Approved April 29, 1984
Date

MINUTES OF THE Senate COMMITTEE ON Energy and Natural Resources.

The meeting was called to order by Senator Charlie L. Angell, Chairperson, at

10:00 a.m./XXX on Tuesday, April 24, 1984 in room 527-S of the Capitol.

All members were present XXXXX

Committee staff present:
Ramon Powers, Research Department
Raney Gilliland, Research Department
Don Hayward, Revisor's Office
LaVonne Mumert, Secretary to the Committee

Conferees appearing before the committee:
David Anderson, K. W. Brown and Associates, Inc.
Frank Wilson, Kansas Geological Survey
Professor Ross McKinney, Department of Civil Engineering, The University of Kansas
Janis Butler, Kansas Engineering Society

H.B. 2725 - Ground burial of hazardous waste; prohibited

Senator Gordon moved that the minutes of the April 5, 1984 meeting be approved. Senator Vidricksen seconded the motion, and the motion carried.

David Anderson read his written testimony (Attachment 1). He reviewed hazardous waste landfill practices. He said it is necessary to develop more effective techniques for managing hazardous waste, including reduction of waste at the source, pretreatment of waste before final disposal and solidification of treatment residues and final disposal in aboveground landfills. Mr. Anderson testified that aboveground landfills should be constructed on a slope and described a double liner system with a flexible membrane liner and a combination liner consisting of clay and another flexible membrane liner. He recommended incentives for reduction, treatment and solidification of waste and that only solidified waste be placed in aboveground landfills. Mr. Anderson favors H.B. 2725. He also mentioned concerns of underground injection of hazardous waste. Responding to questions from Senator Feleciano, Mr. Anderson said that there are no advantages to aboveground landfills over ground burial unless design features he recommends are incorporated. Senator Feleciano asked what incentives Mr. Anderson would recommend. Mr. Anderson replied that he was referring to such things as tax credits. In response to questions from Senator Gannon, Mr. Anderson said that after the liquid is collected in the pipes, it exits and enters into an aboveground tank. Answering a question from Chairman Angell, Mr. Anderson said that the entire mound is covered with topsoil and a permanent vegetation cover. He said because the entire structure is sloped there won't be ponding of the leachate before it enters the pipes.

Frank Wilson reviewed his written testimony (Attachment 2). He discussed the idea that eventually there will be a few large regional landfill facilities established on large tracts of land. These facilities would be equipped to treat the waste so that the volume of materials to be buried or stored would be reduced. Mr. Wilson also mentioned an idea where a state agency, similar to the Kansas Turnpike Authority, would be established and have oversight of the development of such a regional landfill facility. Senator Gordon asked what amount of solidified waste should be placed in an aboveground landfill. Mr. Wilson said he would suggest a depth of about 40 feet. Mr. Wilson stated that one landfill has an inflated dome which covers the entire mound during the operable stage. There is also a theory that if the mound is not covered, rainfall will cause the more mobile elements to migrate out into the collection system before the mound is covered.

Professor Ross McKinney testified he is a professor of environmental engineering and is a member of the Kansas Environmental Advisory Commission but was not representing either group. He stated that he does not think that banning land burial of hazardous waste will solve the problem. He said these materials have to be put somewhere, and the problem is what to do with the waste. Professor McKinney said that concentrated organic materials can be incinerated. However, incinerators specifically designed for hazardous waste are very expensive. Some wastes can be burned in conventional incinerators but unless the temperatures are high enough, the organic material is not completely broken down. Some organic material can be broken down biologically into elemental materials. He said that inorganic materials are best handled by proper solidification. Professor McKinney said the biggest problem is where there is a relatively small quantity of hazardous waste in a large volume of inert material. He feels people must recognize that hazardous waste disposal is a real problem that must be addressed. Professor McKinney said people must be willing to fund an adequate health department to insure protection of the environment. This also means greater involvement in government regulations and less ability to make individual decisions. He said that industries must be educated to recognize hazardous materials. He stated that without the public doing its job, this problem is not going to be solved. He said tough regulations may just move the problem some place else. He is opposed to deep well injection. Professor McKinney said he does not think H.B. 2725 is necessary. It won't hurt anything, but he doesn't think it will change anything. He said burial is the way to handle solids and that liquids should never be buried. He said liquids should be treated to remove the contaminates.

Janis Butler read her written testimony (Attachment 3). She said the Kansas Engineering Society (KES) agrees that ground burial of hazardous wastes is not environmentally acceptable. They support the provision in H.B. 2725 that limits the exemption of small generators of hazardous waste but recommend that the small generator exemption be completely eliminated in the final phase of the schedule. She discussed concerns about mound burial. Ms. Butler said that it is important to consider the physical form of the waste. After the waste is rendered inert, it can be buried. Ms. Butler testified that KES is very concerned about deep well injection of hazardous waste fluids and land treatment. KES recommends that a centralized waste treatment, processing and disposal site be established. This would be under the control of a state authority. Answering questions from Senator Gordon, Ms. Butler said that the wastes would be segregated by the various industries and then the wastes would be treated by various methods at the facility. In response to questions from Vice-Chairman Kerr, Ms. Butler said the KES recommends that mound burial be deleted from the bill, underground injection be restricted and that land treatment be more strictly defined. Answering a question from Senator Feleciano, Ms. Butler said that she opposes injection of concentrated hazardous waste but feels this method of disposal is suitable for such substances as highly mineralized brines.

After discussion, Senator Chaney made a conceptual motion that the bill be amended to provide that the Secretary shall prohibit the ground burial of wastes considered to be hazardous to the environment of Kansas. Senator Gannon seconded the motion.

Vice-Chairman Kerr made a substitute motion that the language in lines 215-237 of the bill be stricken and the following be put in its place: "(b) If the secretary finds that there is an environmentally more desirable procedure available other than ground burial for the disposal of a particular type of hazardous waste, the secretary shall order that the use of ground burial for the disposal of that type of hazardous waste be discontinued. The secretary in developing such consideration may require the generator to provide information and plans for potential environmentally more desirable procedures."; and that the words "mound landfill" be stricken from line 240; and that the phrase "and establishing standards for the granting of exceptions to the prohibition of below ground burial of hazardous wastes" be stricken from lines 241-243; and further that subsection (d) beginning on line 244 be stricken. Senator Rehorn seconded the motion, and the substitute motion carried.

Vice-Chairman Kerr moved that subsection (y) beginning on line 157 be stricken from the bill. Senator Feleciano seconded the motion, and the motion carried.

Vice-Chairman Kerr moved that the bill be further amended as follows: by inserting a new subsection (ee) after line 187 as follows: "'Acutely hazardous waste' means a commercial chemical product or manufacturing chemical intermediate having a generic name listed in 40 CFR 261.33(e), or an off-specification commercial chemical product or manufacturing chemical intermediate which, if either met specifications, would have a generic name listed in 40 CFR 261.33(e) as in effect on the effective date of this act."; and that New Section 3 beginning on line 254 read as follows: "(a) Any person who generates a total of 2.2 pounds (one kilogram) or more of acutely hazardous waste as defined in K.S.A. 65-3430(ee) in any calendar month shall be subject to regulations by the secretary pursuant to K.S.A. 65-3430 et seq. and amendments thereto. (b) Any person who generates any hazardous waste, which is not an acutely hazardous waste, in any calendar month shall be subject to regulation by the secretary pursuant to K.S.A. 65-3430 et seq. and amendments thereto in accordance with the following schedule: (1) On and after July 1, 1984, all persons generating 165 pounds (75 kilograms) or more per month. (2) On and after July 1, 1985, all persons generating 110 pounds (50 kilograms) or more per month. (3) On and after July 1, 1986, all persons generating 55 pounds (25 kilograms) or more per month.". Senator Vidricksen seconded the motion.

