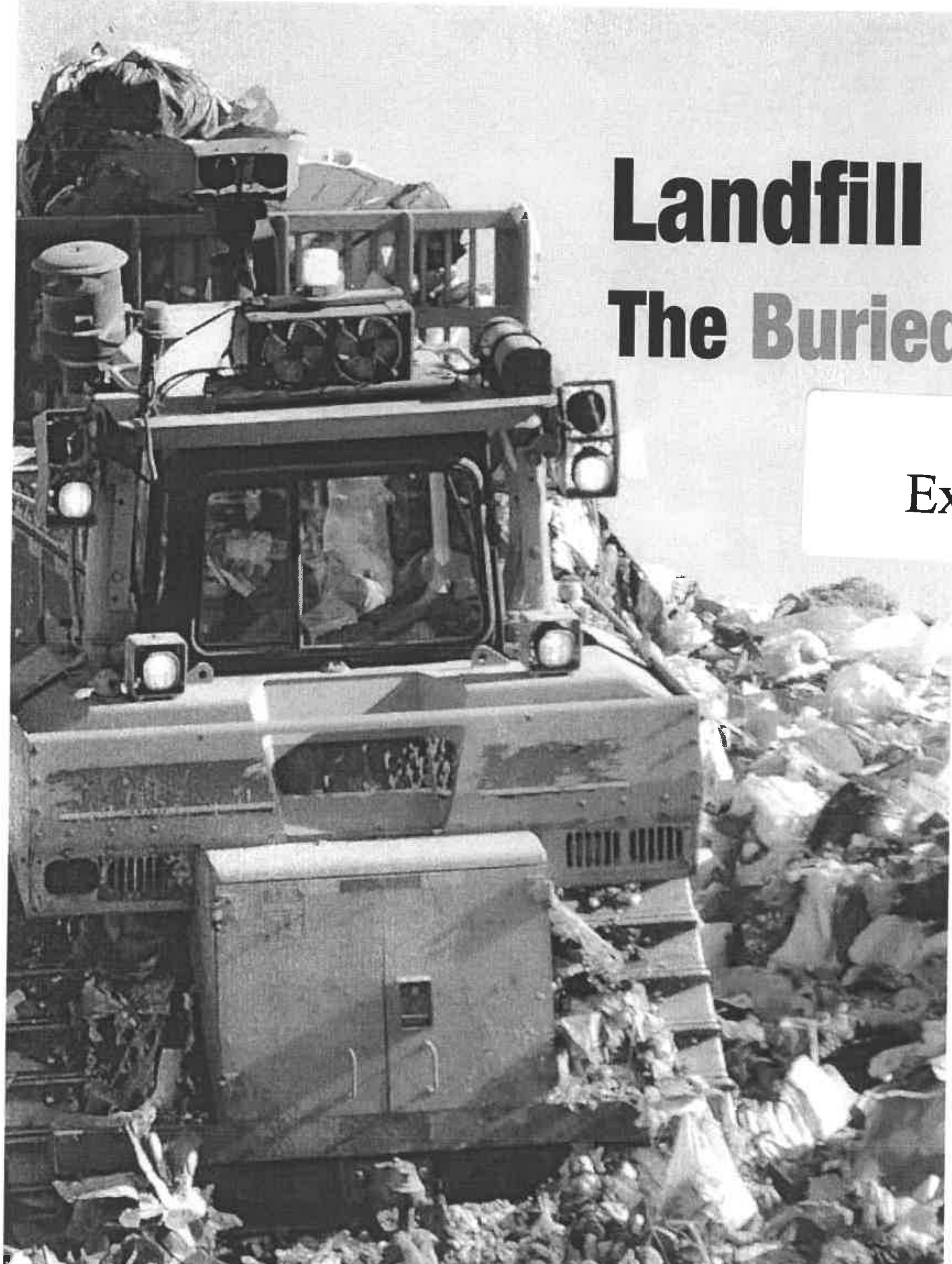
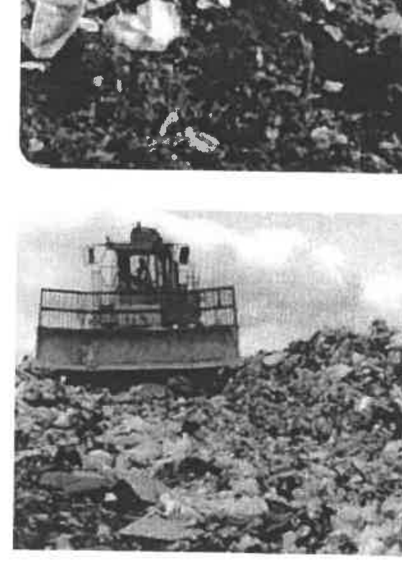
Landfill Failures
The Buried Truth

Exhibit 15



FactPack – P009



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Center for Health, Environment & Justice
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Mentoring a Movement
Empowering People
Preventing Harm

About the Center for Health, Environment & Justice

CHEJ mentors the movement to build healthier communities by empowering people to prevent the harm caused by chemical and toxic threats. We accomplish our work by connecting local community groups to national initiatives and corporate campaigns. CHEJ works with communities to empower groups by providing the tools, strategic vision, and encouragement they need to advocate for human health and the prevention of harm.

