Burning garbage for power generation: Playing with a deadly hazard

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Worldwide the opposition to garbage incineration is mounting everyday and installation of new garbage incineration plants have already come to a halt and is not heard any more. Incineration as a technology is dead and is no more considered an acceptable solution. It has suffered the same fate as the nuclear power plants for the catastrophic threats inherent in both of these technologies.

PHOTO: SYED ZAKIR HOSSAIN

Unacceptable landfill, but incineration is no alternative either.

RECENTLY, the national newspapers reported on a proposal where some 30 MW (megawatt) power will be produced daily by burning municipal garbage. Only an incinerator will be imported and installed at a suitable site, where daily garbage collected by the Dhaka City Corporation can be trucked and fed into the burner. The heat produced through burning of garbage will be utilised for generating electricity. The 30 MW electricity thus generated will be supplied to the national grid.

Given the massive shortage of power in the country disrupting our life and industrial development, the proposition is apparently very attractive. But it is, in effect, comparable to alluring a monkey to take a short walk for getting a banana, eventually only to trap it to death. For decision-makers not equipped with the essential information to enable them to make an informed decision, burning municipal solid waste has already been proven in the western world as similar to a child playing with fire. Because of the severe threat to health and environment posed by toxic byproducts of incineration, it is actually much more hazardous and deadlier than playing with fire.

Dhaka city now produces 4,000 tons of garbage daily. Historically, since introduction of conservancy services, the City has been dumping its garbage as land filling at low-lying sites at outer boundaries or away from habitats. But such sites are fast vanishing in the city due to rapid urban sprawl. It was during the reign of a khaki top brass at the helm of the City that the dumpsites were first brought right next to our homes and in the middle of residential areas. The General had ordered the filling of low lying natural drainage channels and lakes in Banani with garbage. We were made to endure the nauseating smell for quite a long period. With the low-lying open spaces away from habitats becoming rare, the search for alternative sites became obvious. This has been a process through which all large cities around the world have gone through at different times.

In the process of searching for a solution, some frontrunners made costly mistakes jeopardising lives and environment and squandering public money. Only a few lucky and pragmatic ones, mostly because they were behind others though, have learnt from the mistakes of the ones ahead of them. The most unfortunate are those cities that did not investigate their options enough and opted to burn their fingers, accepting alluring offers from smart salesmen touting incineration as a solution. Can we afford to be one of these unwary and unfortunate cities? I am sure, we cannot. (International Air Quality Advisory Board -- A Policy Statement on the Incineration of Municipal Waste -- Windsor, Ontario, Canada -- http://-ww-w.ijc.org/boards/iaqab/incin.html)

Garbage disposal: Search for safe option

The indispensable search for safe option for garbage disposal has made the developed countries to explore alternatives including designing and constructing of sanitary landfills with an impermeable bottom layer and piping for collecting leachate and gas produced from decomposing garbage. The collected gas can be utilised as energy and the toxic leachate is treated and disposed safely. These modern landfills thus reduce to a great extent the chances of contaminating the environment or the groundwater. Remediation of such landfill sites after shut down is much easier for future reuse of the land. Because of these, even throughout the developed world, landfilling still remains a major option for municipal solid waste (MSW) disposal. In USA, 80 per cent of the municipal solid waste, i.e. 160 million ton each year is still buried in 5,500 operating landfills. However, the task of successfully designing, constructing and monitoring, during the working life and post shutdown, of such landfills can also be very challenging indeed. Failures are not totally unlikely and so incineration, in-vessel composting and zero waste (waste minimisation through awareness and other means) campaigns emerged as alternatives and/or complementary measures.

In in-vessel composting of municipal wastes -- particularly kitchen and garden waste it is composted in sealed vessels to produce a commercially profitable product, which is sold as a soil conditioner or 'fertiliser'. In-vessel composting, as a technology, is continuously improving and gaining acceptance. Although waste minimization through awareness is a slow process requiring a paradigm change in people's habit, still 'zero waste' waste minimization campaigns are fast becoming popular and successful in developed countries through increased recycling, waste avoidance and increased community awareness. These have resulted in diverting millions of tons of garbage from landfills and thus extending their operative life and capacity of existing landfills. Against this, within a short time from its inception, incineration has already been discarded as it proved to be a nasty and hazardous technology. Let's have a close look why:

With the discovery of ground and surface water contamination at various sites including the Love Canal, Niagara Falls, NY, both landfill leachate and dumping of industrial effluents became suspects. With the rise of community outcries, the focus was on the hazards of landfills and the opposition to new landfills grew. Some government agencies and businesses started touting garbage incineration as the solution. The arguments put forward were simple -- landfills contaminate groundwater and burning of garbage in incinerators results in a 75 per cent reduction by weight thus reducing much the need for new landfills. Most western countries and land-scarce Japan embarked upon installing incinerators in large numbers. Giant companies like Mitsubishi, NKK< Wheelabrator, Kvaemer and ABB started churning out massive incineration plants knowing little that they are sowing for hazards to public health and environment that will be reaped later on.