MINUTES OF THE Senate COMMITTEE ON Energy and Natural Resources,

room 527-S, Statehouse, at 10:00 a.m./pXXX on Tuesday, April 24, 1984.

Senator Roitz made a substitute motion to amend the bill as proposed by Vice-Chairman Kerr but striking the proposed item (3) in subsection (b) of New Section 3. Senator Gannon seconded the motion. After discussion and advice of Barbara Sabol (Secretary of the Kansas Department of Health and Environment) that used oil is not a hazardous waste, the motion and second were withdrawn. Vice-Chairman Kerr amended his motion to include an item (4) in subsection (b) of New Section 3 as follows: "(4) On and after July 1, 1987, all persons generating 22 pounds (10 kilograms) or more per month.". Senator Vidricksen seconded the amended motion, and the motion carried.

Senator Hess moved that the bill be amended by adding a new subsection (b) in Section 2 as follows: "The below ground burial of hazardous waste is hereby prohibited in the state of Kansas. Such prohibition shall not be construed as prohibiting above ground storage or land treatment of hazardous waste. All hazardous waste shall be rendered non-hazardous by treatment including but not limited to incineration, neutralization, precipitation, biological or chemical oxidation, fixation by admixture of cement-like binders and solvent recovery. Any existing hazardous waste disposal facility which utilizes below ground burial shall cease such burial practices and with the approval of the secretary, shall implement closure and post-closure plans on all hazardous wastes which have been disposed of below ground."; and that the language in lines 215-228 be stricken. Senator Rehorn seconded the motion. The motion failed 5-6. Senators Hess, Feleciano and Rehorn requested that their votes in favor of the motion be recorded.

Vice-Chairman Kerr moved that the bill, as amended, be recommended favorably for passage. Senator Chaney seconded the motion, and the motion carried 10-1.

H.B. 2726 - Hazardous waste clean-up fund; established

Senator Feleciano moved that the bill, as amended, be recommended favorably for passage. Senator Chaney seconded the motion.

Senator Werts made a substitute motion that the bill be amended by striking subsections (a), (b) and (c) of Section 3. Senator Vidricksen seconded the motion, and the motion carried.

Senator Chaney moved that the bill, as amended, be recommended favorably for passage. Senator Vidricksen seconded the motion, and the motion carried 11-0.

The meeting was adjourned at 4:45 p.m. by the Chairman. The next meeting of the Committee will be at 8:00 a.m. on April 26, 1984.

Senate Energy & Natural Resources
April 24, 1984

Name		Organization
L. Linenberger		UPI
S Johnson		KTWU
Bill Wilson		KWCH-TV
D. Fuber		AP
[illegible] Miller		KCCA KCOA.
Kenneth E Miller		
Marjorie Bodecker		concerned citizen
Jane Bodecker		" "
[illegible] Bodecker		" "
Pete McGill		P McGill & Assoc
TREVA POTTER	TOPEKA	NORTHERN NAT. GAS
Allan S. Abramson		KDHE - Topeka
Helen Stephens		LWV - Jo. Cty.
Ed Remert		Ks LWVs &
Frank Wilson		Ks Geological Survey
JAMES L. YOUNG		CWM
DONALD A. WALLGREN		WASTE MANAGEMENT, INC.
M. Hawver		Topeka Cap. Journal
Dennis Murphey		KDHE
Charles V. Hamm		Topeka - Kans Dept of Health + Environment
BARB REINERT		KS WOMEN'S POLITICAL CAUCUS
Bill Henry		KS Engineering Society
John Ruf		KS. Eng. - Society
Jerry Cornwell		KG & E
BUD GRANT		KCCI
DAVID C. ANDERSON		K.W. BROWN and Assoc.

TESTIMONY TO THE SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

CONCERNING HB 2725

April 24, 1984

by

David C. Anderson
Senior Associate
K. W. Brown and Associates, Inc.

Chairperson and Members of the Committee:

I appreciate the opportunity to appear before the Committee today to present a brief overview of hazardous waste management and what I believe to be the most effective means to improve these practices in the State of Kansas.

I. Hazardous Waste Landfill Overview

For five years, the EPA has been moving slowly toward a regulatory framework for governing hazardous waste landfills (HWL). In 1980, the EPA promulgated rules prohibiting the placement of "free" waste liquids in an HWL. In 1982, the EPA promulgated rules requiring a new HWL to have either two flexible membrane liners (FML) or a single FML and groundwater monitoring. Bills that are currently before the United States Congress will require both a double FML and groundwater monitoring. While these rules are intended to protect groundwater quality and human health, it is rapidly becoming apparent that this intent will not be reached within this regulatory framework.

Even after "free" liquids are removed from waste, the overburden pressures and gravitational forces within a landfill can cause drainage of waste liquids. A recent study examined waste containing 5% organic liquid, a concentration far below that at which "free" liquid would be present

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(Anderson and Brown, 1984). The wastes released much of this organic liquid when water passed through the waste. When excess sorbents were added to the waste, the amount of organic liquid released was reduced but not eliminated. I bring this study to your attention because organic liquids have been shown in numerous studies to increase the permeability of clay (Macey, 1942; Brown et al., 1983; Brown et al., 1984; Anderson and Jones, 1983; Brown and Anderson, 1983A; Schram, 1981; White, 1976; Buchanan, 1964; Van Schaik, 1974; Anderson, 1981). Organic liquids, then, can be released from waste containing no "free" liquids. Clay liners deteriorate when exposed to concentrated organic liquids. This was part of the reasoning behind the EPA's preference for landfills double lined with FMLs.

While a small FML test section can be shown to have a "de minimus" permeability in short term tests, no membrane liner company will guarantee its product for more than 30 years. In New Jersey, all three membrane lined hazardous waste landfills were found to leak. Two of these FMLs were leaking within two months of their installation (Montague, 1981). No membrane liner can be expected to be effective for the length of time over which landfilled waste will remain hazardous. More effective techniques for managing hazardous waste must be found if the long term integrity of groundwater is to be maintained. These techniques should include the following three features:

1) reduction of waste at the source;

2) pretreatment of waste before final disposal so as to
    a) destroy organic wastes and
    b) detoxify inorganic wastes; and

3) solidification of treatment residues and final disposal in aboveground landfills.

II. Improving Waste Management Practices

The logical place to begin improving hazardous waste management practices is with the waste generators. These generators know more than anyone else about their wastes. Generators could begin to reduce waste quantity and toxicity through investigation of the following:

1) in-plant process changes;
2) use of alternative feedstocks;
3) waste reuse and recycling; and
4) transfer of waste to another plant that can use it as a feedstock or provide the proper waste pretreatment.

