

Comments on
Michael Caldwell's Presentation,
“Performance-Based System for Post-Closure Care at MSW Landfills”
to the CA IWMB Landfill Financial Assurance Workshop
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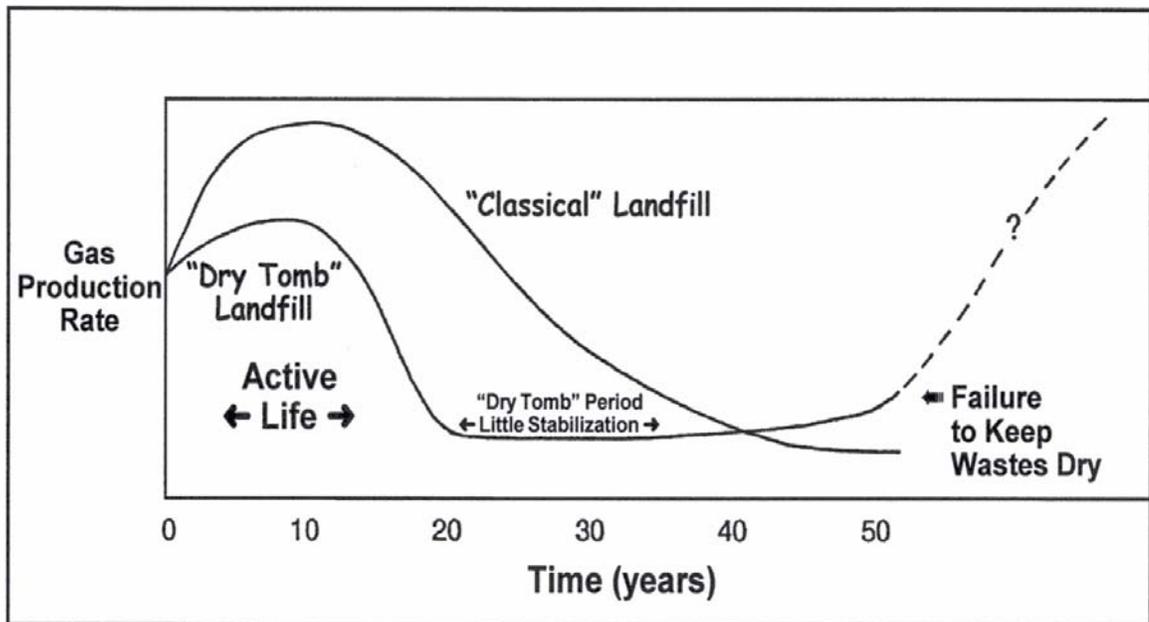
Post-Closure Care Issues

Michael Caldwell, Sr. Director Environmental Protection at Waste Management, Inc. in Houston, TX (corporate) made a presentation entitled, “Performance-Based System for Post-Closure Care at MSW Landfills,” at the California Integrated Waste Management Board Post-Closure Maintenance Period and Financial Assurance for Post-Closure Maintenance Workshop (Workshop) on December 6, 2004 (Caldwell, 2004). His presentation echoed attempts by private landfill owners to convince regulatory agencies that through monitoring landfill releases for a period of time, it is possible to conclude that the landfill no longer poses a threat and no further post-closure care (monitoring and maintenance) is therefore needed. This approach is designed to limit the time that landfill owners are obligated for postclosure care. The Caldwell presentation was a follow-up to a presentation on this issue by GeoSyntec staff in the summer of 2003; they claimed that it is possible to extrapolate landfill gas and leachate generation data from a dry-tomb type landfill to the infinite period of time that the wastes in this type of landfill will be a threat. My comments on the GeoSyntec summer 2003 presentation are available as Lee (2004) "Comments on GeoSyntec's 'Performance-Based System for Post-Closure Care at MSW Landfills.'" As discussed in my comments, the Geosyntec/EREF PCC approach ignores the properties of MSW waste components in a plastic-sheeting and clay-lined dry tomb type landfill.

Caldwell (2004) attempted to use a figure from a paper by Christensen in Demark on the decomposition of MSW in a landfill to demonstrate that the decomposition processes that occur in an MSW landfill proceed in an orderly, predictable manner. The use of that figure for that purpose is highly misleading because it applies to an MSW landfill that does not have a plastic-sheeting layer in the cover. As Dr. Jones-Lee and I published over 15 years ago (Lee and Jones, 1991), the pattern of MSW decomposition in a dry tomb type landfill is significantly different from that in the classical sanitary landfill. If the plastic sheeting layer in the cover of a dry tomb landfill is installed properly, the wastes in the landfill will dry out, and fermentation and leaching of the wastes will stop,

until moisture, again, enters the landfill through the cover. Lee and Jones (1991) developed Figure 1 to illustrate the expected landfill gas production in a dry tomb type landfill.

