Short Communication

How to Plan for Methane Mitigation and Utilisation Strategies?

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Amongst all the greenhouse gases (GHG) present in the atmosphere methane has assumed considerable significance. Atmospheric concentration of methane has almost doubled after industrial revolution. It contributes to 20% of total GHG effect. In industrial countries, 15% of total GHG contribution comes as methane emission and it is expected to contribute to 18% of the total expected global warming over the next 50 years. Along with the warming effect, methane also participates in troposphere ozone formation, which amplifies methane's direct infrared absorption by approximately 70 percent.[1] Ten percent of total methane emissions come from industrial and municipal wastewater. Anaerobic bacteria are the main factors behind methane emission. Therefore, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are two important water-quality parameters on the basis of which methane emission from a particular water-body can be determined.[2-4] The present analysis would be useful before planning any methane-mitigation or utilisation strategy.

Per-capita Country-wise Methane Emission

The BOD and COD values of wastewater are the parameters, which mainly determine potential for methane emission. Municipal and industrial wastewater having higher BOD or COD values emit more methane under the similar climatic conditions. Organic fractions present in the municipal wastewater are degraded to produce methane.[5,6]

In this paper, a comparison was made between methane emissions from wastewater in various developed and developing countries.[7] It is observed that over the years there has been continuous increase in methane emission from wastewater in both the countries. In America, methane emission has increased from 24.85 million MT (CO_2-eq.) in 1990 to 35.21 million MT (CO_2-eq.) in 2005. During the same time in India, this increase was from 56.90 million MT (CO_2-eq.) to 73.25 million MT (CO_2-eq.), respectively (Figure 1).[7]

Another analysis was carried out on the basis of per-capita emissions from municipal wastewater in different countries.[5] India, Pakistan and China turn out to be the lowest contributors in terms of per- capita methane emissions (Figure 2). On the other hand, developed countries like Australia, Canada, France, Japan, Germany, and USA have 7.86, 8.57, 8.57, 8.57,10 and 10 times more per-capita contributions than that of India. While Mexico, Egypt, Brazil, Lebanon and Indonesia have 1.29, 1.29, 1.43, 1.43 and 2 times more than that of India.

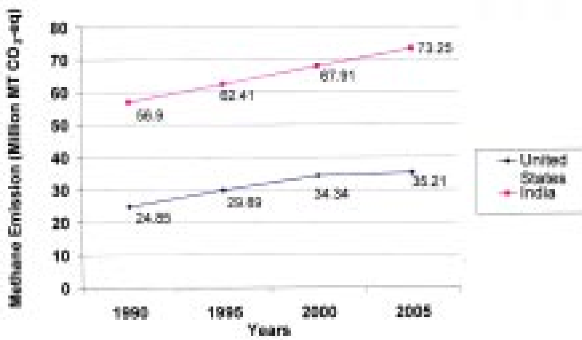

Figure 1. Year-wise methane emissions from wastewater treatment

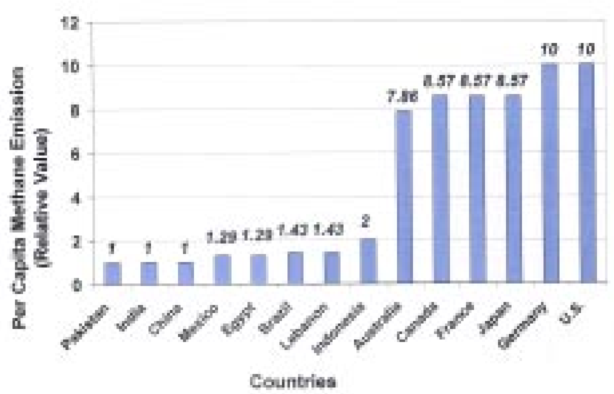

Figure 2. Per-capita methane emission (1997) [wise ranking: relative values]

Country-wise BOD Comparisons

Since BOD values of municipal wastewater are prime indicators of methane emission, a comparison was made on the basis of per-capita BOD in different countries (Figure 3).[6] This comparison shows that per-