Pretreatment of waste should usually be the responsibility of waste generators due to their knowledge concerning waste composition. If a waste contains degradable organics (such as oil) the waste may be destroyed through some form of biodegradation. If the waste contains relatively nondegradable organics (such as chlorinated solvents) the waste may be destroyed by incineration or chemical oxidation. Toxic inorganic wastes and treatment residues should be solidified to immobilize hazardous constituents and provide the compressive strength necessary to provide long term support for the landfill cover.

The advantages to waste reduction, pretreatment, and solidification are readily apparent. What may not be apparent to many are the advantages of landfilling waste above ground. Actually, simply placing waste above ground does not solve anything. To realize the potential advantages of aboveground landfills, these facilities should include the following:

1) A detailed site selection process that considers proximity to groundwater resources, site geology, climate, topography, and all the other factors normally considered during landfill site selection.

2) Construction over an above grade, sloped base to provide continuous gravitational removal of leachate from the landfill. The sloped construction and above grade exit of the leachate collection pipes eliminates ponding of leachate on the liner. This greatly reduces both the driving force responsible for leakage and the exposure of liners to the potentially damaging effects of leachate.

3) A double liner system with a primary FML and a secondary liner that is a combination FML/clay liner (Figure 1). The synergistic effect of a FML/clay secondary liner are as follows:

   a. Since clay adsorbs leachate, only a secondary FML would allow accurate quantification of leakage through the primary liner.

   b. A secondary FML would provide added assurance that the clay liner would not come in contact with the relatively high strength initial flushes of leachate.

   c. Longevity of both the primary and secondary FML can be measured in decades. Only a clay liner can minimize the leakage rate over a time frame comparable to the length of time for which the waste may remain hazardous.

   d. Only clay liners have a significant capability to attenuate waste constituents.

   e. Leakage into the clay liner may only take place directly under leaks in the secondary FML. The synergistic interaction in the FML/clay liner system can only be obtained by placing the secondary FML in direct contact with the underlying clay liner.

4) Slope of the liner/leachate collection system should be at least 4% (to allow for subgrade settlement). In addition, the system should slope across the narrowest cross section of the landfill to minimize leachate collection pipe length. By using the sawtooth configuration shown in Figure 1, need for a fishbone network of leachate collection laterals is eliminated. The most repairable and accessible leachate collection network is composed of short and straight pipe lengths that exit the above grade toe of the landfill. After closure, leakage rate for each portion of a landfill can be monitored at each leachate outlet pipe. An increase in leachate output from a given pipe would immediately indicate both the volume and approximate location of a cover leak.

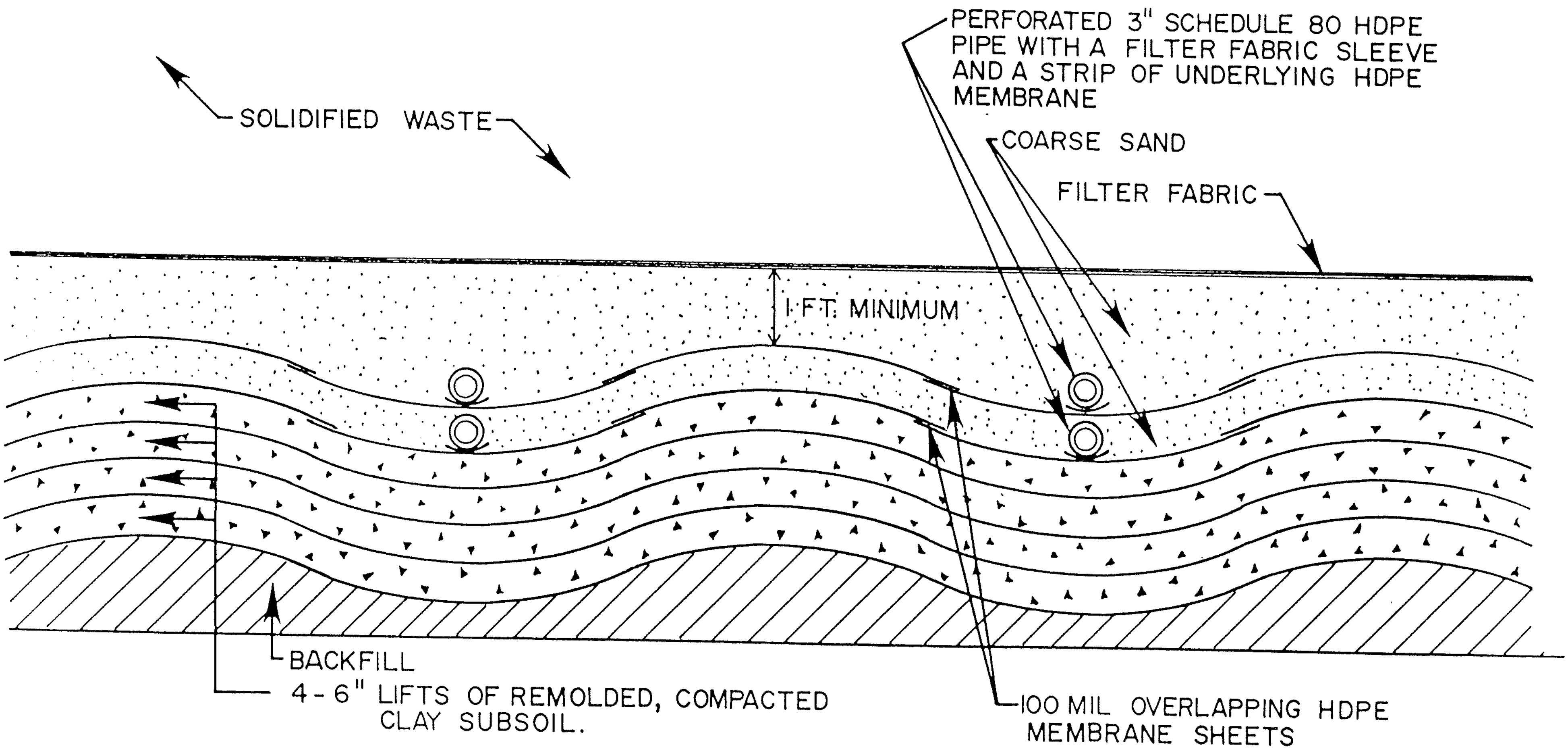

Figure 1. Double liner systems for hazardous waste landfills should consist of a primary flexible membrane liner (FML) and a secondary liner that is a combination FML/clay liner.

5) A cover system consisting of a gas collection layer, FML, clay liner, a drainage layer in certain climates, fill soil, top soil (with terraces in certain climates) and a permanent vegetative cover that requires minimal maintenance. Optimal side slope may also vary with climate but should generally be a maximum of four (length) to one (height).

6) An abovegrade system of both leachate collection tanks and leachate treatment facilities.

III. History of Man-made Abovegrade Earthen Mounds

Man has built earthen mounds since at least 3500 BC. When designed properly and left unmolested by man, these mounds have had a remarkably high survival rate. Vegetative covers and clay caps have had a stabilizing effect on these ancient earthen mounds (Lindsey et al., 1983).

