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#217 - Plastics -- Part 2: Why Plastic Landfill Liners Always Fail
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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;