Hazards of incineration

About 25 per cent by weight of the garbage burnt in an incinerator remains as left over ash. Besides this, during incineration, numerous highly toxic substances are continuously released in the environment as smoke and particulates, which then disperse with airflow and settle over a very wide area. Some of these byproducts like dioxins, heavy metals and some other products of combustion (and incomplete combustion) are toxic carcinogens (cancer causing) or mutagens (substances that cause genetic mutation). Most of these are very persistent (not biodegradable and remain in the environment for a very long period). These are also cumulative (i.e. their concentration becomes higher with time) thus increasing the level of toxicity in the environment. To appreciate the serious consequences for the health of a community resulting from the release of unknown quantities of these known toxins in the environment, let us examine one of these groups of toxins -- dioxin.

Dioxin is the name generally given to a group of super-toxic-chemicals, which are generally the by-products of various chlorine-based industrial processes (including herbicide/pesticide, paper, plastic manufacturing) and waste incineration. The toxicity of dioxins is second only to radioactive (nuclear) wastes. There are over hundred different chemicals in this group and many of these are byproducts of the municipal solid waste incineration process. One particular type, TCDD (tetra-chloro-dibenzo-dioxin) is so toxic that the toxicity of other such chemicals is measured in relation to it. The US Environment Protection Agency (US EPA) and a number of other environmental regulatory bodies consider TCDD to be perhaps the most hazardous synthetic chemical carcinogen (cancer causing) ever identified. Sponsored by the US EPA and the Chlorine Institute (an industry group), toxicologists and biochemists convened in 1999 to consider the "biological basis for risk assessment of dioxins and related compounds." Studies undertaken showed that "dioxin's effects are exerted through the genetic system..." The US EPA acknowledged that the "hazards of dioxin go far beyond the risk of cancer. The expected non-cancer effects include:

-Disruption of endocrine hormone system, especially those related to sexual development;

-Disruption of critical stages of embryonic development, for example of the nervous system;

-Damage to the developing immune system.

"These are all interg-enerational defects; they are imprinted for life on the developing foetus by the effects of dioxin on the mother and sometimes father." It should not be assumed, therefore, that damage is not occurring because the effects of these toxins are not visible immediately. Bizarre health effects noted at all locations exposed to dioxin have included birth defects, autism, liver disease, endometriosis, reduced immunity, chronic fatigue syndrome, and various nerve and blood disorders. (For more information, http://www.cqs.com/edioxin.htm).

Therefore, the technology of incineration has proved to be an unacceptable 'solution' to the continuing municipal waste crises everywhere. It is a nasty technology that does not meet the safety standards of environmental and health protection, two major responsibilities of governments everywhere. To ignore the outcome of decades of experience, from all over the developed world, of using this apparently 'convenient' but actually hazardous 'solution' will definitely be proved in course of time as an inexcusably bad judgment on the part of our decision-makers. But the damage to the present and future generations will already be done. Even if it is abandoned later on, for some of the victims it will be very painful and irreversible. How do you compensate a mother who gives birth to an abnormal or deformed baby, how do you compensate for the deadly imprint of genetic mutation some families will carry for generations and how do you compensate a family which has lost its dear one to cancer caused from a blunderous decision by someone else? And how do you compensate us all after polluting the air we breathe, water we drink, the fish in our water and the cattle that graze on our greens?

A discarded technology

Worldwide the opposition to garbage incineration is mounting everyday and installation of new garbage incineration plants have already come to a halt and is not heard any more. Incineration as a technology is dead and is no more considered an acceptable solution. It has suffered the same fate as the nuclear power plants for the catastrophic threats inherent in both of these technologies.

Several years back, environmental activists and community members in New Zealand successfully opposed the efforts by an American company to install an incineration plant near Auckland. In America, dozens of brand new incineration plants could not be commissioned due to regulatory restrictions or community opposition. The European Union has already come up with standards practically banning garbage incineration. Even in newly industrialized and developing countries, where western multinationals were initially able to export some incineration plants, a movement opposing the already installed or new incinerator proposals are gaining momentum fast. "We will no longer be the cesspit for the industrialised world", declared the delegates at the Waste Not Asia (an alliance of 12 Asia-Pacific nations for promotion of 'cleaner production' and 'zero waste' technology) in its July 2000 convention in Bangkok. "Incineration is a toxic technology being dumped on us by some of the most polluted nations in the world," said Tara Buakamsri of Greenpeace South East Asia and one of the delegates. "Japan and Europe have poisoned their own people with incinerators and now they want to sell their burners in the rest of Asia."