Waste has often been disposed by simply piling it up and covering it with soil. Moving above grade with waste has also been used as a means of expanding below ground landfills. Neither of these methods of abovegrade waste disposal contain the necessary design features that can make abovegrade disposal preferable to belowgrade disposal. Abovegrade waste disposal can only be as effective as its design.

There are examples of abovegrade landfills with underdraniage in Florida, Texas, and other states. Others are in the design stage in many states, including Alabama and Colorado. Only those in the design stages have all the suggested features discussed in the previous section.

IV. Alleged Disadvantages of Aboveground Landfills

Several recently produced articles and reports have discussed the potential advantages and disadvantages of aboveground landfills (Minnesota Waste Management Board, 1984; Bridge et al., 1982; Graybill, 1983; Brown and Anderson, 1983B; Brown and Anderson, 1984; Anderson and Frentrup, 1984; Hallowell et al., 1984). The major disadvantages sited are visibility, climatic exposure, and high cost of these facilities. I believe that the added visibility of aboveground landfills may improve public acceptance, if the public is educated as to the environmental advantages of these facilities. In addition, the time has passed where an out-of-sight below ground landfill is out of the minds of a concerned public.

There is an added degree of climatic exposure for aboveground landfills. If the facility has gentle side slopes and a permanent vegetative cover, however, the additional climatic exposure should not translate into higher long term maintenance or a greater propensity for cover failure.

Aboveground landfills have been assumed to cost significantly more to construct than a belowground landfill. The only definitive study comparing the cost of above and below ground landfills, found these costs to be almost identical (Hallowell et al., 1984). A summary of these cost comparisons is given in Table 1.

V. Conclusions

While the aboveground landfilling of hazardous waste has several inherent advantages over below ground landfills, it is not the total solution to the currently inadequate waste management practices. If it is the desire of this committee to take the necessary steps to substantially improve hazardous waste management practices, the following combination of steps should be taken:

1) provide strong incentives for reduction, treatment and solidification of hazardous waste; and

2) place only solidified waste in aboveground landfills that incorporate the design features discussed above.

Table 1. Comparison of the Cumulative 20-year and Per-ton Cost of Below Ground and Aboveground Landfills*

	Cumulative 20-year Cost (millions of dollars)	
	Below Ground	Aboveground
5,000 ton per year facility	19.0	19.4
30,000 ton per year facility	39.3	40.2
80,000 ton per year facility	71.1	68.8
	Per Ton Cost (dollars per ton)	
	Below Ground	Aboveground
5,000 ton per year facility	190	194
30,000 ton per year facility	67	67
80,000 ton per year facility	44	43

* Hallowell et al., 1984.

HB 2725 would, in my opinion, be a significant step in the direction of improving hazardous waste management in Kansas. The bill does not provide for an absolute ban on disposal of hazardous waste, a step that could well stimulate illegal dumping rather than improved waste management practices. It is my view that additional legislation is needed to provide strong incentives for the reduction, destruction, detoxification, and solidification of hazardous waste.

One other point I would like to make is that underground injection of hazardous waste has many of the same shortcomings as shallow below ground burial. Wastes injected into deep wells may not always stay where they are put. Monitoring for waste migration is difficult because it is impossible to perform detailed inspections of deep strata confining the waste (Anderson and Frentrup, 1984).

Thank you for the opportunity to appear before the Committee today and I would be pleased to answer any questions.

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TESTIMONY OF FRANK W. WILSON BEFORE
THE KANSAS SENATE COMMITTEE ON ENERGY
AND NATURAL RESOURCES, APRIL 24, 1984

-Attachment 2

Members of the Committee, thank you for asking me to share with you some of my ideas as to alternate geotechnical methods, other than below-ground burial, of storing or disposing of hazardous wastes.

This is a brief summary of requested testimony presented by me before the Agriculture Subcommittee of the U.S. House of Representatives' Committee on Science and Technology in Wichita last August.

The ideas did not originate with me, but are modified from conversations and correspondence with several other people who are dealing with similar problems in other states.

The first is a concept set forth by Professor K.R. Brown of Texas A&M University. He has proposed that rather than underground burial pits, that the solidified wastes be stored indefinitely in engineered earth mounds at the ground surface.

In this method, the waste would be placed at ground level over a gently sloped surface under which a compacted clay layer, a plastic membrane and another cushioning layer of soil or clay is constructed. Under each waste cell a shallow longitudinal vee-shaped gravel layer and a perforated drainage pipe would be installed to drain by gravity to a collection basin or tank which would catch any leakage, if it should occur.

Upon completion of the filling of each cell, earth would be mounded over and around the waste containers, another plastic membrane installed on the top and sides and a sufficient layer of top soil placed to support vegetation. If desired, the vegetation could be planted through a net-like plastic fabric for control of erosion.

The peripheral borrow pits for the mounded material would serve as collecting basins for precipitation runoff from the mounds and/or for fire protection and possible dilution and treatment of selected wastes for underground injection, if that were permitted.

The advantages of this sytem are that precipitation is shed rapidly off the mounds and if leakage should occur, which is unlikely, it will be collected automatically. Another advantage which one might not think of is the fact that a physical mound remains to remind

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future generations that something is buried there, whereas a pit might be forgotten.

I have attached a copy of one of Professor Brown's papers describing the construction details and the advantages of the method.

Although the stated aim of the U.S. Environmental Agency's Resource Conservation and Recovery Act is eventually to reduce or recycle wastes, it is likely that some sort of waste treatment facilities will be necessary for the foreseeable future.

In regard to that, I like the idea put forward by an official of Browning-Ferris Industries at a hazardous waste management symposium that I attended several years ago. He predicted that after many of the small-area type land fills were closed or went out of business because of environmental, financial or regulatory problems, that a few strategically located regional facilities would be established on large tracts of land in environmentally suitable areas.

These fewer facilities would then be able to charge fees that would enable them to chemically or biologically break down the concentrated wastes, incinerate, inject, recycle, etc. and only bury or store a much smaller volume of materials. The squeal of the pig, so to speak. Such sites would also be suitable for storage or disposal of low-level radioactive wastes, a problem that is becoming increasingly acute.

I have attached a copy of Mr. Knieper's abstract.

Considering the likely public opposition to such facilities, how might they be developed in a way that would be more palatable?

Pickett Simpson, who is Deputy Director of the New York State Environmental Facilities Corporation, a state agency similar to he Kansas Turnpike Authority, has suggested an interesting approach.

He suggests that a state agency be established independent of the regulatory agencies to issue bonds to raise funds with which to engage private consulting firms to find suitable sites to the specifications of the Authority. The Authority would then get options on the land or exercise its powers of eminent domain, if necessary, hold public hearings and do whatever else was necessary to get a permit to operate from the state and federal regulatory agencies.

With permits in hand, the Authority could seek bids from private industries for construction and operation of the facility, again to the specifications and under the oversight of the Authority. This would do away with the tremendous up-front financing and risk which is faced by industry without assurances that a site will be approved. It should also result in less-expensive fees to generators.

Presumably, the bids would be based upon a percentage of the net annual profits of the operating company. Funds received would be used to retire the bonds, perpetually monitor the site upon closure and to redo the process if another site or sites were necessary.

The Authority would ideally consist of appointed members and a small operating staff paid by funds generated from the operating contract.