Figure 1. Comparison of Pattern of Landfill Gas Generation over Time at Classical Sanitary Landfill and “Dry Tomb” Landfill
(from Lee and Jones, 1991)



While with good quality construction of the landfill cover, it is possible to shut off the moisture supply to a landfill, over time the plastic sheeting layer in the cover will decay due to free radical attack and rupture due to differential settling stresses; at some unpredictable time in the future, it will allow moisture to enter the wastes again. As discussed by Lee and Jones-Lee (2004) in their paper, “Flawed Technology of Subtitle D Landfilling,” the decay/rupture of the plastic sheeting cannot be observed since the plastic sheeting layer in the cover is buried under several feet of top soil and a drainage layer. As a result, the repair of the plastic sheeting layer in the cover cannot be accomplished as needed to keep the wastes dry.

One of Caldwell’s slides stated,

- “The quality of leachate and LFG in landfill can be correlated to the “phase” of the life of the landfill;
- The factors that affect a landfill as it progresses through each phase of its life are understood and can be identified for a particular landfill; and
- The future trends of leachate and LFG can be predicted based on known, current quality and knowledge of the phase of its life.”

These statements apply to some extent to the classical sanitary landfill where there is no attempt to keep moisture from entering the wastes through the cover; they do not apply to a dry tomb landfill that is dormant due to limited moisture input.

Caldwell mentioned in his presentation that Christensen has listed over 50 papers on landfills on his website. A review Christensen's papers should include a paper by Christensen and Kjeldsen (1989) entitled, "Basic Biochemical Processes in Landfills," that discussed the importance of moisture in controlling landfill gas production. As they reported (see Figure 2), when the moisture content of the waste is about 20%, landfill gas production greatly slows down/stops. The same applies to leachate generation. However, the onset of a dormant-dry period does not mean that the wastes in the landfill are no longer a threat to generate landfill gas and leachate.

Figure 2. Impact of Moisture on Landfill Gas Formation
(from Christensen and Kjeldsen, 1989)

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Christensen and Kjeldsen

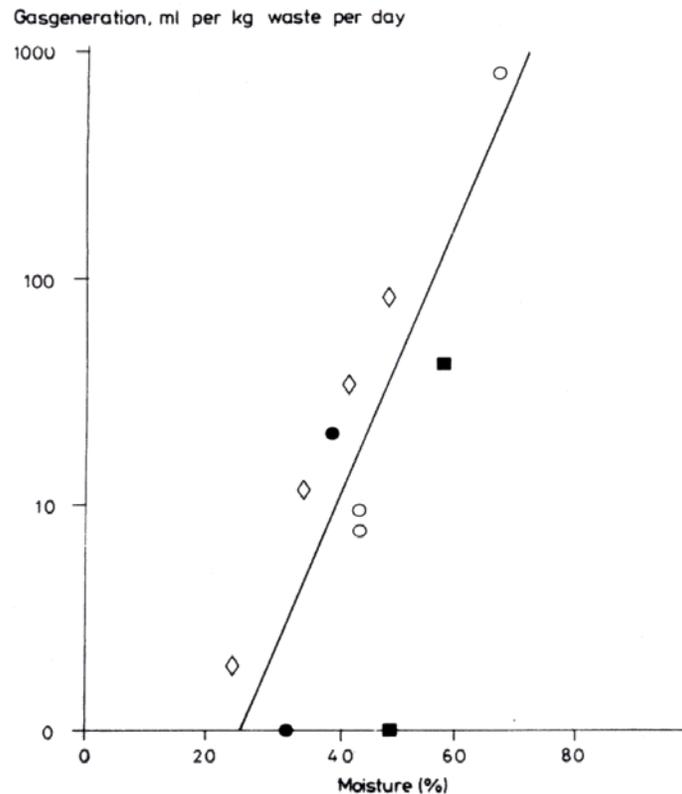
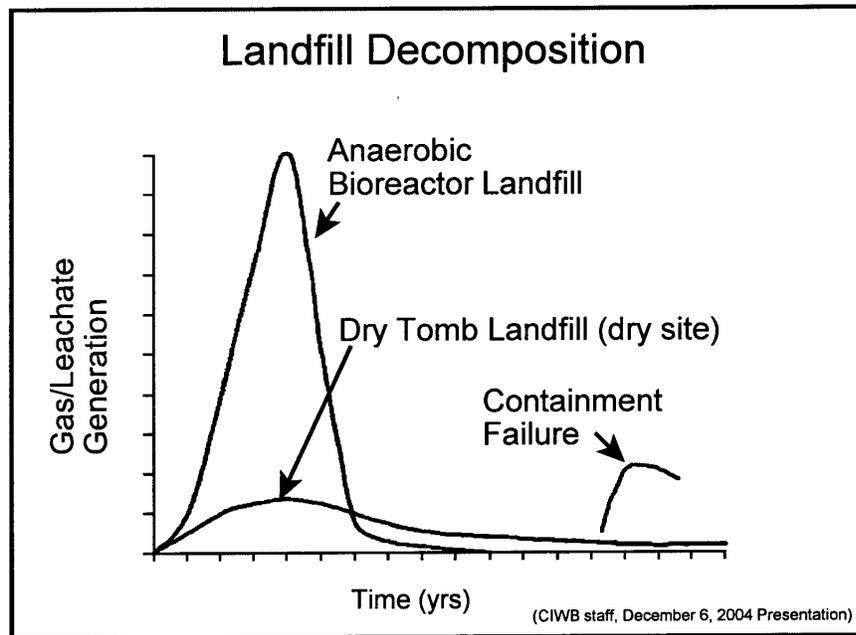