Following her successful effort to prevent further harm for families living in contaminated Love Canal, Lois Gibbs founded CHEJ in 1981 to continue the journey. To date, CHEJ has assisted over 15,000 groups nationwide. Details on CHEJ's efforts to help families and communities prevent harm can be found on www.chej.org.

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WHAT IS A LANDFILL?

A secure landfill is a carefully engineered depression in the ground (or built on top of the ground, resembling a football stadium) into which wastes are put. The aim is to avoid any hydraulic [water-related] connection between the wastes and the surrounding environment, particularly groundwater. Basically, a landfill is a bathtub in the ground; a double-lined landfill is one bathtub inside another. Bathtubs leak two ways: out the bottom or over the top.

WHAT IS THE COMPOSITION OF A LANDFILL?

There are four critical elements in a secure landfill: a bottom liner, a leachate collection system, a cover, and the natural hydrogeologic setting. The natural setting can be selected to minimize the possibility of wastes escaping to groundwater beneath a landfill. The three other elements must be engineered. Each of these elements is critical to success.

THE NATURAL HYDROGEOLOGIC SETTING:

You want the geology to do two contradictory things for you. To prevent the wastes from escaping, you want rocks as tight (waterproof) as possible. Yet if leakage occurs, you want the geology to be as simple as possible so you can easily predict where the wastes will go. Then you can put down wells and capture the escaped wastes by pumping. Fractured bedrock is highly undesirable beneath a landfill because the wastes cannot be located if they escape. Mines and quarries should be avoided because they frequently contact the groundwater.

WHAT IS A BOTTOM LINER?

It may be one or more layers of clay or a synthetic flexible membrane (or a combination of these). The liner effectively creates a bathtub in the ground. If the bottom liner fails, wastes will migrate directly into the environment. There are three types of liners: clay, plastic, and composite.

WHAT IS WRONG WITH A CLAY LINER?

Natural clay is often fractured and cracked. A mechanism called diffusion will move organic chemicals like benzene through a three-foot thick clay landfill liner in approximately five years. Some chemicals can degrade clay.

WHAT IS WRONG WITH A PLASTIC LINER?

The very best landfill liners today are made of a tough plastic fi lm called high density polyethylene (HDPE). A number of household chemicals will degrade HDPE, permeating it (passing though it), making it lose its strength, softening it, or making it become brittle and crack. Not only will household chemicals, such as moth balls, degrade HDPE, but much more benign things can cause it to develop stress cracks, such as, margarine, vinegar, ethyl alcohol (booze), shoe polish, peppermint oil, to name a few.

WHAT IS WRONG WITH COMPOSITE LINERS?

A Composite liner is a single liner made of two parts, a plastic liner and compacted soil (usually clay soil). Reports show that all plastic liners (also called Flexible Membrane Liners, or FMLs) will have some leaks. It is important to realize that all materials used as liners are at least slightly permeable to liquids or gases and a certain amount of permeation through liners should be expected. Additional leakage results from defects such as cracks, holes, and faulty seams. Studies show that a 10-acre landfill will have a leak rate somewhere between 0.2 and 10 gallons per day.

WHAT IS A LEACHATE COLLECTION SYSTEM?
Leachate is water that gets badly contaminated by contacting wastes. It seeps to the bottom of a landfill and is collected by a system of pipes. The bottom of the landfill is sloped; pipes laid along the bottom capture contaminated water and other fluid (leachate) as they accumulate. The pumped leachate is treated at a wastewater treatment plant (and the solids removed from the leachate during this step are returned to the landfill, or are sent to some other landfill). If leachate collection pipes clog up and leachate remains in the landfill, fluids can build up in the bathtub. The resulting liquid pressure becomes the main force driving waste out the bottom of the landfill when the bottom liner fails.

WHAT ARE SOME OF THE PROBLEMS WITH LEACHATE COLLECTION SYSTEMS?
Leachate collection systems can clog up in less than a decade. They fail in several known ways: they clog up from silt or mud; they can clog up because of growth of microorganisms in the pipes; they can clog up because of a chemical reaction leading to the precipitation of minerals in the pipes; or the pipes become weakened by chemical attack (acids, solvents, oxidizing agents, or corrosion) and may then be crushed by the tons of garbage piled on them.

WHAT IS A COVER?
A cover or cap is an umbrella over the landfill to keep water out (to prevent leachate formation). It will generally consist of several sloped layers: clay or membrane liner (to prevent rain from intruding), overlain by a very permeable layer of sandy or gravelly soil (to promote rain runoff), overlain by topsoil in which vegetation can root (to stabilize the underlying layers of the cover). If the cover (cap) is not maintained, rain will enter the landfill resulting in buildup of leachate to the point where the bathtub overflows its sides and wastes enter the environment.