The concept has the advantages of keeping public control and oversight by separating the Authority from the regulating agencies and involving private consultants and industry.

Thank you again for asking me to talk to you.

LANDFILLS OF THE FUTURE: ABOVEGROUND AND ABOVEBOARD

(Draft: April, 1983)

Aboveground landfills, when constructed over sloped double liners, offer several advantages over below ground facilities. Continuous gravitational leachate removal would greatly reduce the potential for groundwater pollution. Aboveground leachate collection systems would be accessible and repairable. A discussion of advantages and disadvantages of both above and below ground landfills follows.

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Landfills have come a long way from the days of open dumping and ravine-filling. New hazardous waste landfills are required to have leachate collection systems, liners, and caps. If properly constructed and maintained, these measures should substantially reduce the short-term quantity of leachate that escapes from a landfill. Liners, leachate collection systems, and caps on below ground landfills may, however, cease to function properly sometime within the first few decades after closure of the landfill. There is now no requirement for leachate collection following the 30-yr. closure period. Yet, many wastes are likely to remain hazardous for centuries.

A failed liner or leachate collection system may not be detected and, if detected, may be impossible to repair without taking drastic measures such as waste excavation. Many of these problems could be avoided by constructing future landfills above ground and on a sloped, double lined base (Figure 1A). The expense of building a sloped-base could be avoided by constructing a "hillfill" using gently sloping hills as the landfill base. Much of the technology already developed for existing landfills, including double liners, leachate collection systems, waste stabilization, and caps could be readily adapted to aboveground landfills.

Leachate Collection Systems

Below ground landfills do not have leachate collection systems designed for continuous leachate removal. Most of these systems cannot remove leachate until the collection pipes are submerged in leachate. Consequently, below ground landfills may well have at least shallow pools of leachate standing on their liners at all times. Futhermore, no provisions are currently being made for monitoring or removing leachate after the sites are completely closed. Thus, leachate will likely accumulate over time. If a leachate collection system fails due to clogging or collapse of the collection pipes, it would be extremely difficult to repair.

An aboveground landfill may be constructed with a continuously operating leachate collection system. By simply incorporating a slope in the base of an aboveground landfill, leachate would be continuously removed by gravity. Since all leachate collection pipes would be above ground level, they would be accessible, in the event that repairs are needed, and serviceable for centuries. The system would also be relatively inexpensive because no pumps or labor would be required for leachate removal.

With both a drainage layer and collection pipes constructed over the sloped liner (Figure 1A), leachate would continue to be removed by gravity even if the collection pipes collapsed. Consequently, there would be

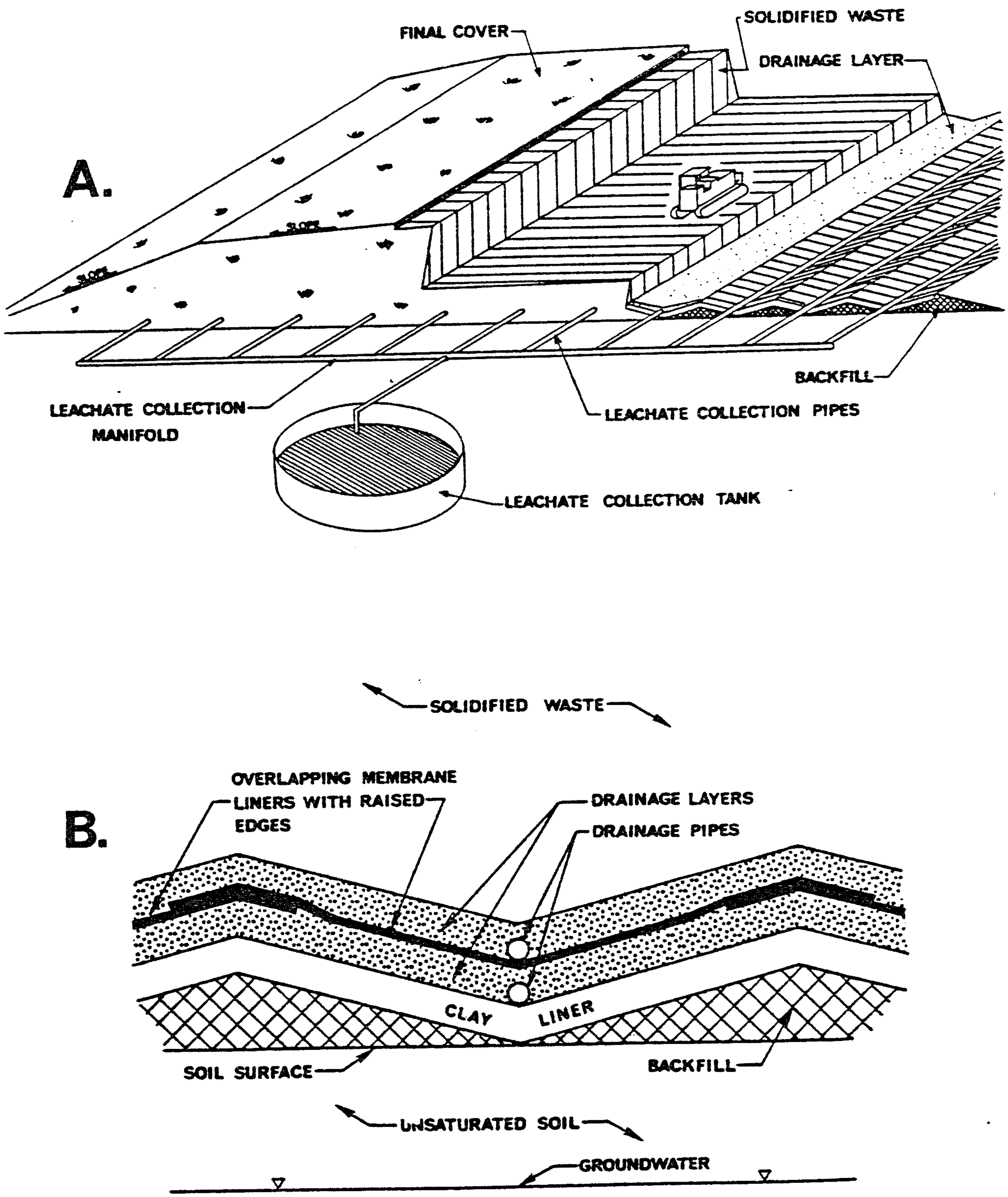

Figure 1. Landfills should be constructed on an aboveground sloped base to facilitate any needed repairs (Figure A); the leachate collection system over the sloped base should include both drainage layers and drainage pipes so that either drainage system would continue to remove leachate from the surface of the liners even if the other system failed (Figure B).

little opportunity for other problems to occur, such as seepage through either the liner or sidewalls.

Liners and Caps

Flexible membranes and clay are the two main materials used to construct low permeability landfill liners. Clay liners may be rendered significantly more permeable by exposure to concentrated leachates that hazardous waste may initially release. While flexible membrane liners may have initial low permeabilities, their 10-30 year useful lifetime covers only a fraction of the period during which a landfill may generate contaminated leachate. Any hazardous waste disposal facility would be better off with a double liner system, and the best double liner would be a combination of a flexible membrane upper liner with an underlying clay liner (Figure1B). Compatibility tests may be used to select the best membrane material for containing particular waste leachates.

