matter from total 210 MT of MSW collected is 23.66%. As per the CDM tool, GHG gas emission for the solid waste material being dumped into Solid waste dumping site can be quantified using above the equation. The calculations have been made by taking the average conditions. Actually the decomposition rate is more during summer than in winter. The amount of organic content varies in different seasons, during festivals and other occasions.

Conclusions

The results showed that the quantity of GHG produced from the dumping sights is very high. The problem can be mitigated by using the organic fraction for the production of Biogas. Soil is considered as a very good sink for methane and landfill covered with smaller soil particles are important for reducing their emission into the atmosphere help in transforming methane into carbon dioxide, by means of methane oxidation.

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