WHAT ARE THE PROBLEMS WITH COVERS?
Covers are vulnerable to attack from at least seven sources: 1) Erosion by natural weathering (rain, hail, snow, freeze-thaw cycles, and wind); 2) Vegetation, such as shrubs and trees that continually compete with grasses for available space, sending down roots that will relentlessly seek to penetrate the cover; Burrowing or soil- dwelling mammals (woodchucks, mice, moles, voles), reptiles (snakes, tortoises), insects (ants, beetles), and worms will present constant threats to the integrity of the cover; 3) Sunlight (if any of these other natural agents should succeed in uncovering a portion of the umbrella) will dry out clay (permitting cracks to develop), or destroy membrane liners through the action of ultraviolet radiation; 5) Subsidence--an uneven cave-in of the cap caused by settling of wastes or organic decay of wastes, or by loss of liquids from landfilled drums--can result in cracks in clay or tears in membrane liners, or result in ponding on the surface, which can make a clay cap mushy or can subject the cap to freeze-thaw pressures; 6) Rubber tires, which "float" upward in a landfill; and 7) Human activities of many kinds.

Prepared by: Environmental Research Foundation

THE NORMAN LANDFILL ENVIRONMENTAL RESEARCH SITE WHAT HAPPENS TO THE WASTE IN LANDFILLS?

U.S. Geological Survey Fact Sheet 040-03
August 2003

By Scott C. Christenson and Isabelle M. Cozzarelli

This Factsheet is also available as pdf (949KB).

DO LANDFILLS LEAK?

We call it "garbage" or "trash" but it is "municipal solid waste" to your city government and the waste industry. Municipal solid waste is a combination of non-hazardous wastes from house holds, commercial properties, and industries. The U.S. Environmental Protection Agency (USEPA) reports that the United States produced about 230 million tons of solid waste in 1999, about 57 percent of which is disposed of in landfills (U.S. Environmental Protection Agency, 1999).

Disposal of municipal solid waste in landfills was largely unregulated prior to the 1970s. Most solid waste was deposited in unlined pits. Precipitation and ground water seeping through this waste produces leachate, which is water contaminated from the various organic and inorganic substances with which it comes in contact as it migrates through the waste. Leachate seeping from a landfill contaminates the ground water beneath the landfill, and this contaminated ground water is known as a plume. The normal movement of ground water causes the leachate plume to extend away from a landfill, in some cases for many hundreds of meters. Many studies have shown leachate plumes emanating from old unlined landfills. Estimates for the number of closed landfills in the United States are as high as 100,000 (Suflita and others, 1992).

Federal and state regulations were passed in the 1980s and 1990s to manage disposal of solid waste. Those regulations require that most landfills use liners and leachate collection systems to minimize the seepage of leachate to ground water. Although liners and leachate collection systems minimize leakage, liners can fail and leachate collection systems may not collect all the leachate that escapes from a landfill. Leachate collection systems require maintenance of pipes, and pipes can fail because they crack, collapse, or fill with sediment. The USEPA has concluded that all landfills eventually will leak into the environment (U.S. Environmental Protection Agency, 1988). Thus, the fate and transport of leachate in the environment, from both old and modern landfills, is a potentially serious environmental problem.

SOLID WASTE LANDFILL TECHNOLOGY
A DOCUMENTED FAILURE

HIGH DENSITY POLYETHYLENE LINERS (HDPE) ARE NOT EFFECTIVE BARRIERS TO LANDFILL LEACHATE.

Two major classes of chemicals are responsible for HDPE failure. Aromatic hydrocarbons such as benzene and naphthalene, "permeate excessively and cause package deformation," and halogenated hydrocarbons such as trichlorethylene and methylene chloride can permeate HDPE and cause,"softening, swelling, and part deformation."

Marlex Polyethylene TIB 2 Packaging Properties, Plastics Division, Phillips 66 Company, Bartlesville, OK 74004

The "best demonstrated available technology" for composite liners (clay and plastic) allow leakage rates from .02 to 1.0 gallons per acre per day. This would result in 730 to 36,500 gallons per year from a 100 acre landfill.

Geoservices Inc. Background Document on Bottom Liner Performance in Double-lined landfills and Surface Impoundments, April 1987

LANDFILL CAPS ARE SUBJECT TO NATURAL ELEMENTS AND LEAKAGE

Lightning bolts striking the ground typically five million volts and 2,500 to 220,000 amperes can bore holes in the ground eight inches in diameter and fifteen feet deep. In western North Carolina, an average number of lightning strikes per hundred acres is 2.96 per year.

AT&T Telecommunication Electrical Protection, AT&T Technologies, Inc. 1985

Burrowing animals can move 5.3 tons of soil to the surface per acre per year. "Similar activity would have a dramatic impact on landfill cap integrity...synthetic liners, measured in mils are not likely to impede these same animals." Clay presents little barrier to such animals.

