Ability of "Dry Tomb" Landfills to Provide Long-Term Protection of Groundwater Quality: The Picture **Is** Bleak

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To the Editor:

L. Cohn and C. Lundell of Waste Management of North America, Inc. stated in their August 1991 letter to the editor that we have not presented the facts pertinent to the ability of soil and plastic sheeting-lined landfills of the type being constructed today to provide for true long-term protection of groundwater quality from landfill leachate pollution. It appears that they are not aware of the current state of information on this topic. We have yet to find a single recognized authority on the ability of compacted soil-clay or plastic sheeting-HDPE liners who asserts that such liners, either alone or in combination as a composite liner, will provide true long-term protection of groundwater quality from landfill leachate for as long as the waste present in the landfill represents a threat to groundwater quality. As discussed by Lee and Jones (1991a), municipal landfills and their leachates contain a variety of known and unidentified contaminants (conventional, non-conventional, and hazardous) that can readily pollute groundwaters rendering them unusable for domestic water supply purposes. The inorganic and many of the organic contaminants present in municipal solid waste will be present and leachable for as long as the wastes are present in a "dry tomb" landfill, i.e., forever. Therefore, the "dry tomb" landfill liners used to "protect" groundwaters from landfill leachate must function perfectly forever, not just 30 years as is often assumed and proposed by landfill proponents.

Cohn and Lundell, in their refutation of our discussion that HDPE liners ultimately deteriorate and allow pollution of groundwater, simply state, *"Studies* [unnamed] *show that HDPE will not degrade when exposed to conditions that occur in landfills."* Oh, would that saying it is so, make it so! One need only consider the second law of thermodynamics to see that it cannot possibly be so. The second law of thermodynamics does, indeed, apply to HDPE liners in landfills. It is of interest and revealing to find that landfill liner companies only warrant their liners for a period of about 20 years (not forever). Furthermore, such warranties are pro-rated over that period and typically require that the owner/operator of the landfill remove what could be hundreds of feet of solid waste above the defective area of the liner, if it can be found, before the landfill liner company will make repairs under warranty. This, alone, speaks to the manufacturers' confidence in the long-term stability of HDPE liners when used in a landfill, to provide groundwater quality protection for as long as the wastes represent a threat to it.

The US EPA (1988a) in its proposed Subtitle D regulations governing municipal landfills states,

"First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in MSWLF (municipal solid waste landfill) containment technologies suggest that releases may be delayed by many decades at some landfills."

and in the US EPA Criteria for Municipal Solid Waste Landfills (1988b),

"Once the unit is closed, the bottom layer of the landfill will deteriorate over time and, consequently, will not prevent leachate transport out of the unit."

While Cohn and Lundell stated, *"Studies show that HDPE will not degrade when exposed to conditions that occur in landfills."* the real issue is actually not whether HDPE, when placed in a landfill as a waste material, will show long-term stability. The issue is whether HDPE and other similar types of liners, **when used to line landfills**, will protect groundwater quality for as long as the wastes in the landfill represent a threat to it, i.e., forever. In the consensus US EPA report of the ad hoc meeting on the service life in landfill environments of flexible membrane liners and other synthetic polymeric materials of construction, Haxo and Haxo (1988) stated,

"The polymers that were discussed and first-grade compounds based on these polymers should maintain their integrity in landfill environments for considerable lengths of time, probably in terms of 100's of years. Nevertheless, when these polymers or compounds are used in products such as FMLs, drainage nets, geotextiles, and pipe, they are subject to mechanical and combined mechanical and chemical stresses which may cause deterioration of some of the important properties of these polymeric products in shorter times."

They also pointed out,

"The combined mechanical and chemical stresses under which the liner system functions may cause cracking and breaking of the components due to environmental stress-cracking or possibly to mechanical fatigue under long service."

"Seams of FMLs continue to be an area of concern, as none of the test methods truly assess the effects of long-term exposure in landfills."

"Clogging of drainage and detection systems continues to present a problem. The clogging can be by biological clogging due to growth or sedimentation or through precipitation of dissolved constituents."

Cohn and Lundell have also significantly misrepresented the facts on the ability of the currently used groundwater monitoring programs at landfills to detect landfill leachate pollution of groundwaters. The facts directly refute their statement. It is obvious, when critically examined, that the approach currently typically used for "monitoring" at municipal lined landfills in an attempt to detect groundwater pollution by the landfill - having one or so upgradient wells and several (three or four) downgradient wells - has a low probability of detecting leakage before large-scale pollution

occurs. Lined landfills will initially leak from point sources, i.e., holes or cracks in the liner. As discussed by Cherry (1991), the horizontal spread of such leachate-contaminated groundwaters is well-known to be highly limited, with the contaminated groundwater moving downgradient in a finger-like shape rather than in a rapidly expanding fan shape. The zone of capture of the typical groundwater monitoring well being used today is about a foot or so from the center of the well. With downgradient wells typically spaced hundreds to a thousand or so feet apart, such a monitoring program has a very low probability of detecting leachate pollution of groundwater before widespread pollution occurs. Additional discussion of the problems with currently designed landfill monitoring programs is provided by Parsons and Davis (1991).