A properly installed and tested membrane liner should last at least 10 years if the need to rely on the seams could be eliminated. This would be possible if flexible membrane liners were constructed on a sloped, sawtoothed base as shown in Figure 1B. Because leachate would be continuously removed by gravity, the liquid level should never reach the overlapped membrane edges. By the time the membrane deteriorated, the concentration of salts, acids, bases, and organics should have decreased substantially.

Clay minerals, with their proven ability to last thousands of years, may be a better liner material for minimizing the long-term leakage of weak leachates. With an overlying membrane liner, the clay liner would be protected from the strong initial leachate that might otherwise increase liner permeability.

With continuous removal of leachate, liners in aboveground landfills should have less exposure to leachate and should, therefore, leak much less and last much longer than similar liner configurations in below ground landfills. Consequently, there would be less dependence on site geology for containment of the waste and a lower potential for groundwater contamination. These and other advantages of landfilling waste using an aboveground sloped liner are listed in Table 1.

Table 1. Advantages of Landfilling Waste on an Aboveground Sloped Liner

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No head of liquid would collect on the liner due to continuous gravitational drainage. Consequently:

(1) potential for groundwater contamination would be minimized;
(2) dependence on site geology for waste containment would be lessened;
(3) potential would be reduced for liner deterioration from contact with leachate.

A leachate collection system constructed over the aboveground sloped base and consisting of drainage layers and perforated collection pipes would provide for the following:

(1) leachate collection pipes would be accessible for clean-out should they become clogged;
(2) continuous gravitational removal of leachate would continue through the drainage layer even if the collection pipes completely collapsed;
(3) any increase in the volume of leachate produced would be an immediate indication of the need for cap repair;
(4) long after closure, if leachate were released, it would be readily observable rather than move undetected into groundwater.

Both above and below ground landfills may be equipped with low permeability caps. While caps reduce leachate generation resulting from infiltration of water, these caps may shear or crack due to settlement of the landfilled waste. Compared to leaking liners, cracked caps may be relatively easy to repair. However, cap deterioration may not be readily apparent through visual inspection once the landfill is covered with top-soil and permanent vegetation. Cap failure may only be detected through increase in leachate production. Such an increase in leachate volume may go unnoticed in a below ground facility until the groundwater was polluted. However, it would be readily evident as an increased leachate discharge rate in an aboveground landfill.

Advantages and Disadvantages of Aboveground Landfills

Continuous leachate removal and the resultant increased effectiveness of liners in aboveground landfills may greatly reduce the potential for both groundwater pollution and long-term liability. Since aboveground facilities would be further removed from groundwater, siting requirements would be less severe than those for below ground facilities. With gases generated above the ground surface, the possibility of subsurface migration to adjacent areas would be virtually eliminated. Advantageous options that could be incorporated into aboveground landfills include the following:

1) above the leachate collection system, layers of materials such as crushed limestone and activated charcoal could be placed to remove heavy metals and organics, respectively;

2) before placement of the low permeability cap, leachate could be recirculated through the landfill cells to both hasten digestion of readily degradable organics and leach the highly mobile waste constituents prior to the post-closure period.

There are a variety of other advantages to keeping waste above ground. For instance, no one would ever forget the location of the disposal site. In addition, if the waste became valuable someday, it could easily be mined. The uncapped landfill surface could be used as an intensive land treatment unit.

Disadvantages of aboveground landfills include the potential for poor site aesthetics and the need for erosion control. However, with proper design and use of vegetation, both problems could be overcome. Site aesthetics of aboveground facilities may be improved by maintaining a permanent vegetative cover over the facility. Additional improvements in site aesthetics could be obtained by planting trees and small woody species around the periphery and along adjacent roadways. Erosion could be minimized by a permanent vegetative cover and a site design that minimized steepness and total area of side slopes. Using adjacent landfill cells would decrease the total area of slopes, while a small amount of earth-fill could sufficiently reduce the steepness of exposed sidewalls.

Advantages and Disadvantages of Below Ground Landfills

The main advantage of below ground landfills is that these facilities are out-of-sight and hence out-of-mind. The main disadvantage is that these facilities eventually get out-of-control. One technique used to site below ground landfills in humid climates is to artificially lower the groundwater table by continuously pumping out leachate (Figure2A). This technique is supposed to force liquids to flow into the landfill, thereby preventing contamination of groundwater or deterioration of the liner due to exposure to leachate. The main problem with this design is the unrealistic requirement for perpetual pumping.

State-of-the-art below ground landfills minimize groundwater contamination by pumping out leachate and maintaining a low permeability cap (Figure 2B). While these measures should prevent widespread groundwater