Johnson & Dudderar, WASTE AGE, March 1988, p.108-111

LEAK TESTING OF NEW LANDFILL LINERS REVEALS MAJOR FLAWS

Tests of the new municipal solid waste liner after burial by an Arizona contractor revealed that even with the most careful construction and quality assurance testing at every stage of emplacement, the liners had holes and punctures. *American City and County, July 1991*

EVEN EPA PREDICTS FAILURE OF THE NEW LANDFILL TECHNOLOGY

"First, even the best liner and leachate collection systems will ultimately fail due to natural deterioration..."

Federal Register p.33345 August 30, 1988

BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE

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www.BREDL.org

Starting in the 1970s and continuing throughout the 1980s, U.S. Environmental Protection Agency [EPA] funded research which showed that burying household garbage in the ground poisons the groundwater. On several occasions, EPA spelled out in detail the reasons why all landfills leak. (For example, see RHWN #37, #71, and #116)

Then in late 1991, after several years of deliberation, EPA chief William Reilly issued final landfill regulations that allow the continued burial of raw garbage in landfills. (See RHWN #268.) EPA's 1991 regulations require an expensive landfill design: two liners in the ground and an impervious plastic cover over the landfill after it has been filled with garbage. This is "state of the art" technology, the very best that modern engineers can build. However, EPA officials still expect such landfills to fail and eventually poison groundwater.

As early as 1978, EPA knew why all landfills eventually leak. The main culprit is water. Once water gets into a landfill, it mixes with the garbage, producing a toxic leachate ("garbage juice"), which is then pulled downward by gravity until it reaches the groundwater. Therefore, the goal of landfill designers (and regulators) is to keep landfills dry for the length of time that the garbage is dangerous, which is forever.

Now a 1992 report from a California engineering-consulting firm, G. Fred Lee & Associates, has examined recent scientific studies and has confirmed once again why modern "dry tomb" landfill technology will always fail and should always be expected to poison groundwater.[1]

The new report, authored by Fred Lee and Anne Jones, reviews recent evidence--much of it produced by government-funded research--that landfill liners leak for a variety of reasons; that leachate collection systems clog up and thus fail to prevent landfill leakage; that landfill leachate will remain a danger to groundwater for thousands of years; that even low-rainfall areas are not safe for landfill placement; that gravel pits and canyons are particularly dangerous locations for landfills; that maintaining a single landfill's cap for the duration of the hazard would cost hundreds of billions, or even trillions, of dollars; that groundwater monitoring cannot be expected to detect landfill leakage; that groundwater, once it is contaminated, cannot be cleaned up and must be considered permanently destroyed; and that groundwater is a limited and diminishing resource which modern societies grow more dependent on as time passes.

A 1990 examination of the best available landfill liners concluded that brand-new state-of-the-art liners of high density polyethylene (HDPE) can be expected to leak at the rate of about 20 gallons per acre per day (200 liters per hectare per day) even if they are installed with the very best and most expensive quality-control procedures.[2] This rate of leakage is caused by pinholes during manufacture, and by holes created when the seams are welded together during landfill construction. (Landfill liners are rolled out like huge carpets and then are welded together, side by side, to create a continuous field of plastic.) Now examination of actual landfill liners reveals that even the best seams contain some holes.

In addition to leakage caused by pinholes and failed seams, new scientific evidence indicates that HDPE (high density polyethylene, the preferred liner for landfills) allows some chemicals to pass through it quite readily. A 1991 report from University of Wisconsin shows that dilute solutions of common solvents, such as xylenes, toluene, trichloroethylene (TCE), and methylene chloride, penetrate HDPE in one to thirteen days. Even an HDPE sheet 100 mils thick (a tenth of an inch)--the thickness used in the most expensive landfills) is penetrated by solvents in less than two weeks.

Another problem that has recently become apparent with HDPE liners is "stress cracking" or "brittle fracture." For reasons that are not well understood, polyethylenes, including HDPE, become brittle and develop cracks. A 1990 paper published by the American Society for Testing Materials revealed that HDPE liners have failed from stress cracks in only two years of use. Polyethylene pipe, intended to give 50 years of service, has failed in two years. Lee and Jones sum up (pg. 22), "While the long-term stability of geomembranes (flexible membrane liners) in landfills cannot be defined, there is no doubt that they will eventually fail to function as an impermeable barrier to leachate transport from a landfill to groundwater. Further, and most importantly at this time, there are no test methods, having demonstrated reliability, with which to evaluate long-term performance of flexible membrane liners."