Figure 8. Gas generation rates as a function of moisture content. After Rees (1980a).

In their presentation at the Workshop, the Integrated Waste Management Board staff (Michael Wochnick and Richard Castle) correctly portrayed the potential course of stabilization in a dry tomb landfill (CIWMB, 2004) (see Figure 3). In their report they showed that landfill gas and leachate generation will occur again, at some undetermined and unpredictable time in the future during the very long period of time that the wastes in a dry tomb landfill will be a threat. This situation must be prepared for in postclosure monitoring, maintenance, and funding established for these activities, as well as in the funding established for the remediation of polluted groundwater in a “Superfund-like” groundwater cleanup that will be needed when the liner system eventually fails to collect all leachate generated in the landfill.

Figure 3. Potential Course of Stabilization in a Dry Tomb Landfill
(from CIWMB, 2004)



Another factor to consider in this issue is that the groundwater monitoring that is used – based on vertical monitoring wells at the point of compliance for groundwater monitoring – is so unreliable for detecting groundwater pollution before offsite groundwater pollution has occurred as to be essentially of no value. As a result of this ineffectiveness, considerable groundwater pollution can occur before monitoring wells show pollution indicating that the liner system has failed to collect all the leachate produced in the landfill. These issues are summarized in Lee and Jones-Lee (2004) and in references provided therein.

In summary, the Caldwell/GeoSyntec presentations and the Environmental Research and Education Foundation (EREF) efforts to try to convince regulatory agencies to adopt an approach to limit the long-term liability of private landfill owners for post-closure

funding for dry tomb type landfill monitoring, maintenance and clean up of the groundwater pollution that will occur are based on technically invalid approaches and a misrepresentation of the processes that will occur in dry tomb type landfills.

Assured Postclosure Funding

As recently reviewed by Lee and Jones-Lee (2004) it has been recognized for many years that minimum 30-year RCRA-prescribed post-closure funding is significantly deficient compared to the funding that will ultimately be needed for this purpose. In reporting a stock-offering by Waste Management International (the largest solid waste management company in the US) in *Barron's*, Cochran (1992) stated,

"Legal liability in this [solid waste management] field is significant and uninsurable. Illustrating the risks, WMX [Waste Management Inc.] has agreed to pay WMII [Waste Management International] \$285 million over 50 years for 'certain environmental costs and liabilities which may be suffered by the Company' because of past practices, and which are 'both probable of incurrence and capable of reasonable estimation.' The amount for known problems exceeds WMII's total earnings for its corporate history."

The US Congress General Accounting (now "Accountability") Office (GAO, 1990), in the Executive Summary of its report, "Funding of Postclosure Liabilities Remains Uncertain," under a section labeled "Funding Mechanisms Questionable," concluded,

"Owners/operators are liable for any postclosure costs that may occur. However, few funding assurances exist for postclosure liabilities. EPA only requires funding assurances for maintenance and monitoring costs for 30 years after closure and corrective action costs once a problem is identified. No financial assurances exist for potential but unknown corrective actions, off-site damages, or other liabilities that may occur after the established postclosure period."

Further, in a report entitled, "RCRA Financial Assurance for Closure and Post-Closure," the US EPA Inspector General came to similar conclusions (US EPA, 2001):

"There is insufficient assurance that funds will be available in all cases to cover the full period of landfill post-closure monitoring and maintenance. Regulations require postclosure activities and financial assurance for 30 years after landfill closure, and a state agency may require additional years of care if needed. We were told by several state officials that many landfills may need more than 30 years of post-closure care. However, most of the state agencies in our sample had not developed a policy and process to determine whether post-closure care should be extended beyond 30 years, and there is no EPA guidance on determining the appropriate length of post-closure care. Some facilities have submitted cost estimates that were too low, and state officials have expressed concerns that the cost estimates are difficult to review."