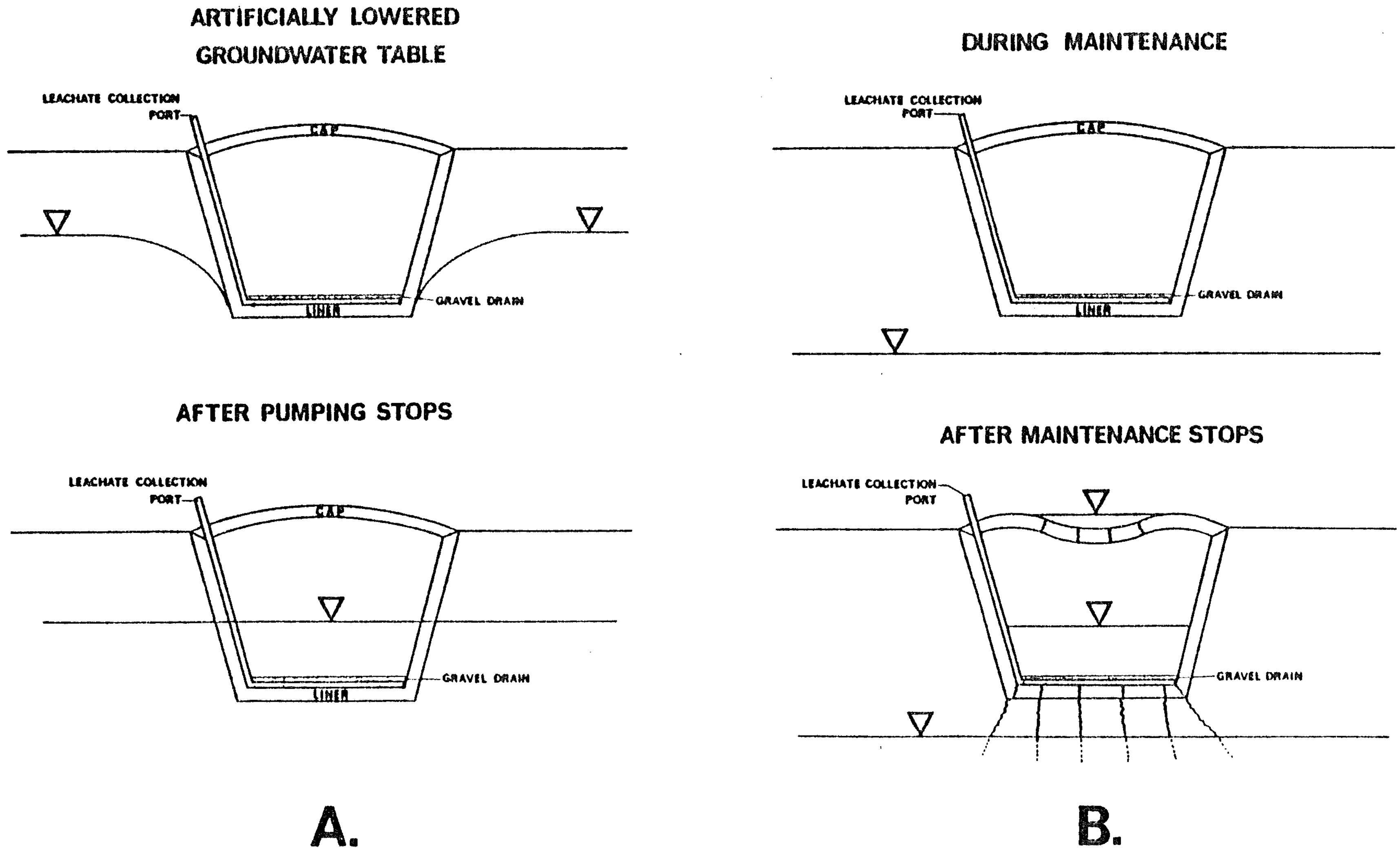

Figure 2. Below ground landfills sited within a groundwater table require perpetual pumping to prevent groundwater contamination (Figure A); state-of-the-art below ground landfills may only reduce the potential for groundwater contamination until maintenance stops (Figure B).

contamination during the active life of a facility, the situation after maintenance stops may be quite different. As organic wastes decompose, voids form in the fill which may well cause the cap to settle and crack. Liquids may even pond on the cap or move through the cap and pond on the liner. The hydraulic gradient formed due to the ponded leachate could then accelerate leakage, liner deterioration, and groundwater contamination.

Improving Landfills

Landfills have come a long way in the past two decades, but there is still need for improvement. Lack of enthusiastic public acceptance and the threat of long-term liabilities due to groundwater contamination from below ground landfills are two of the indications that further changes are warranted. Current hazardous waste regulations limit the landfilling of liquids. The next step should be to reduce the landfilling of organic chemicals by encouraging the use of land treatment (for readily degradable organics such as oily refinery wastes) and incineration (for nondegradable organics such as PCBs). The remaining inorganic wastes and incinerator residues could be solidified and safely disposed in aboveground landfills.

Well designed aboveground facilities have the potential to both improve the acceptability and greatly decrease the pollution risks of landfills. Landfilling waste over an aboveground sloped base is an idea whose time has come.

INFORMATION ABOUT K. W. BROWN & ASSOCIATES

Solving environmental problems today requires a broad range of scientific and engineering expertise as well as knowledge of the governmental regulations that affect all aspects of waste disposal, surface mining, and contaminated soil cleanup. K. W. Brown & Associates has a multidisciplinary staff of professionals who can provide the state-of-the-art expertise needed to develop solutions to your environmental management and pollution control needs.

K. W. Brown and Associates (KWB&A) specializes in the treatment and disposal of both hazardous and nonhazardous wastes, cleanup assessment of salt and chemical spills, evaluation of liners to contain wastes, reclamation of mined and disturbed lands, and interpretation of soil analyses. Through research and consulting, KWB&A has developed an in-depth understanding of the movement and degradation of chemical compounds and plant nutrients in the soil environment which is an essential part of the solution to many environmental problems.

KWB&A has provided assistance to numerous clients, including corporate refineries, waste disposal companies, mining companies, manufacturing facilities, industries, utility companies, other environmental consultants, law firms, individuals, and federal, state, and local government agencies.

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Symposium on Hazardous and Special Waste Management
St. Louis Section AEG
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FINANCIAL AND ORGANIZATIONAL IMPACTS ON THE HAZARDOUS WASTE MANAGER

by
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The past decade witnessed the maturation of the waste management industry, now a carefully designed and controlled business. This development was spurred on by state and federal regulation and by society's concern for the impact of man's activity on our environment. The most dramatic development has occurred since the passage of Resource Conservation and Recovery Act (RCRA) in 1976 more precisely delineating a chemical waste market.

Major technologies have not been altered significantly throughout this growth and development. Incineration, landfilling, and deep well injection procedures have changed only slightly from pre-RCRA operations. Physical/Chemical/Biological Treatment facilities and Recycling/Reclamation operations have developed significantly but remain only a small segment of the private waste management sector. The impact of RCRA has been most keenly felt at the pre-disposal operations level and in the peripheral support segments of a hazardous waste management facility.

Increased sophistication has been mandated in the protocols for chemical waste transportation, acceptance, off-loading, storage, and tracking (on and off site). Within hazardous waste management facility operations, regulatory impact has created improvements in communications, emergency response, record keeping, security, and equipment maintenance. The greatest challenge presented by RCRA was the development of adequately trained hazardous waste management facility personnel from managers to laborers. The greatest challenge created by RCRA is facility siting and public education.

Increased sophistication generally creates increased operational costs and therefore higher prices. As new facility siting and final regulations remain stagnant, supply and demand economics also serve to increase hazardous waste management costs.

The trend within the private hazardous waste management sector is to a large multi-faceted facility involved in treatment, storage, disposal, reclamation, and recycling. Such a facility may occupy 1000+ acres and process 50,000,000 gallons of waste a year for 20+ years. Generally the cost for developing such a facility, including false starts and delays due to public over-reaction, is estimated at over $15 million. Two to five years are anticipated between conception and operation. Operating costs are expected to exceed $5 million per year. Hazardous waste generators, therefore, can anticipate a disposal cost of $0.30 to $0.40 per gallon plus transportation. Generally, these chemical waste management centers will be few in number and strategically located.

Strong, credible regulatory agencies with good public awareness and education programs willing to take a leadership role in facility siting and permitting can certainly reduce the lead-time and expense of developing the next generation of hazardous waste management facilities.

Table 1

COSTS FOR NEW FACILITIES

Physical/Chemical/Biological Treatment	$4 - 6 million
Incineration	$10 - 20 million
Secure Landfill	$4 - 6 million
Deep Well Injection	$2 - 3 million
Chemical Fixation	$1 - 2 million
Sanitary Landfills	$1 - 2 million
Lab Facilities	$250,000 - 1 million
Permits	$250,000 - 2 million

Table 2

CURRENT DISPOSAL COSTS

Physical/Chemical/Biological Treatment	$0.04 - 0.05/lb.
Incineration	$0.08 - 0.20/lb.
Secure Landfill	$0.01 - 0.06/lb.
Chemical Fixation	$0.005 - 0.05/lb.
Deep Well Injection	$0.01 - 0.02/lb.
Recovery/Reutilization	Variable

Attachment

TESTIMONY

by

Janis C. Butler
J.C. Butler Associates, Inc.
Salina, Kansas

for the
Kansas Engineering Society

24 April 1984

TESTIMONY TO SENATE ENERGY AND NATURAL RESOURCES COMMITTEE ON HAZARDOUS WASTE DISPOSAL, HOUSE BILL 2725.