Recent scientific studies of clay indicate that landfill liners of compacted clay leak readily too. For example, a 1990 study concludes,

[I]F A NATURALLY OCCURRING CLAY SOIL IS COMPACTED TO HIGH DENSITY, THEREBY PRODUCING A MATERIAL WITH VERY LOW HYDRAULIC CONDUCTIVITY, AND IF IT IS MAINTAINED WITHIN THE SAME RANGES OF TEMPERATURE, PRESSURE, AND CHEMICAL AND BIOLOGICAL ENVIRONMENT, IT WOULD BE EXPECTED TO FUNCTION WELL AS A SEEPAGE BARRIER INDEFINITELY. IN WASTE CONTAINMENT APPLICATIONS, HOWEVER, CONDITIONS DO NOT REMAIN THE SAME. THE PERMEATION [PENETRATION] OF A COMPACTED CLAY LINER BY CHEMICALS OF MANY TYPES IS INEVITABLE, SINCE NO COMPACTED CLAY OR ANY OTHER TYPE OF LINER MATERIAL IS EITHER TOTALLY IMPERVIOUS OR IMMUNE TO CHEMICAL INTERACTIONS OF VARIOUS TYPES

The 1992 study by Lee and Jones is an excellent resource for anyone wanting to understand why landfills always fail. In their footnotes, they cite 18 other studies of landfill problems that they themselves have authored, so their expertise is unquestionable, their information reliable, their arguments solid.

There has been sufficient scientific evidence available for a decade to convince any reasonable person that landfills leak poisons into our water supplies, and are therefore anti-social.

The question remains: what will it take to convince government--specifically EPA--to base policy on its own scientific studies and its own understanding?

The new EPA administrator is Carol M. Browner, an avowed environmentalist from Florida. Asked to describe Ms. Browner's style, John Sheb, head of Florida's largest business trade association, said: "She kicks the door open, throws in a hand grenade, and then walks in to shoot who's left. She really doesn't like to compromise."

Maybe Ms. Browner could start with a wake-up grenade in the Office of Solid Waste.

--Peter Montague

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[1] G. Fred Lee and Anne R. Jones, MUNICIPAL SOLID WASTE MANAGEMENT IN LINED, "DRY TOMB" LANDFILLS: A TECHNOLOGICALLY FLAWED APPROACH FOR PROTECTION OF GROUNDWATER QUALITY (El Macero, Calif.: G. Fred Lee & Associates, March, 1992). Available from: G. Fred Lee & Associates, 27298 East El Macero Drive, El Macero, CA 95618-1005. Phone (916) 753- 9630. 67 pgs.; free.

[2] Rudolph Bonaparte and Beth A. Gross, "Field Behavior of Double- Liner Systems," in Rudolph Bonaparte (editor), WASTE CONTAINMENT SYSTEMS: CONSTRUCTION,

REGULATION, AND PERFORMANCE [Geotechnical Special Publication No. 26] (New York: American Society of Civil Engineers, 1990), pgs. 52-83.

CLARIFICATION: RIGHTS OF CORPORATIONS

Last week we suggested the need for a Constitutional amendment declaring that a corporation is not a natural person and is therefore not protected by the Bill of Rights and the 14th amendment to the Constitution. Such an amendment would level the playing field somewhat, giving communities and individuals a greater chance of controlling anti-social corporate behavior. As we noted in earlier newsletters (RHWN #308, #309), corporations are now literally out of control. Shareholders cannot control them; boards of directors cannot control them; workers cannot control them; in a competitive world market, even managers have lost control. In some cases, of course, management doesn't care about the environment or the community. But even when managers, as individuals, want to do the right thing, the logic of corporate growth and short-term gain often dictates choices that do not serve the environment or the community. Since corporate behavior is at the root of nearly all environmental problems, stripping corporations of some of their rights (such as the Constitutional protections guaranteed to individual citizens, which the Supreme Court extended to corporations in 1886), would help communities assert control over corporate behavior. Merely DEBATING such an amendment would get people thinking about power in the modern world, asking who has a legitimate right to control what. Ask yourself: who ever gave private corporations the right to manufacture and sell products that can destroy the planet as a place suitable for human habitation? In suggesting such a Constitutional amendment, we omitted reference to the original source of the idea, author Richard Grossman.

For historical background on control of corporations, get: Richard Grossman and Frank T. Adams, TAKING CARE OF BUSINESS; CITIZENSHIP AND THE CHARTER OF INCORPORATION (Cambridge, Mass.: Charter, Inc., 1992). For a copy, send $4.00 plus a self-addressed, stamped envelope containing 52 cents postage to: Charter, Inc., P.O. Box 806, Cambridge, MA 02140.
--Peter Montague

Descriptor terms: corporations; constitution; us; landfilling; landfill liners; leachate collection systems; groundwater; epa; waste disposal technologies; high density polyethylene; waste treatment technologies; msw;

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Rachel's Environment & Health News
#217 - Plastics -- Part 2: Why Plastic Landfill Liners Always Fail
January 22, 1991

In the landfill business, government and industry say plastic liners are going to save the day. For example, U.S. Environmental Protection Agency (EPA) and industry both argue that incinerator ash can be safely "disposed of" in a double-lined ash "monofill." A "monofill" is a landfill that contains only ash, no raw garbage. Like any other landfill, the basic design is a bathtub in the ground. The bottom of the bathtub is formed by a huge sheet of plastic. In an expensive landfill, you have two sheets of plastic separated by about two feet of sand and gravel--thus creating one bathtub inside another bathtub. Therefore, a doublelined ash monofill is a landfill (which is really just a polite word for a dump) in the form of a bathtub created by two plastic liners, containing incinerator ash and nothing else.