As noted by John Skinner, Executive Director of the Solid Waste Association of North America (SWANA) and former US EPA official in the Office of Solid Waste and Emergency Response, on pg.16 of the July/August 2001 *MSW Management Journal*,

“The problem with the dry-tomb approach to landfill design is that it leaves the waste in an active state for a very long period of time. If in the future there is a breach in the cap or a break in the liner and liquids enter the landfill, degradation would start and leachate and gas would be generated. Therefore, dry-tomb landfills need to be monitored and maintained for very long periods of time (some say perpetually), and someone needs to be responsible for stepping in and taking corrective action when a problem is detected. The federal Subtitle D rules require only 30 years of post-closure monitoring by the landfill operator, however, and do not require the operator to set aside funds for future corrective action. Given the many difficulties of ensuring and funding perpetual care by the landfill operator, the responsibility of responding to long-term problems at dry-tomb landfills will fall on future generations, and the funding requirements could quite likely fall on state and local governments.”

Typically, those developing a landfill propose to only be responsible for providing the financial assurance for closure, post-closure, and corrective action identified during the minimum 30-year period. Hickman (1992, 1995, 1997, 1998), in a series of articles (“Financial Assurance-Will the Check Bounce?”, “Ticking Time Bombs?”, “No Guarantee,” “A Broken Promise Reversing 35 Years of Progress”), discussed the inadequacies in approaches followed for post-closure funding under Subtitle D regulations. Hickman (1992) discussed the problems of providing financial assurance for municipal solid waste landfills, stating,

“Municipal solid waste management (MSWM) system owners/operators are now being challenged to exercise financial prudence, plan for the future, and provide their own safety nets. Owners/operators are being required to assure that if landfills cause a problem, money will be there to fix the problem, and that the check won't bounce when it comes time to pay the bill. Financial assurance has emerged as a major part of owning and operating both present and future landfills.”

Hickman (1992) also noted the difficulty for public agencies and private companies to keep funds available as a "safety net" for future needs of a closed landfill. He stated,

“A surplus of cash allows a company to declare an extra dividend; the stockholders expect it. Surplus funds in a government bank account allows elected officials to engage in all sorts of interesting dances with the electorate.”

Lee and Jones-Lee (1992, 1993) and Lee (2003) have published several reviews on the need for longer-term post-closure care, as well as the use of more reliable financial instruments to provide funding during the post-closure care period than is typically

provided today. While the problems of providing post closure financial assurance for Subtitle D landfills has been documented for about 15 years, little progress has been made to begin to address this issue.

At the California Integrated Waste Management Board (CIWMB) December 6, 2004 workshop, the CIWMB staff presented a review of potential post-closure funding needs for Subtitle D landfills (CIWMB, 2004).

The CIWMB staff report, California has 279 solid waste landfills that must demonstrate financial assurance for closure and PCM. More than a quarter of these landfills has already stopped receiving waste and are, or soon will be, in their PCM period. By 2009 half of California's landfills will be in PCM. In the year 2021 the first California landfill could exhaust its required 30-year PCM demonstration and would enter an unassured PCM period. By 2054 the net present value of unassured PCM liabilities for all sites in PCM could be more than \$600 million; an annual investment of \$18 million beginning in 2005 would be necessary to offset the future value of these unassured PCM liabilities. By 2104 the net present value of unassured PCM liabilities could grow to more than \$3.2 billion; an annual investment of \$46 million beginning in 2005 would be necessary to offset the future value of these unassured PCM liabilities. About three-fourths of these unassured PCM liabilities are attributed to publicly operated landfills

The CIWMB projected costs of post-closure care presented by the CIWMB staff did not include the “Superfund”-like cleanup costs that minimum Subtitle D landfills will demand when sited where the eventual failure of the landfill liner system and the unreliability of the groundwater monitoring systems that are being allowed by regulatory agencies have led to widespread off-site groundwater pollution. The projected post-closure costs will be considerably greater than those projected by the CIWMB staff.

At the CIWMB financial assurance Workshop Anderson (2004) discussed the types of potential post-closure costs that are not covered by the current regulatory requirements for Subtitle D landfills. According to Anderson those costs will be “100 times anything previously recognized.”

Also at the CIWMB Workshop, Lutz (2004) discussed several approaches that are available to provide financial assurance for post-closure care/remediation for landfills. Among them was Insurance or Financial Instrument. He pointed out the characteristics and risks of both approaches.

The California Integrated Waste Management Board is to be commended for organizing this Workshop and the continuing effort that it is devoting to addressing the significant problem of the current regulations failing to provide adequate postclosure funding for today's landfills.

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