I am Jan Butler, President of J.C. Butler Associates Consulting Engineers, Salina, Kansas.

On behalf of the Kansas Engineering Society, I am pleased to testify today on the subject of Hazardous Waste Disposal.

In this testimony, we will discuss the Kansas Engineering Society's support of two (2) features of House Bill 2725, and our objections to three (3) principal features of the bill. Then, we will offer an alternative approach to the solution of the hazardous waste problem in Kansas.

At the conclusion of the presentation we will be pleased to answer any questions you may wish to ask.

Kansas Engineering Society supports the feature of Bill 2725 that the ground burial of hazardous wastes is not environmentally acceptable. This bill does not achieve that.

We also support the section of HB 2725 which limits the exemption of small generators of hazardous waste. We recommend, however that the small generator exemption be completely eliminated in the final phase of the schedule which is presented based on the degree of hazard of the waste. The secretary shall determine by regulation which are exempted.

However important these desirable features of Bill 2725 may be, in three (3) important respects, the bill should be modified for the following considerations:

First: We are particularly disturbed with the concept of mound burial, which we regard as a poor substitute for the proper disposal of hazardous waste. This provision of the bill would simply create new hazardous waste sites like Furley, to be monitored into perpetuity. There is no basic difference between mound burial and below ground burial. The stated intent of the bill to forbid the ground burial of hazardous waste is directly contradicted by the inclusion of the practice of mound burial of waste.

Mound burial is NOT a substitute for proper storage of hazardous waste. Mound burial makes no provisions for the segregation of different kinds of wastes, which is a necessary part of proper storage. With proper waste

Atch. 3

segregation, stored wastes can be treated and rendered inert and non-hazardous at a future time.

Second: The Kansas Engineering Society believes that unregulated deep well injection of hazardous waste fluids is an unacceptable mode of disposal. The assumption that there is unlimited capacity in the deep disposal formations to accept all hazardous wastes is a very dangerous assumption. The long range potential hazard associated with deep well injection of highly corrosive hazardous waste fluids is significant.

Typically, the deep disposal well in Kansas is 4,000 feet deep, and the casing passes through the drinking water aquifers. A casing leak or break would lead to direct contamination of drinking water supplies. The Arbuckle formation is used in Kansas for deep well disposal. The Kansas city of Pittsburg draws its drinking water from the same zone, as do many communities in Oklahoma. We may be polluting future generations' drinking water supplies by injecting hazardous wastes into this deep zone. The issue of disposal of hazardous waste by deep well injection is complex and should be the subject of comprehensive review and regulation.

Third: Land treatment of hazardous waste is a generally ineffective mode of treatment. It invites pollution of underground water supplies which are increasingly being subjected to contamination by industrial wastes. Kansas Engineering Society does not support hazardous waste land disposal disguised as "land treatment".

From these considerations, the Kansas Engineering Society recommends H.B. 2725 be revised in committee, and that current law be modified to reflect our previously stated concerns. The Engineering Society's position favoring alternatives to hazardous waste burial is supported by the U.S. Congress and by the U.S. Office of Technology Assessment.

The U.S. House of Representatives Bill 2867 was passed by the House this session. This bill prohibits ground burial of many wastes and requires EPA to conduct a review of all hazardous wastes to determine if land disposal prohibition is warranted. There is no provision for "mound burial" in the House bill.

Bill S-757 has been reported to the Senate. It contains provisions prohibiting ground burial similar to the House bill. It is likely that significant federal legislation will be enacted this year which will prohibit ground burial of wastes.

The United States Office of Technology Assessment issued a damning critique of EPA's current hazardous waste rules this month. The Office of Technology Assessment (OTA) report concludes that groundwater protection standards which encourage ground burial issued under the Resource Conservation & Recovery Act are not designed and, indeed, are incapable of preventing RCRA-regulated waste disposal sites from becoming future Superfund sites.

Specifically, the OTA staff finds that RCRA rules are seriously inadequate if they are meant to provide "for' effective, long-term management of hazardous wastes." The existing regulations give no consideration to the "huge cost of cleaning up groundwater contamination," and are based on slight "consideration of alternate approaches."

The Office of Technology Assessment concludes that landfills for hazardous waste should be the disposal method of last resort, and should be limited to "inert, low-hazard wastes" in "facilities where groundwater is not threatened."

Kansas Engineering Society, therefore, recommends that the Kansas Legislature take a fresh approach to solving the hazardous waste problem as rapidly as possible by establishing a centralized waste treatment, processing and disposal site. The planning and construction of such a site will require at least three (3) to four (4) years, so the Legislature is urged to move with dispatch to provide these urgently needed facilities.

The provisions for such a centralized facility will be a great service to both the small quantity generator and to those generators who produce larger waste quantities but who elect not to provide approved and permitted on-site treatment.

Almost all hazardous wastes can be rendered non-hazardous by treatment. The principal types of treatment include:

* incineration
* neutralization
* precipitation
* biological or chemical oxidation
* fixation by admixture of cement-like binders
* solvent recovery

These technologies are known - they are state-of-the-art now. Most big industries in the country are already treating their hazardous wastes. The example of the Boeing Company in Wichita is a good one. Aircraft manufacturing waste contains a wide range of pollutants including solvents, heavy metals, acids and caustics. Boeing has a waste treatment plant on-site to treat their wastes. The treated liquid wastes are sufficiently clean for surface discharge under an NPDES permit. The solid residues are inert and non-hazardous, and are landfilled on-site under an approved State permit.

In 1983, I prepared a report under a contract to the Kansas Department of Health and Environment which detailed the procedures for the treatment of paint and printing wastes, which constitute approximately 40% of Kansas generated hazardous wastes. This Report is an example of how one large segment of hazardous wastes could be rendered inert, with non-hazarous residues suitable for burial in an ordinary landfill. A copy of this report is available for the committee to review.

In conclusion, the Kansas Engineering Society recommends that the State of Kansas should own and operate, or cause to be operated, a comprehensive treatment facility for hazardous wastes. Such a facility will receive and store properly segregated hazadous waste from generators, provide appropriate treatment to render the wastes non-hazardous, and dispose the residues in an environmentally sound manner in an ordinary "industrial waste" landfill.

The facility operator shall determine the amenability to treatment by the facility of specific wastes.

Generators of wastes which are non-treatable or for which the appropriate processing is not available within the facility must apply for and receive approval from the oversight agency for long-term storage and/or disposal of the waste while still in its hazardous form.

To implement this program the State of Kansas should create a separate authority operating in conjunction with the Kansas Department of Health and Environment. The authority should be fully operational, funded from charges to industry for waste processing. The State of Kansas should purchase property, construct, own and cause the facility to be operated as a separate treatment and disposal utility. Legislation should be developed around this concept and fully funded, initially from the State General Revenues, with repayment by the using industries. Care should be taken to allow fiscal flexibility so as to insure and maintain the utilization of current technology.

We recommend that the Kansas Legislature take an entirely new approach to solving the hazardous waste problems by instituting legislation which will not only disallow land burial, but one which offers a positive solution to hazardous waste disposal, incorporating a regional waste storage, treatment, and disposal center as I have outlined here today.

The Kansas Engineering Society stands ready to assist in the development of this concept in hazardous waste legislation.

Thank you.