The theory behind the monofill is that ash contains only small amounts of aggressive organic chemicals that might eat a hole in the plastic liner, so the plastic liner will remain intact and protect us against the lead and cadmium and other toxic metals contained in the ash. (See RHWN #92.) As always, the key question is: what is the duration of the hazard and what is the duration of the protection provided by the plastic liner? (The "cap" or umbrella covering a landfill will also be made of the same plastic, so a landfill is really a "baggie" in the ground, containing toxins. What is the lifetime of this baggie? How long will it protect us?)

What is the duration and nature of the hazard from metals in incinerator ash? As we saw earlier (in RHWN #92) incinerator ash is rich in toxic metals. For example, it typically contains anywhere from 3000 parts per million (ppm) to 30,000 ppm of lead. U.S. Environmental Protection Agency Region (Boston), and the Harvard University School of Public Health have recommended a cleanup action level of 1000 ppm for lead in soil--in other words, they recommended that remedial action, as would be needed at a Superfund site, should be undertaken wherever lead in soils exceeds 1000 ppm.[1] In recommending the 1000 ppm action level, EPA and Harvard wrote, "While we believe a greater margin of safety would be achieved with an action level of 500 ppm, we think it necessary to set priorities for remedial activity." (What they meant was that there are so many places in urban America where there is 500 ppm lead in soil that EPA would be overwhelmed with work if 500 ppm were set as the threshold for remedial action--so 1000 ppm is a more "realistic" cleanup action level even though it's not as safe as the nation's children really need it to be.)

Given that EPA Region I and the Harvard School of Public Health have recommended that Superfund-type cleanup be initiated whenever soils contain more than 1000 parts per million (ppm) of lead, we know immediately that every ash monofill will have to be cleaned up at some time in the future because all incinerator ash contains more than 1000 ppm lead. (Ash also contains dangerous amounts of other toxic metals-- cadmium, arsenic, chromium, and perhaps others, so lead is not the only reason why a cleanup might be needed.) Therefore, when we create ash monofills we know we are creating Superfund sites that our children will pay for--either in damage to their brains and nervous systems, or in enormous outlays of money--or both.

Because lead and cadmium and other metals never degrade into anything else, but remain toxic forever, the duration of the hazard is perpetual, everlasting, eternal. The danger will never go away.

The incineration industry, and its acolytes in government, argue that the plastic liners will protect us and our children forever. Unfortunately, this idea is based on a misunderstanding (or more likely an intentional misrepresentation) of what happens to plastics as they get older. Plastics are not inert; they do not stay the same as time passes. They change. They come apart spontaneously.

A recent book by Deborah Wallace, Ph.D., describes this process well. [2] The book is about the dangers of plastics in fires, but in telling the story of "Why today's fires are so dangerous," (the answer is because burning plastics give off toxic gases that kill people who breathe them), Dr. Wallace included a section on the makeup of plastics at the molecular level, which helps us understand why all plastics eventually fall apart.

The building blocks of plastics are found in natural gas, coal, and wood, but the major source is oil. Oil (like coal and natural gas) is a mixture of molecules of different sizes and structures. To separate out the different molecules, crude oil is distilled in an oil refinery. The oil is boiled and smaller, lighter molecules are separated from the larger, heavier molecules. The heavier molecules are then "cracked" to break up the large, heavy molecules into smaller, lighter molecules.

The result of this distillation and cracking is organic chemicals, which is the name for chemicals containing carbon and other elements (chiefly hydrogen, oxygen, and nitrogen). These organic chemicals form the building blocks of pesticides, glues, and plastics. Other chemicals (such as chlorine and lead) are added to give the raw materials new characteristics (strength, stiffness, color, and so forth).

After the building blocks are manufactured, they are turned into plastic resin by a process called polymerization. A polymer is a large, organic, chain-like molecule made of repeated units of smaller molecules. Polymerization usually requires heating the raw materials in the presence of helper chemicals called catalysts, until the building blocks form long chains. Even with the catalysts, a great deal of heat is used in the polymerization process. "Because of this heat, the long chains, even during manufacture, may decompose slightly and have defect points along them," Dr. Wallace explains. The defect points are in the chemical bonds, which absorb the energy used in the manufacturing process. The law of conservation of energy states that the amount of energy in a system after the reaction is the same as the amount of energy before the reaction. The large amounts of energy (heat) thus must go somewhere; they go into the bonds between the atoms of the plastic and are stored there. But nature does not favor this gain of energy--nature favors low energy chemical bonds, and high energy bonds tend to release their energy by breaking spontaneously. These are defect points. Although polymer scientists have striven to reduce the number of defect points, they have not been able to completely eliminate them from synthetic polymers.

Dr. Wallace continues, "The physical and chemical defects that are produced by ordinary processes in the manufacture and use of plastics demonstrate the fragile and unstable character of these long chains of molecules that are joined by high energy chemical bonds. When the resin is further processed to become the finished marketable product, additional defect points are created because the product is again heated and handled."

