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Special report

A special report on waste Down in the dumps

Feb 26th 2009
From *The Economist* print edition

Managing waste properly is expensive, which is why rich countries mostly do it better than poor ones

THERE are really only three things you can do with waste: bury it, burn it or recycle it. All of them carry environmental and financial costs, and all require careful management. At first sight burying or burning the stuff seem the simplest options, but the potentially hazardous consequences require strict controls, as this section will show. Recycling, which is a highly complicated business, will be dealt with in a later section (see article).

The very idea that waste needs to be "managed" is relatively new. Throughout much of human history waste took care of itself, and in many parts of the world it still does. In poor agricultural societies there is not much of it to begin with. Broken tools and worn clothes are repaired, food scraps are fed to livestock and so on. In such places waste is seen as having an inherent value. The reason why plastic bags blow about by the roadsides in so many poor countries, says Philippe Chalmin of the Université Paris Dauphine, is not that the local people are litterbugs but that they are frugal enough not to need a waste-collection system of any sort. Plastic bags are among the few items they cannot recycle.

Waste first became a problem in cities, where it accumulated faster than it rotted away, creating an eyesore and a health hazard. In 1552 Shakespeare's father was fined a shilling for leaving excrement in the street instead of taking it to the designated spot at the edge of town. Benjamin Franklin helped to set up America's first street-cleaning service in Philadelphia in 1757. But even in cities most items that would now be considered rubbish were collected and put to use. Human and animal droppings were gathered up and spread on fields as fertiliser. Rags were used to make paper.



Anything that had no further use was, and still is, burned or buried. To begin with, dumps were simply places where waste was left to rot with little or no treatment. At best, a layer of dirt or debris was spread over the decaying rubbish to help control smells and vermin, a technique adopted by the inhabitants of Knossos in Crete in about 3000BC.

The amount of waste a community generates tends to grow with its economy (see chart 2). Thus America produces over 700kg of municipal waste per person each

year, compared with Nairobi's 220kg. The richer people get, the more paper, plastic and metals they chuck out, so the proportion of food waste goes down. Ash tends to disappear from household waste altogether as electricity and gas replace coal- and wood-fired boilers and stoves.

Buried, not gone

The increased volume of waste going to landfill causes several problems. The first one is to find enough space for it. Some countries have no trouble with that: America's existing landfills, for example, have 20 years' worth of capacity left, according to NSWMA, the industry group. The former Fresh Kills landfill in New York, at 12 square kilometres (five square miles), is the world's biggest man-

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America's Environmental Protection Agency publishes Lisa Jackson's statement at her confirmation hearing and a background on the Love Canal tragedy. The UNEP has information on marine litter. Google Books offers a preview of the book by Richard Porter. Greenpeace has an overview of incineration techniques. See also NSWMA.

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made structure, dwarfing Egypt's pyramids. But in densely populated countries such as Singapore, or in mountainous places such as Japan, finding an appropriate site can be hard.

Even where plenty of land is available, locals are often hostile to landfills because of the damage they can do to human health and to the environment. Densely packed organic matter produces methane as it rots, which can catch fire or cause explosions. That is also bad for the atmosphere, because methane is a greenhouse gas 21 times more potent than carbon dioxide. The process of decay produces ammonia too, which in sufficient concentrations can poison fish and amphibians and render water undrinkable.

The changing composition of waste going to landfill also gives rise to other forms of pollution. The bacteria that break down rotting waste produce acids. In the past the high proportion of ash in household rubbish would have helped to neutralise them, but now they can be concentrated enough to dissolve poisonous heavy metals such as lead and cadmium. Water leaching through the landfill can carry such toxins into the groundwater or nearby bodies of water, and from there into drinking water and the food chain.

Western household waste is full of dangerous chemicals. There are paints and batteries containing lead; thermometers and lightbulbs containing mercury; electronic goods full of hazardous substances; pesticides from the garden; solvents for cleaning; and used motor oil from the garage, to name a few of the most common. In theory, none of these items should go into ordinary landfills. In practice, many do.

Industrial waste, medical waste and mining waste often contain toxic substances in even greater quantities and concentrations. Cyclus estimates that the world's biggest economies produce perhaps 150m tonnes of hazardous waste a year between them, but information is alarmingly thin on the ground. Heavy metals and acids often commingle in mining waste, much as they do in ordinary landfills, and can leach into the soil and water. At the most polluted sites even the dust blown from tailings can be dangerous.

Yet the main alternative, burning waste, can be just as bad, both for people and for the planet. Smoke from incineration may carry many of the same toxic substances up the chimney and into the atmosphere. Nitrogen and sulphur in the smoke contribute to acid rain, and soot particles cause respiratory problems. In addition, burning organic waste produces chemicals called dioxins and furans, suspected carcinogens which damage the nervous and immune systems, among other ill effects, and are harmful even in minuscule quantities. After burning there is still the ash to be disposed of, usually in a landfill, again with potentially baleful consequences.

