Unreliability of Predicting Landfill Gas Production Rates and Duration for Closed Subtitle D MSW Landfills[1]

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Typically, new Subtitle D municipal solid waste (MSW) landfills or landfill expansion require that the landfill applicant prepare an environmental impact statement/report/assessment of the potential impacts of the proposed landfill on public health and the environment. One of the principal areas of concern is the production of landfill gas and its impact on nearby property owners/users, as well as wildlife. Frequently (for example, see Dames and Moore, 1999), those preparing such assessments utilize the US EPA AP-42 landfill gas emission rate estimates (US EPA 1997) to predict the rate and duration of MSW landfill gas production. However, a critical evaluation of how US EPA MSW landfill gas emission AP-42 guidelines were developed compared to the characteristics of closed Subtitle D landfills once the landfill has been closed with a low-permeability plastic sheeting layer cover, shows that the use of AP-42 to predict landfill gas emissions and the duration of landfill gas production is highly unreliable (Lee 1999). Thus far, the USEPA has not developed a reliable approach for estimating landfill gas production for closed Subtitle D landfills (Thorneloe 1999).

A critical analysis of the characteristics of closed Subtitle D landfills and the processes that govern landfill gas production shows that landfill gas production rates are directly proportional to the moisture content of the wastes between about 20% moisture and close to waste saturation where there is free moisture adjacent to the waste particles (Christensen and Kjeldsen 1989). As shown in Figure 1, below about 20% moisture, there is insufficient moisture in the waste to support biological activity of the bacteria responsible for landfill gas production. Lee and Jones-Lee (1995) discussed that once a Subtitle D landfill is closed and the low-permeability plastic sheeting flexible membrane liner is installed in the landfill cover, the rate of moisture entering the landfill will, unless sloppy construction of the cover has taken place, be very low, resulting in a drying out of the waste and ultimately cessation of gas production until such time as the flexible membrane plastic sheeting layer in the cover deteriorates and allows moisture to reenter the waste. These relationships are shown in Figure 2.

At that time, which can be decades after landfill closure, the unfermented organic components of the waste will again begin to produce landfill gas at a rate proportionate to the moisture content of the waste. Under the current regulatory requirements (Hickman 1992, 1995, 1997) (Lee and Jones-Lee 1998), there is no assurance that funds will be available to minimally maintain the cover of the landfill, much less the low-permeability layer of the landfill cover, which cannot be visually inspected because of its burial under a soil layer. At the time when

[1] Lee, G. F. and Jones-Lee, A., "Unreliability of Predicting Landfill Gas Production Rates and Duration for Closed Subtitle D MSW Landfills," Report of G. Fred Lee & Associates, El LMacero, CA, September (1999).

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Figure 1
Landfill Gas Generation Rates as a Function of Moisture
from Christensen and Kjeldsen (1989)

