LANDFILLS COMPARED TO OTHER BIOMETHANATION ALTERNATIVES FOR DISPOSAL OF MUNICIPAL SOLID WASTES.

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BACKGROUND

MSW requiring treatment/disposal contains large amounts of organics, even with the intensive waste recycling/reuse efforts over the past quarter century. This situation will likely remain, even with future attainment of the 50% national waste reduction goal. Thus, generation of methane from MSW, both from source separated organics and mixed MSW, is a subject of high interest. This is due to the substantial energy recoverable as methane from wastes and, also, ensuing reduction in waste volumes (which can be considered waste reduction). A great deal of information has accumulated for over two decades about the kinetics and yields of waste to-methane processes from various MSW fractions and sources, and from cost/performance analyses performed at varying levels of detail.

WASTE CONVERSION TO METHANE:

The conversion of MSW to methane, variously termed anaerobic digestion or biomethanation, has been brought to large scale operation in Europe, U.S. and elsewhere using a number of different approaches In-vessel approaches include stirred tanks, packed beds, high solids semi-batch and "plug-flow" processes. Also, landfills, including controlled and optimized "bioreactor" landfills, have been exploited for methane gas recovery from MSW. Landfill methane now fuels about 1,000 MWe in the U.S.

ENVIRONMENTAL AND COST CONSIDERATIONS: IN-VESSEL PROCESSES VS. LANDFILLS

Comparison of alternative MSW-to-methane processes allows assessment of both their near- and long-term environmental and economic costs. Operating data from European in-vessel plants are increasingly available across a range of plants. More data are becoming available from bioreactor landfills engineered for maximum fugitive emission abatement and maximum gas recovery. We base this analysis on both published data and our own estimates.

Environmental "balance sheets" including both benefits and cost, suggest landfills can compare surprisingly well environmentally to waste-to-methane alternatives. For example, for given MSW feeds, landfills with designs now being implemented on large scale can recover methane as well or better than, in-vessel processes. Advantages accrue to landfills due to far longer residence times, and introduction of the highest possible amount of organics in mixed feeds or wastes. Controlled landfills can recover close to maximum methane potential of "as-received" MSW resources. By contrast, in-vessel processes take lesser fractions of the MSW organics and recover lower amounts of the renewable energy potential of organics, particularly when considering parasitic energy consumption. In-vessel digestion kinetics also dictate incomplete conversion at economic residence times.

Greenhouse gas balance sheets can also favor optimized landfill disposal with engineered methane recovery over in-vessel processes, due to greater methane emissions mitigation and the long-term photosynthetically derived C-sequestration possible in landfills. Conversely, composting MSW residuals in-vessel can result in CO2 emissions, and transfer to land of any unconverted components such as heavy metals. Composting must consider atmospheric emissions of local pollutants, also liquid emissions. A parallel comparison of the in-vessel processes and landfills shows that groundwater pollution from modern landfills can actually be lower than from MSW composting and land application atop permeable soil. Methods being demonstrated can capture over 90%, of gas generated in properly engineered landfills.

DEVELOPING OPTIONS WITH LANDFILLS

It is important to note that composting of decomposed waste residue from landfills can be accomplished either in situ in the same landfills, or by mining and composting the same waste once it is anaerobically decomposed in the landfill. Anaerobic-aerobic processing sequences can be employed Landfill mining, particularly from controlled bioreactor landfills, offers long-term options for compost recovery from landfilled wastes. Thus "re-usable" landfills can form an integral part of processing sequences. Such processing sequences involving landfills accomplish the same ends as in-vessel biomethanation followed by composting, or composting alone. These options are all receiving attention in the scientific and professional literature. In several cases processing is already being demonstrated experimentally on large scales in actual landfills.

ECONOMIC AND PROCESS CONSIDERATIONS

Aside from environmental considerations, landfills with methane recovery are also strongly favored economically over in-vessel biomethanation approaches. Even with favorable assumptions, in-vessel processes show an over one-order of magnitude higher costs than advanced landfill designs. Full-scale in-vessel operations are only feasible using carefully segregated wastes and where mandated high tipping fees and other governmental subsidies encourage such ventures Perhaps most importantly, in-vessel systems can typically handle only a relatively moderate fraction of intensively pre-processed MSW and, overall, with observed conversions, do not even significantly reduce the need for ultimate MSW disposal. .

CONCLUSIONS

The environmental and social costs of waste management policies need careful review in terms of the technological alternatives for MSW management, energy recovery and global warming mitigation. Careful, continuing field-scale measurements (with engineering assessments) of alternative waste management impacts are a research need. However to now, accumulating information shows landfills can be operated as an integral part of waste management systems accomplishing the same ends as composting. In addition, landfills can yield maximum net energy, at order(s) of magnitude lower cost, than in-vessel biomethanation processes. Because composting and in-vessel processes are associated with greenhouse gas emissions, properly managed landfills appear to compare quite well to alternatives on greenhouse gas and other environmental grounds. Given these factors, it is becoming questionable whether newer landfill approaches merit extant poor standing and opposition from many entities (regulatory and environmental), and whether low rank of landfills in waste management hierarchies should instead become more favorable

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