In the 1960s and 1970s a series of grisly accidents with toxic waste prompted governments in rich countries to regulate its disposal more stringently. In Japan, for example, the discharge of mercury-laden chemicals into Minamata Bay killed at least 1,000 people and made another 10,000 ill. In America a neighbourhood in Niagara Falls called Love Canal turned out to have been built on top of clay pits containing hazardous waste from a chemical factory. Following a huge rise in birth defects and miscarriages the government moved over 800 families to new homes.

Most Western governments have since imposed rules to minimise pollution from landfills and incinerators and to prevent leaks of toxic waste. Firms generally need a licence to use, transport or dispose of the most dangerous substances, which are kept track of and often have to be treated before incineration or landfilling. These rules tend to be strictly enforced. Last month, for example, firms and municipalities that had dumped hazardous waste in a landfill in New Jersey, causing local groundwater to be contaminated, agreed to a legal settlement of almost \$100m to cover past and future clean-up costs.

Modern landfills are forced to take elaborate precautions (see [article](#) for an example from a British town called Pitsea). At a recent hearing about the

**AND
 DEMAND**

proposed expansion of a landfill on the coast of California, one questioner disputed a bureaucrat's claim that global warming would not cause sea levels to rise fast enough to affect the site. Another wondered whether the landfill was as earthquake-proof as its owners claimed. A third queried the location of the wells used to test for groundwater contamination. Several worried that the five-yearly reviews of all these precautions would not be tough enough. The application was eventually approved—but a decade had passed since it was first lodged.



Eyevine In his book "The Economics of Waste", Richard Porter, an academic, examined the costs and benefits of the American government's decision to tighten controls on leachate from landfills in 1991, using data supplied by the Environmental Protection Agency (EPA). The EPA said its new rules would save 2.4 people from cancer over 300 years, at a cost, Mr Porter calculated, of \$3.5 billion each. If the agency's standard discount rate is applied, the cost rises to \$32 billion for each life saved. True, leachate can lead to many lesser health problems and environmental effects that the EPA did not assess. But the sums give a sense of how stringent landfill regulation in rich countries has become.

The same is true of the rules for incinerators. Indeed, their advocates now prefer to call them waste-to-energy or energy-from-waste plants, which sounds more positive. One of the world's biggest such plants, in Fairfax County, Virginia, takes in about 1m tonnes of municipal waste a year, slightly more than the Pitsea landfill. Two sinister-looking six-taloned mechanical claws

Hulking hazards

worthy of a Bond film grasp rubbish five tonnes at a time and drop it onto a conveyor. The moving metal grates carry the waste slowly through a furnace at ever-increasing temperatures to ensure a thorough burn. The plant generates up to 80MW, enough to power 75,000 homes.

In the control room technicians pore over second-by-second readings of the levels of different pollutants in the exhaust. To eliminate dioxins, regulations require that the waste reach a temperature of at least 1,800°F. In the smokestack, different filters remove oxides of sulphur and nitrogen, acidic gases, heavy metals and soot. All the water used goes through its own treatment plant. The ash is moved straight to an adjacent landfill, where it takes up only a tenth of the volume of the original waste.

Burnt offerings

The EPA has calculated that such controls have reduced emissions of dioxins and furans from America's incinerators from 8,900 grams a year to 80. By contrast, burning of household and garden waste in barrels and bonfires produces 500 grams a year. Germany's environment ministry reckons that incinerators have actually helped to improve air quality by reducing the need for dirtier coal-fired power plants. Yet local authorities in many countries remain hostile to new incinerators. No new ones have been built in America, for example, since 1995.

It would be reckless to claim that stricter controls have solved all the West's waste problems. Much still remains to be cleared up from the time before the new rules were adopted. And no regulations are foolproof. Environmental groups such as Greenpeace argue that landfill gas systems capture a lower proportion of methane emissions than waste firms claim, and that the liners that keep leachate in landfills are bound to spring leaks sooner or later. The regulators who say that burning rubbish is now safe were making the same claim when incinerators were still spewing out dioxins. And anything that is burned rather than recycled represents an energy loss, since more power will be needed to produce replacement materials from scratch.

On the whole, however, landfills and incinerators seem to attract a disproportionate amount of scrutiny and regulation—especially given that some equally dangerous facilities are barely monitored at all. A worrying loophole in America's rules was revealed in December of last year when a collapsed dyke sent a billion gallons of toxic sludge pouring into 300 acres of rural Tennessee. The sludge, a mixture of water and ash from a coal-fired power plant, contained significant amounts of poisonous heavy metals. Officials say the local drinking water is still safe, although the spill has killed fish in nearby rivers. The utility concerned, the Tennessee Valley Authority, says it is spending \$1m a day on the clean-up.