Waste Not Asia alliance members have committed themselves to a zero waste society, in which discarded materials are composted, recycled and/or reused rather than being incinerated or landfilled. The alliance singled out incineration as a particularly dangerous technology. Australia is supplying incinerators in different countries (India) but it is recycling its waste for quite some time. Seventy-five per cent of the total required quantity of paper is from recycling the garbage and remaining 25 per cent is imported from Indonesia keeping Australian forests intact. The Environment Protection Agency of Australia is very particular to keep their cities clean and pollution free. For construction of any built-up area, prior approval of the EPA is essential. Cutting and felling a tree even on a private land needs prior permission of the City Council. One will be surprised to notice not only the coastal areas under cover of thick shade of forest but even the bush-lands (a small piece of urban forest) inside the cities separating one suburb to another. (For more information; http://www.bcc.q1d.gov.au or www.visy.com.au)

Incinerators have been identified throughout the industrialised world as a source of dioxins, considered the most potent toxic chemical known to human. Can the message be more clear? Can we afford to ignore it, burn our fingers and then learn what we ought to learn from it?

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Earthquake: Prediction and measures

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FACE of the earth is changing through geological processes, sea floor spreading and plate tectonics. Earthquake is the outcome of such geological processes. Study of world wide frequency suggests that the more severe an earthquake, the less it occurs. A catastrophic earthquake with a magnitude more than 8.0 on Richter scale usually occurs once in every 5-10 years; disastrous on local scale with magnitude 6.2-6.9 about 100 or more in a year, and moderate (magnitude 4.3-4.8) more or less 5000 per year. Earthquake with magnitude less than 3.4 recorded only by seismograph, the annual number of such tremor is about 800,000.

So far at least 12 large-to-great earthquakes occurred in and around Bangladesh. In this context the people, government policy-makers as well as professional community viz. engineers, architects, seismic geologists, planners etc may consider recurrence interval for hazard avoidance through structural design and by proper land-use.

The Calcutta Earthquake of October 1, 1737 recorded a death toll of 300,000. This is the third most disastrous quake in this region which occurred during the last 800 years in terms of loss of life (the highest deaths estimated 820,000 in 1556 at Shen-shu, China and the next 700,000 in 1976 at T'ang-shan, China).

The Assam Earthquake of June 12,1897 is one of the 10-graetest quakes occurred with a magnitude of 8.7 on the Richter scale and an intensity of VII on the Modified Mercalli Scale that caused a damage to the tune of US $25 million. The Bihar-Nepal Earthquake of January 15, 1934 recorded magnitude 8.1 and an Intensity X with a damage to the tune of US $ 25 million and estimated death toll of about 10,000.

The Chittagong Earthquake of April 2, 1762 recorded an Intensity of VIII on the Modified Mercalli Scale and a damage of US $5m. The Bengal Earthquake, Manikganj of July 14, 1885 recorded a considerable damage. The Srimangal Earthquake of July 8,1918 occurred with magnitude 7.6 and recorded damage of more than US $1.0m.

Realising the earthquake hazards and its impact on national economy, Geological Survey of Bangladesh (GSB) took initiative in 1988 for a geological investigation on earthquakes and the potential hazards of their recurrence. In April 1989 Dr Darell G Herd of US Geological Survey along with representatives of GSB carried out a geological investigation to determine the tectonic origin of the Assam Earthquake of June 12, 1897 on the Dauki fault. A project titled "Detailed geological mapping for coal and other mineral exploration and Neotectonic study related to natural hazards" was initiated also for identification of major geological features for Earthquake Hazard Reduction Programme. Provision to install micro-seismic equipment was kept to collect seismic data of even smaller than magnitude 3.4 for neotectonic study.

A network of modern, wide frequency ,digital seismographic stations at Sylhet, Cox's Bazar (alternately Chittagong), Mongla (alternately Khulna) and Rangpur would provide an accurate location (within several kilometers) for most earthquake events including even of smaller magnitude of 2 to 3 for preparation of micro-seismic map of Bangladesh.

During the 1897 quake, an area of more than 300,000 square km covering Bangladesh, India, Bhutan and western Mynmar was severely shaken. The fault origin of the 1897 Assam Earthquake may have originated on the Dauki fault running east-west along India (Assam)-Bangladesh (greater Mymensingh and Sylhet) border. Several other potential areas of geological features and elements are Dhaka-Srimangal lineament, the Tista lineament, the Atrai lineament, the Brahmaputra-Jamuna lineament, the Bogra fault(?), the Mymensingh lineament , the Tangail scarp, the Chittagong fault identified from interpretation of satellite imagery by GSB. Neotectonic study on such potential areas may be carried out to collect data on paleoseismology for Earthquake Risk Assessment Map by identifying active faults, fault scarps by detailed trench investigations, searching river banks, stream channels, irrigation ditches and excavations in flood plain materials for geological evidence of multiple liquefaction events and sand blows.