Cohn and Lundell stated, *"The new generation landfills perform well and evidence indicates they will continue to do so for long periods of time."* That statement totally evades the real issues. The issue is not what landfill company representatives (Cohn and Lundell) anticipate, based on uncited "evidence," to be a *"long period of time."* The issue is, will *"new generation"* landfills provide groundwater quality protection for as long as the wastes represent a threat to it, i.e., *forever*? The answer is obviously "no." As stated in our letter to the editor on the Bee Canyon landfill situation, the *"new generation"* type landfills only postpone groundwater pollution, they do not prevent it.

Cohn and Lundell further misstate the facts when they charge that we are simply opponents of landfills and that we do not have proposals for alternatives to current design practice for landfills. The facts are that we are repeatedly on-record recognizing the need for properly sited, designed, constructed, closed, and maintained landfills. We are, however, vigorous opponents of landfills that only postpone the pollution of groundwaters. We discuss alternatives to today's "dry tomb" landfilling in the published literature (Lee and Jones, 1990; 1991b), in an overview paper, "Safety of Landfills: A Groundwater Quality Perspective" submitted to Civil Engineering, and in short courses that we present on landfills and groundwater quality issues through University Extension, University of California, Davis, and through the Association of Groundwater Scientists and Engineers-NWWA. As discussed in those sources, the key to true protection of groundwater quality from pollution by municipal landfill leachate is the proper siting of landfills so that they cannot pollute groundwaters; this can only be achieved if there is no groundwater hydraulically connected to the landfill that can be polluted. As a second alternative to proper siting of landfills at geologically suitable sites (i.e., areas that do not have hydraulically-connected groundwater) we advocate treatment of the wastes to remove leachable components before landfilling of the residues in landfills with appropriate lining, leachate detection, collection, and removal, closure, and post-closure maintenance and monitoring. Those are two alternatives that we believe can be considered to be permanent, appropriate management of solid waste. As we discuss elsewhere, there are others, such as incineration with appropriate air pollution control and ash management.

For those who are unwilling to properly site landfills at geologically suitable sites and are also unwilling to treat the wastes so they will not produce leachate that could pollute groundwater, only a temporary storage approach would be possible. We advocate that such a temporary storage landfill be designed with double composite-sandwich liners, and managed so that when leachate penetrates through the uppermost composite-sandwich liner, the waste would have to be removed from the

landfill, properly treated, and disposed of in a manner such that it would not represent a threat to groundwater quality (as outlined above). A key to its successful implementation is an up-front trust fund developed from disposal fees that would be of sufficient magnitude to remove the wastes and treat them when the uppermost composite liner has failed to prevent migration of leachate through it. In our view there is no justification to wait until groundwater is polluted before action is taken.

Cohn and Lundell state, *"We believe that landfilling represents the most cost-effective and environmentally secure method of disposal for many communities."* There is no doubt that for the current generators of wastes that are landfilled in "dry tomb" landfills that will ultimately pollute groundwaters, the current *"new generation"* landfills represent a highly cost effective method of *disposal* of garbage when viewed from the short-term perspective. A well-designed, constructed, operated, closed, and maintained *"new generation"* landfill liner containment system should last for a sufficient period of time so that the current generators of the waste that ultimately pollute groundwaters will not have to pay the cost of, or experience the public health and water quality hazards that will develop from, groundwater pollution by the landfill. Basically what Cohn and Lundell are advocating is that today's society should be allowed to pay a cheaper-than-real price for garbage disposal at the expense of the health, welfare, and groundwater resources and groundwater quality of future generations. If today's society wishes to adopt a policy of exploitation of future generations' groundwater resources by constructing *"new generation"* landfills that only postpone the problems of groundwater pollution, this should be done through the adoption of regulations that clearly recognize that this is the approach being accepted. However, state of California "Chapter 15" regulations (that apply to the Bee Canyon landfill in southern California) have performance standards that require protection of groundwater quality-beneficial uses for as long as the wastes represent a threat to it. Clearly the "new generation" - "dry-tomb" landfills have a high probability of not complying with regulations requiring protection of groundwater quality from waste management units.

In support of the inadequately protective "dry tomb" landfills of which we are critical, Cohn and Lundell stated, *"it's also important to realize that waste is an immediate problem that must be dealt with today, and with existing technology."* We strongly oppose the position taken by landfill companies that we must accept inadequately protective approaches for solid waste management of constructing inadequate landfills located in geologically unsuitable areas because of the immediate waste management problem. Unless measures are taken today to provide true long-term protection of groundwater quality from landfill leachate, today's irresponsibilities will cause tomorrow's loss of groundwater resources.

We feel that it is very important that representatives of landfill companies and others properly inform the public about the ability of *"new generation"* landfills to protect groundwater quality for as long as the wastes present in the landfill represent a threat to it. If *"new generation"* landfills only temporarily postpone groundwater pollution, as will typically be the case, the public should be informed of this situation. They should not be misled as is being done today by landfill company representatives that state without proper qualifications that *"new generation"* landfills will protect groundwater quality.

If readers wish to receive copies of materials that address the technical issues of the problems with the so-called "new generation" "dry tomb" landfills in providing long-term protection of groundwater quality, please contact us.

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