That coal-ash pond in Tennessee is just one of about 1,300 similar repositories across America. The EPA believes that lax disposal of coal ash has led to the contamination of groundwater in 24 states. But under pressure from utilities it had previously dropped plans to classify coal ash as hazardous waste. Last month Lisa Jackson, the agency's new boss, promised in her confirmation hearing to return to the subject.

In poor countries waste is still much less strictly regulated, and the few rules are seldom enforced. In Madagascar, for example, only 6% of the rubbish is collected at all. Other countries manage to gather their waste, but do not supervise its disposal. The biggest landfill in Mumbai, India, called Deonar dumping ground, is just that. Opened in 1927, it occupies the same area as Pitsea but takes in almost twice as much waste a year. Goats and buffaloes graze amid the reeking mounds, and thousands of scavengers comb the site, looking for items of value. When trucks arrive to dump their loads, these "rag-pickers" surge forward to get first choice of the refuse. The ensuing mêlées often lead to injuries, says Prakash Tawase, Deonar's manager.

Hold your nose

Mr Tawase has no budget for fencing or crowd control, let alone modern environmental safeguards. No attempt is made to control leachate, which swills out into the surrounding creeks and marshes and on into the Arabian Sea. He does not know how dangerous it is, because the water is not tested. Nor is there any system to collect landfill gas. So during the dry season several fires break out every day and smoulder away, releasing plumes of acrid smoke. Mr Tawase's staff try to fight these with a water truck and hoses.



Greenpeace

Local residents complain that the dump gives off horrible smells and that the smoke from the fires causes asthma and other respiratory ailments. They regularly lodge complaints and march in protest to the city council's offices. Last year some went on hunger strike. Local officials freely admit that the dump is a source of serious pollution.

Deonar is by no means unusual. Most of the developing world's waste, says Luis Diaz, of CalRecovery, a waste

Not as clean as it looks

consultancy, is put into open dumps with no controls on leachate or landfill gas. Open burning of waste, another common disposal method, releases lots of dioxins, just as it did in incinerators in the rich world before the rules were tightened.

In 2007 the Blacksmith Institute, an American NGO, listed Dandora in Kenya, the site of Nairobi's main dump, among the world's 30 most polluted spots. Other places on the institute's list included La Oroya, Peru, where poorly managed effluent from 80 years of mining and smelting has left local children with three times more lead in their blood than the World Health Organisation's recommended maximum; and Dzerzhinsk, Russia, where 300,000 tonnes of chemical waste were disposed of haphazardly, mostly in Soviet times. Life expectancy in the city is 42 years for men and 47 for women.

Another big worry is the export of hazardous waste from rich countries, where it would be expensive to get rid of, to poor ones, where it can be dumped cheaply. In principle, under a treaty called the Basel Convention, this is illegal unless the receiving government has given explicit prior consent. But exporters sometimes succeed in passing off waste chemicals as useful ones, or clapped-out computers as donations for the poor. If ill-paid customs officials spot the deception, they can often be bribed to turn a blind eye.

The United Nations estimates that the world discards up to 50m tonnes of electronic goods, or e-waste, every year. Official recycling efforts in rich countries capture just a small fraction of this, according to Greenpeace. Most ends up in poor countries where scavengers break apart old mobile phones, computers and televisions to extract valuable metals for recycling, releasing various harmful substances in the process. In an area in Ghana where e-waste is stripped, Greenpeace recently found high levels of lead, dioxins and phthalates, which can damage the liver and testes. Similar degrees of contamination have been found at e-waste dumps in India and China.

Many poor countries have built thriving, officially sanctioned industries to recycle waste that would be considered hazardous in the rich world. Almost all the world's big ships, for example, are dismantled and recycled in India, Bangladesh and Pakistan. Shipbreaking provides jobs for tens of thousands of people, as well as cheap raw materials for industry. But slicing up huge oil tankers or freighters on beaches releases oil, heavy metals, dioxins, asbestos and other toxic chemicals into the sea.

Last voyage

The sea is the ultimate receptacle for much of the world's waste. Rubbish is dumped into it by ships, or thrown or blown into it from coastal settlements, or washed into it through rivers, drains and sewage pipes. According to the United Nations Environment Programme (UNEP), perhaps 6.4m tonnes of waste finds its way into the sea each year. The Pacific "gyre" is the worst-affected area, but the problem is universal. Research suggests that every square kilometre of the ocean has an average of 13,000 pieces of plastic floating in it. And according to other studies, the floating portion makes up just 15% of "marine litter"; another 15% washes up on the shore and 70% ends up on the sea bed.

The plastic waste, in particular, does great harm to marine life. Birds, fish and other animals often die after becoming entangled in it or mistakenly eating it. It can smother reed beds, reefs and other important ecosystems. It can absorb toxins, making it more dangerous still to ingest. Even tiny barnacles take in microscopic fragments of the stuff, which then move up the food chain, with unknown consequences. The damage is not just to the environment but to fisheries and tourism too. Yet the world's governments have made little effort to regulate marine waste at all.

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