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Managing our waste

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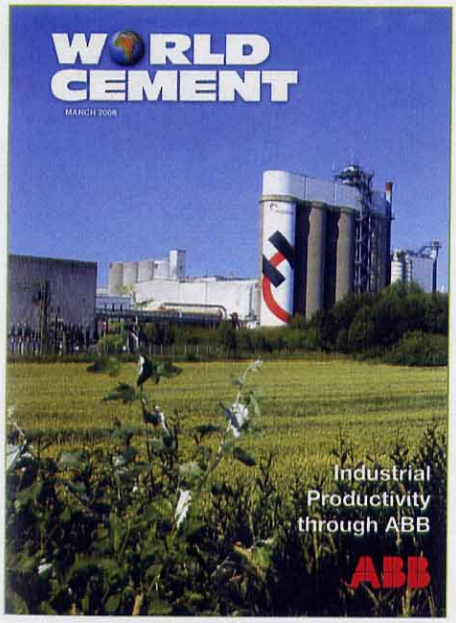
This month's front cover...



In this issue, ABB looks at the question of whether advanced process control technologies are helping to cope with the challenges that face cement producers, such as the rising usage of alternative fuels, the reduction of energy consumption, and the minimisation of process disruptions. ABB reports on one such system that does deliver solutions to these problems: ABB's Expert Optimizer (see article, p. 45). Energy Optimizer (formerly LINKman) has a long and successful history in the cement industry, providing advanced process control techniques, such as fuzzy logic and model predictive control, in a user-friendly, graphical environment. This success is linked to ABB's approach, which combines the best mathematical tools with extensive industry knowledge to improve productivity.

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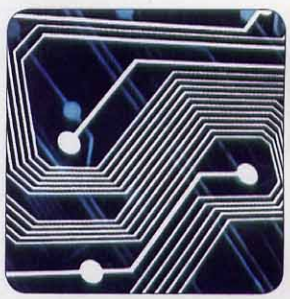

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Introduction

The consumer habits of modern lifestyles are causing a huge, worldwide waste problem. Municipal solid waste (MSW) management systems are now shifting from landfill-based to resource recovery-based solutions following the setting of national and international targets to divert waste from landfill and to increase recycling and recovery rates. This article looks briefly into the resource recovery-based solutions as opposed to the conventional solid waste management system, which is predominantly landfill-based.

MSW management practices

Several MSW management practices, such as source reduction, recycling and composting, prevent material from reaching or diverting materials from the waste stream. Other practices address those materials that require disposal in landfills. Combustion is another MSW practice that has helped reduce the amount of landfill space required. Combustion facilities burn MSW at a high temperature, reducing waste volume and generating electricity.

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Dr Faisal Ibney Hai, JSPS Postdoctoral Fellow, Environmental Science Center, University of Tokyo, summarises municipal solid waste management systems.

Table 1. Potential WTE technologies and their present state of development		
Technology	**Description**	**Implementation**
Thermal technologies	**Involves high temperature processing of waste feed stock**	
Incineration	Involves the combustion of waste at high temperature and simultaneous energy recovery. Different types, namely mass-burn, modular and fluidised bed incinerators, require different extents of waste preprocessing.	Predominantly mass-burn systems are used. The use of the other types for small to medium scale plants is increasing.
Pyrolysis	Under high temperature and pressure and oxygen limited conditions, waste is converted into solid ('char'), liquid, and gas ('syngas') products, each of which has potential as a fuel.	May be more energy efficient than incineration; however, the cost impedes widespread application at present.
Gasification	Under high temperature and pressure and oxygen limited conditions, waste is converted directly to a synthetic gas ('syngas'), composed of carbon monoxide and hydrogen, which can be used as fuel.	May be more energy efficient than incineration; however, the cost impedes widespread application at present.
Plasma arc waste disposal	Uses high temperature created by an electrical arc to break down waste primarily into elemental gas and slag.	High electricity consumption restricts its use to small scale industrial waste treatment.
Non-thermal technologies	**Involves lower temperature than the thermal technologies**	
Landfill gas (LFG) collection	Modern landfills have facilities to collect the biogas (typically, 54% methane + 46% carbon dioxide; potential greenhouse gases) produced by anaerobic digestion of the organic waste. LFG can be used to produce electricity.	Capital investment and the complexity of gas processing equipment may limit this technique to the larger sites.
Anaerobic digestion	Involves the breakdown of organic materials in the absence of oxygen by bacteria and the collection of the methane or biogas thereby released.	Has been extensively used for sewage treatment; commercial systems for solid waste have only been developed to a limited extent.
Refuse derived fuel (RDF)	RDF is a fuel made from MSW that has been mechanically processed (separation, size reduction, palletising) to produce a storable, transportable and homogenous fuel for combustion.	Complexity of the process and unit cost has restricted its use to primarily European countries with limited success.

Problems with landfills

When MSW in landfill sites is acted on by rainwater, the organic and inorganic constituents are dissolved, and a highly toxic leachate results. This is normally high in heavy metals, ammonia, toxic organic compounds and pathogens, and, if it escapes into the groundwater, it causes serious contamination. Meanwhile, at the top of the landfill, gas is produced by the fermentation of organic material. Approximately equal quantities of the greenhouse gases CO_2 and methane (CH_4) are released. To do away with these problems, modern landfill sites are situated where clay deposits and other land features act as natural buffers between the landfills and the surrounding environment. Also, the bottom and sides of modern landfills are lined with layers of clay or plastic to keep the leachate from escaping into the soil. A network of drains collects the leachate and pumps it to the surface where it can be treated. Landfills can collect the methane gas, treat it, and then sell it as a commercial fuel, or they can burn it to generate steam and electricity.

However, in addition to leachate and biogas problems, landfill sites are unpopular with local residents: traffic, smell, noise, vermin, seagulls and blown litter can all spoil the neighbourhood and lower property prices. But that is not the end of the problem. Medical research has linked proximity to landfill sites to lung, throat, and prostate cancers, asthma, kidney damage, and to an increased risk of birth defects including cleft palate, low birth weight, and premature birth. Obtaining permits to build new landfills has become increasingly difficult because of public opposition: people do not want landfills built in their backyards.

Waste-to-energy technologies

The benefits of energy recovery from MSW are multifaceted: not only the energy benefit itself, but also the mainly positive environmental implications, such as conservation of fossil fuel and reduction of waste volume to be landfilled. Table 1 summarises the potential waste-to-energy (WTE) technologies. With modern combustion and pollution control technologies, WTE plants can retrieve significant amounts of energy from waste while minimising undesirable emissions. WTE plants seem especially suited to areas with high population densities, shallow water tables, and relatively scarce and expensive land. And while one may wonder whether WTE programmes hamper recycling programmes, they can actually complement each other. That is because it makes good sense to recycle some materials (e.g, metals), and better sense to burn others (e.g., difficult-to-recycle plastics). Both recycling and WTE can be used as alternatives to landfilling.

Conclusion

Source-separation of waste, and recovery of energy from combustible MSW, is a potential way to reduce the amount of waste going to landfill and also the consumption of fossil fuel. Improperly maintained landfill sites (e.g. open dumping) are a serious threat to the local community. However, such a threat can be efficiently reduced by using sanitary landfill design. Also, the biogas produced from the digestion of waste within the sanitary landfill can be used as fuel. Having said that, it is always difficult to acquire land for landfill sites (even if it is a sanitary one) because of the NIMBY (not in my back yard) syndrome. Cost of transportation of waste to the landfill site, which is usually located far from the city centre is also an issue. It does make sense to use MSW as fuel, although the cost-efficiency of the process is site-specific.