As time passes, plastics decompose--their molecules come apart spontaneously--beginning at the defect points. Polymer scientists refer to this decomposition as "aging." All plastics "age" and there is nothing that can be done about it. Within a few years (at most a few decades), all plastics degrade, come apart, and fail. They become brittle, lose their strength, crack, break into fragments. At that point, any protection the plastic may have afforded against the toxic dangers lurking in an ash monofill is gone. By that time, the people who created the ash monofill will have taken their profits and left town, but the deadly residues they leave behind--the ash--will remain to plague the community forever, poisoning the community's children with toxic lead and other metals.

The only affordable solution to this problem is a simple one: prevent the creation of incinerator ash.

--Peter Montague

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[1] P.L. Ciriello and T. Goldberg, "Lead-contaminated Soil Cleanup

Draft Report" which appears as Appendix E in: Agency for Toxic Substances and Disease Registry, THE NATURE AND EXTENT OF LEAD POISONING IN CHILDREN IN THE UNITED STATES: A REPORT TO CONGRESS (Atlanta, Ga: Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services [1600 Clifton Rd. -Mail Stop E-33, Atlanta, Ga 30333; phone (404) 639-0730], July, 1988). Free while supplies last."

[2] Deborah Wallace, IN THE MOUTH OF THE DRAGON (Garden City Park, NY: Avery Publishing Group [120 Old Broadway, Garden City Park, NY 11040; phone (516) 741-2155], 1990). $17.95.

Descriptor terms: epa; landfilling; plastic liners; harvard university school of public health; studies; remedial action; ash monofills; heavy metals; deborah wallace; polymerization; leaks;

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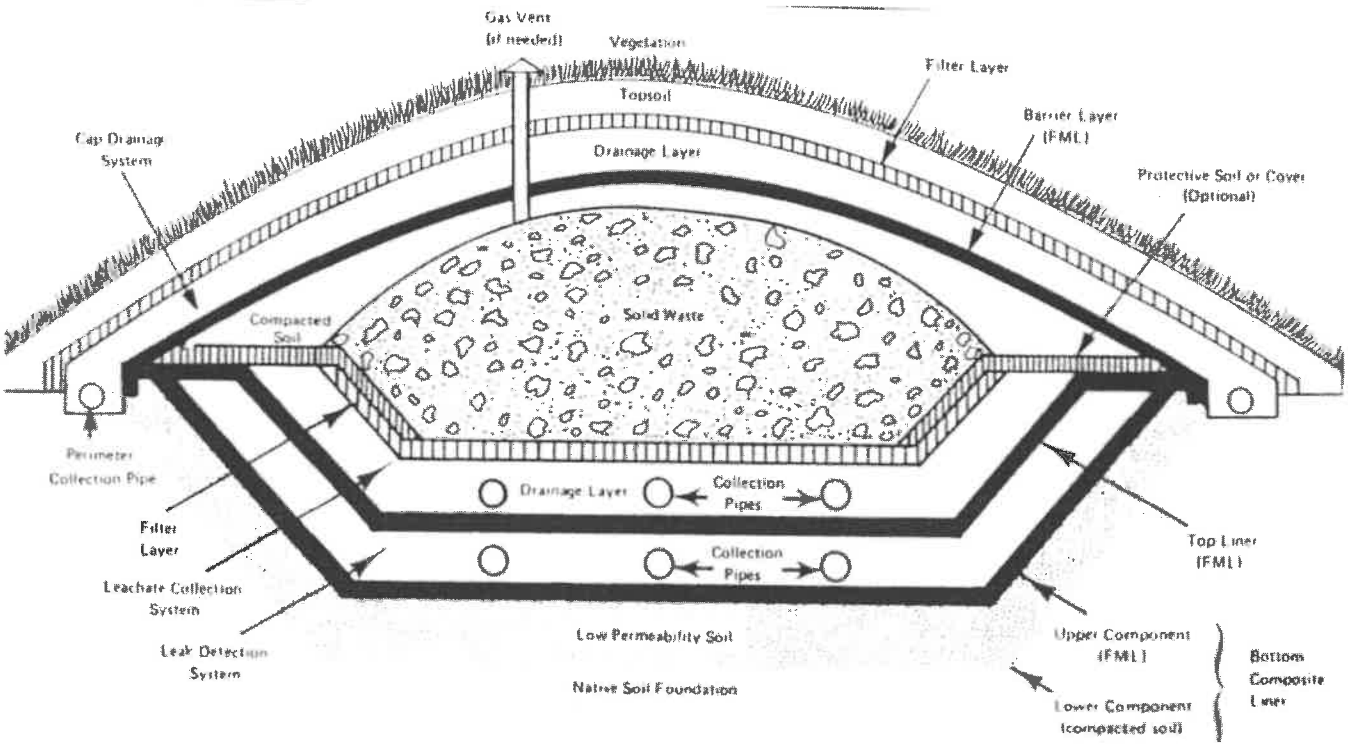
Rachel's Environment & Health News
#119 – Leachate Collection Systems: The Achilles' Heel Of Landfills
March 7, 1989



A landfill is a bathtub in the ground, and a bathtub can leak two ways: it can leak through a hole in the bottom (failure of its bottom liner), or it can fill up with fluid and spill over its sides. Either way, it's bad news. The basic problem is the fluid. If a landfill begins to fill up with fluid, the weight of the fluid puts pressure on the bottom of the landfill, increasing the likelihood of bottom liner failure, so any fluid inside a landfill is a potential source of trouble.