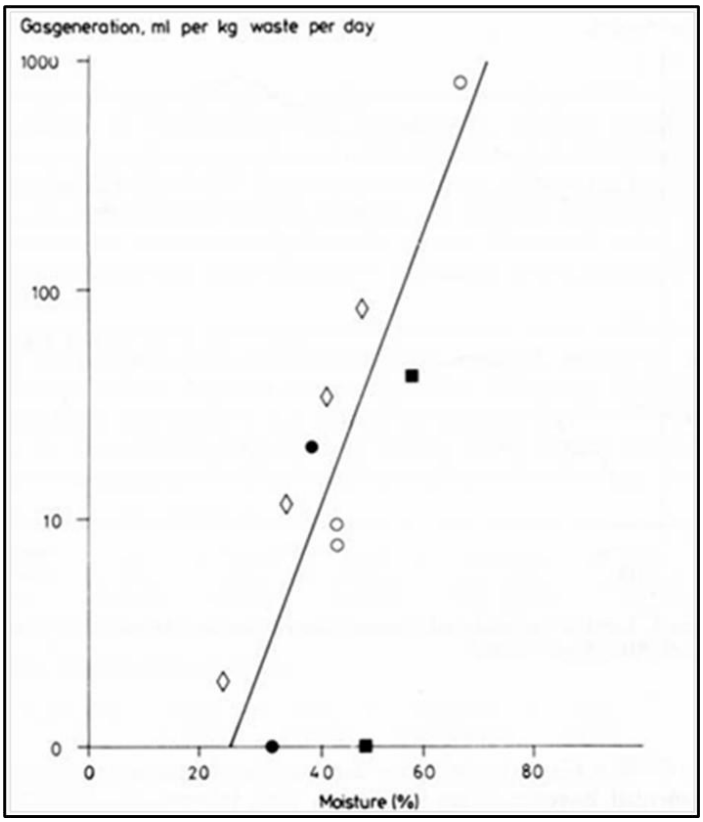
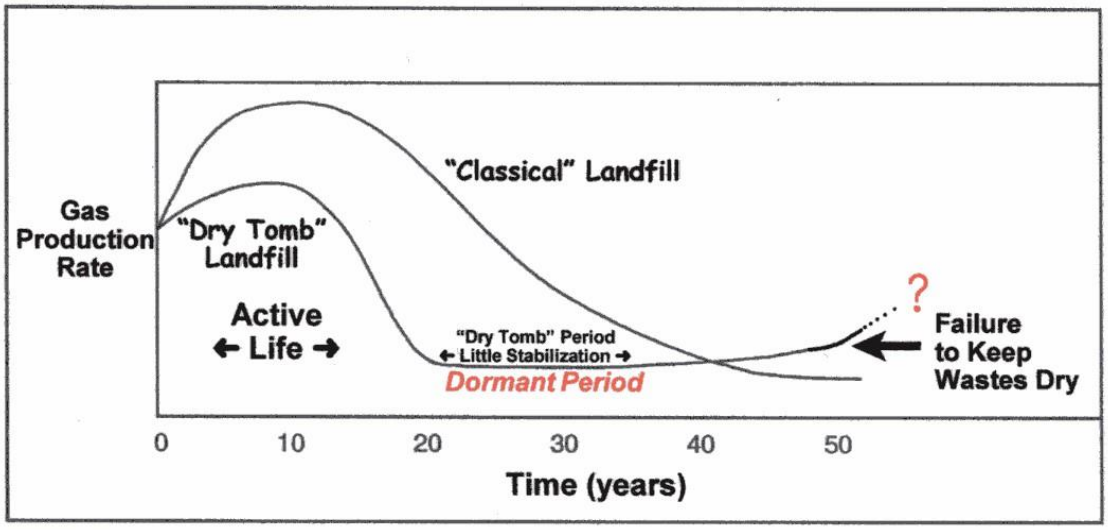


Figure 2
Landfill Gas Production in Classical vs Dry Tomb Sanitary Landfills



sufficient moisture passes through the deteriorated plastic sheeting layer of the cover to enable landfill gas production to again take place at a high rate, there will be a potential for significant adverse impacts on nearby property owners/users, as well as wildlife due to landfill gas release. Further, since landfill gas can be a significant cause of groundwater pollution (Prosser and Janechek, 1995), new groundwater pollution could occur at that time by landfill gas components, that has not occurred previously, since likely by then the HDPE bottom liner for the landfill will have deteriorated to the point where it will not be a significant barrier to landfill gas migration.

Another issue that is not incorporated into today's evaluation of landfill gas production in Subtitle D landfills is that much of the garbage placed in Subtitle D landfills is deposited inside polyethylene bags. These bags, while crushed, are not shredded and will be barriers to moisture interacting with the components within the bags, inhibiting the fermentation of the organics in the bagged wastes due to low moisture content. The plastic bags will slowly decompose and, while the duration of the integrity of the polyethylene plastic bags is unknown, it is likely on the order of at least decades, during which there can be appreciable "hiding" of the garbage from moisture that enters the landfill that can lead to fermentation of some of the organic components of the waste, and landfill gas production. The net result is that the production of landfill gas in a Subtitle D landfill can potentially take place over many decades and could extend to hundreds of years.

The current US EPA and state regulatory approaches for permitting of Subtitle D landfills do not recognize the unreliability of estimates of long-term landfill gas production rates and the extended duration of time that landfill gas production can take place in today's Subtitle D landfills. The net result is that there can be significant public health and/or environmental impacts at some time in the future that are not being reliably described in landfill permitting documents and prepared for as part of the permitting of a landfill.

At this time there is no reliable way to predict landfill gas production rates and duration of production in closed Subtitle D landfills, since they are dependent on the rates of deterioration of plastic layers in the landfill cover and plastic bags that exist within the landfill. It is important, however, for landfill owner/operators and regulatory agencies on behalf of the public to recognize these problems and to prepare to address them when the problems occur over the time that the waste in a Subtitle D "dry tomb" landfill will be a threat to public health and the environment. This will require that reliable funding sources are available to monitor and maintain landfill gas collection and management systems for at least hundreds of years, not just the minimum 30 years of post-closure care that is now allowed in US EPA Subtitle D regulations.

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