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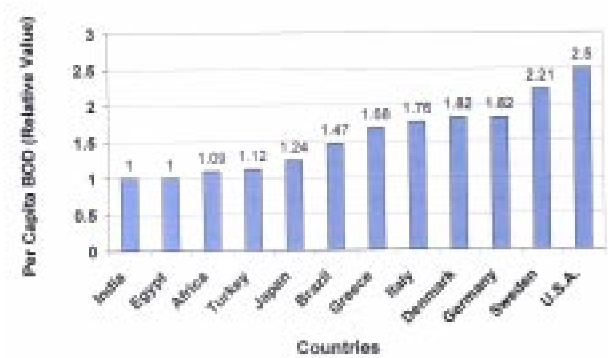

Figure 3. Country-wise per-capita BOD (Relative values)

capita BOD of USA and Sweden is 2.5 to 2.21 times than that of India. While per-capita BOD-emissions from Africa, Turkey, Japan, Brazil, Greece, Italy, Denmark, and Germany are 1.09, 1.12, 1.24, 1.47, 1.68, 1.76, 1.82, and 1.82 times, respectively.

These country-wise differences can be mainly attributed to the population size as well as the fact that in the developed countries mostly centralised aerobic treatment method of wastewater is adopted whereas in the developing countries wastewater management is mainly decentralised and scattered. Wastewater management in urban areas of the developing countries mostly consists of networks of open canal, gutters and ditches.[6] Moreover, in the developing countries, advanced treatment systems are normally not taken recourse to mainly because of higher expenditure involved.

Quantity of degradable organic matter in the wastewater, temperature, and the type of treatment system adopted mainly determine methane emissions. The rate of methane emission increases with increase in temperature. Generally, methane emission starts at 15 ^{0}C since this temperature is suitable for methanogenesis.[1,6]

Developed countries contribute about 76% of the total methane emissions from industrial wastewater treatment while remaining 24% comes from the developing countries. For both the developed and the developing countries, pulp and paper, meat and poultry related industries are the ones which have highest contributions in terms of methane emissions. Municipal wastewaters also contain lots of food waste. Consequently, the have higher per-capita BOD:values, which finally result in higher emissions of methane.[5]

In conclusion, although per capita methane contributions in the developing countries are found to be lower, their gross contributions are still important in view of the larger population size. Therefore, methane mitigation strategies are important in the developed as well as the developing countries too. Similar kind of analysis needs to be done at micro level, viz districts, states, counties etc., before we can identify, plan and implement methane mitigation or utilisation strategies.

REFERENCES

1. Milich L. The role of methane in global warming: where might mitigation strategies be focused? *Global Environmental Change* 1999;9:179-201.
2. Mishra AP, Pandey JS, Wate SR. Municipal wastewater, methane emissions and global perspective. *International Conference on Water Crisis – Challenges and Opportunities*, NEERI, Nagpur, India, February 28-29, 2008; p. ww – 24.
3. Mishra AP, Tembhare MW, Pandey JS, Kumar R, Wate SR. Carbon footprint: where India stands in global scenario. *International Conference on Recent Trends in Environmental Impact Assessment (RTEIA – 2008)*, NEERI, Nagpur, India, Novermber 23-25, 2008; p. 34.
4. Tembhare M, Mishra AP, Pandey JS, Wate SR. Methane emission from wastewater treatment: a comparative analysis. *International Conference on Water Crisis-Challenges and Opportunities*, NEERI, Nagpur, India, February 28-29, 2008; p. ww 21.
5. Fadel ME, Massoud M. Methane emissions from wastewater management. *Environ* poll 2001;114:177-85.
6. IPCC. In: *Guidelines for National Greenhouse Gas Inventories. Available at* http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html.
7. USEPA. Global anthropogenic non-CO_2 greenhouse gas emission: 1990-2020. *Available at* http://www.epa.gov/methane pdfs/global_emissions.pdf