To prevent fluid from causing problems, every modern landfill has a system for draining liquids out of the landfill. This is called a leachate collection system. What is leachate? Think of a landfill as being like a drip coffee maker. The dry coffee is the garbage, the water you pour in the top is rainwater, and the dark, brewed coffee dripping out the bottom is leachate. You might want to drink coffee, but you definitely do not want to drink leachate: it has many toxic and dangerous characteristics. It is badly polluted with chemicals and with micro-organisms (bacteria and viruses) that would make you sick.

The picture below represents a closed landfill; the heavy dark line represents the plastic baggie (bottom liner and top cover) that is supposed to keep leachate from entering the environment. The round circles between the two bottom liners represent collection pipes which have many holes drilled along their length (making these pipes resemble a swiss cheese); they are supposed to collect any leachate that flows to the bottom of the landfill. In theory, these pipes carry off the leachate to a wastewater treatment plant, where the leachate is processed to remove the toxic chemicals. (At the wastewater treatment plant, some of the chemicals are released into the air, and the remaining ones are collected [they're now in a mud-like sludge] and they are sent to another landfill somewhere.)

One of the least-studied aspects of landfill design is how to make a leachate collection system that will work for many decades (much less many hundreds of years). The fact is, leachate collection systems can clog up in less than a decade and, when that happens, fluids begin to build up inside the landfill—a dangerous situation, as we have noted above.

Leachate collection systems fail in several known ways. First, they can clog up from silt or mud. Second, they can clog up because of the growth of microorganisms in the pipes. Third, they can clog because of a chemical reaction leading to the precipitation of minerals in the pipes; anyone who has boiled a pot of "hard" water and seen the whitish crusty residue in the bottom of the pot knows what "precipitated chemicals" look like. Fourth, the pipes themselves can be weakened by chemical attack (acids, solvents, oxidizing agents, or corrosion) and may then be crushed by the tons of garbage piled above them.

The book, AVOIDING FAILURE OF LEACHATE COLLECTION AND CAP DRAINAGE SYSTEMS, by Jeffrey Bass, discusses these four failure mechanisms. The first problem (silt) can sometimes be avoided, or at least reduced, by installing a "filter layer" above the leachate collection system. The filter layer may be made up of gravel or of a rug-like plastic material called "geotextile." Since the oldest leachate collection systems

Technical Factsheet on: POLYCHLORINATED BIPHENYLS (PCBs)

List of Contaminants

As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:
National Primary Drinking Water Regulations

Drinking Water Standards
MCLG: zero mg/L
MCL: 0.0005 mg/L
HAL(child): none

Health Effects Summary

Acute: EPA has found PCBs to potentially cause the following health effects from short-term exposures at levels above the MCL: acne-like eruptions and pigmentation of the skin; hearing and vision problems; spasms.

Chronic: PCBs have the potential to cause the following health effects from long-term exposure at levels above the MCL: effects similar to acute poisonings, irritation of nose, throat and gastrointestinal tracts; changes in liver function.

Cancer: There is some evidence that PCBs may have the potential to cause cancer from a lifetime exposure at levels above the MCL.

Usage Patterns

Production of PCBs has decreased drastically: from over 86 million lbs. in 1970 to 35 million lbs in 1977. EPA banned most uses of PCBs in 1979. In 1975 it was estimated that industries consumed PCBs as follows: Capacitors, 70%; Transformers, 30% PCBs were formerly used in the USA as hydraulic fluids, plasticizers, adhesives, fire retardants, way extenders, dedusting agents, pesticide extenders, inks, lubricants, cutting oils, in heat transfer systems, carbonless reproducing paper.

Release Patterns

Current evidence suggests that the major source of PCB release to the environment is an environmental cycling process of PCBs previously introduced into the environment; this cycling process involves volatilization from ground surfaces (water, soil) into the atmosphere with subsequent removal from the atmosphere via wet/dry deposition and then revolatilization. PCBs are also currently released to the environment from landfills containing PCB waste materials and products, incineration of municipal refuse and sewage sludge, and improper (or illegal) disposal of PCB materials, such as waste transformer fluid, to open areas.

From 1987 to 1993, according to EPA's Toxic Chemical Release Inventory, PCB releases to land and water totalled over 74,000 lbs., of which about 99 percent was to land. The bulk of these releases occurred in 1990 and were primarily from non-ferrous wire drawing and insulating industries. The largest releases (10% or more of the total) occurred in California.

Environmental Fate