With such realisation on one hand and observation of the rapid growth of high-rise building and population, industrial establishments and commercial activities on the other, in the capital city Dhaka and the port city Chittagong, a report entitled, "Natural Hazards in Bangladesh: Earthquakes" was prepared following the Chittagong earthquake of November 21, 1997 for awareness of the policymakers as well as the professional community. Considering the nature and extent of the earthquakes' threat or their recurrence, a strict compliance of the existing Building Code (which is not in force in Bangladesh) was suggested to build suitable engineered structures to minimise hazards.

The Chittagong Earthquake of July 27, 2003 occurred with a magnitude of 5.6 on Richter scale. From press repots, we observed that a crack was developed in Borkal area that called for detailed geological study, the nature and extent, slip rate and identification of earthquake features like sand boils, liquefaction, landslides etc. The 10-km crack is the rupture length of the fault segment produced by the Borkal Earthquake. This is a closely mimicked surface feature of the 1983 Borah Peak, Idaho, Earthquake (OJT 1989 under the supervision of Anthony J. Crone, USGS, Denver). Tremors in Chittagong and a small-scale tsunami (a long ocean wave produced by movement of sea floor following an earthquake) in Andaman sea on August 11, 2003 reveal the evidences of sea floor spreading and plate tectonic activated in the region.

Frequency, the nature and extent of the past earthquakes and recurrence of its behaviour suggest that a big earthquake event in Bangladesh may cause worst catastrophy, potentially more severe than that of the Calcutta Earthquake of October 1, 1737 when about 300,000 lost their life.

Earthquake is inevitable in the regions of seismic belt, but modern experiences with earthquakes in populated areas like the cities reveal the fact that properly designed engineered structures and constructed facilities can withstand even large earthquakes. So ensuring that appropriate engineering design and material standards keeping pace with sensible use of land and event prediction can thus serve effectively in reducing the loss of life and property in the event of a big earthquake.

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Ensuring quality control and safety during construction

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Safety is largely the responsibility of the managers on site rather than that of public inspectors...Quality control should be a primary objective for all the members of a project team. Managers should take responsibility for maintaining and improving quality control.

QUALITY control and safety represent increasingly important concerns for project managers. Defects or failures in constructed facilities can result in huge costs. Even with minor defects, reconstruction may be required and increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities. Accidents during the construction process can similarly result in personal injuries and large costs. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents occur on the project.

As with cost control, the most important decisions regarding the quality of a completed facility are made during the design and planning stages rather than during construction. It is during these preliminary stages that component configurations, material specifications and functional performances are decided. Quality control during construction consists largely of ensuring conformity to the original design and planning decisions.

While conformity to existing design decisions is the primary focus of quality control, there are exceptions to this rule. First, unforeseen circumstances, incorrect design decisions or changes desired by an owner in the facility function may require re-evaluation of design decisions during the course of construction. While these changes may be motivated by the concern for quality, they represent occasions for redesign with all the attendant objectives and constraint. As a second case, some designs rely upon informed and appropriate decision making during the construction process itself. For example, some tunneling methods make decisions about the amount of shoring required at different locations based upon observation of soil conditions during the tunneling process. Since such decisions are based on better information concerning actual site conditions, the facility design may be more cost effective as result.

With the attention to conformance as the measure of quality during the construction process, the specification of quality requirements in the design and contract documentation becomes extremely important. Quality requirements should be clear and verifiable, so that all parties in the project can understand the requirements for conformance.

Safety during the construction project is also influenced in large part by decisions made during the planning and design process. Some designs or construction plans are inherently difficult and dangerous to implement, whereas other, comparable plans may considerably reduce the possibility of accidents. For example, clear separation of traffic from construction zones during roadway rehabilitation can greatly reduce the possibility of accidental collisions. Beyond these design decisions, safety largely depends upon education, vigilance and cooperation during the construction process. Workers should be constantly alert to the possibilities of accidents and avoid taken unnecessary risks.

Constitution of a variety of different groups is possible for quality and safety control during construction. One common model is to have a group responsible for quality assurance and another group primarily responsible for safety within an organisation. In large organisations, departments dedicated to quality assurance and safety might assign specific individuals to assume responsibility for these functions on particular projects. For smaller projects, the project manager or an assistant might assume these and other responsibilities. In either case, insuring safe and quality construction is a concern of the project manager in overall charge of the project in addition to the concerns of personnel, cost, time and other management issues. Inspectors and quality assurance personnel will be involved in a project to represent a variety of different organisations.

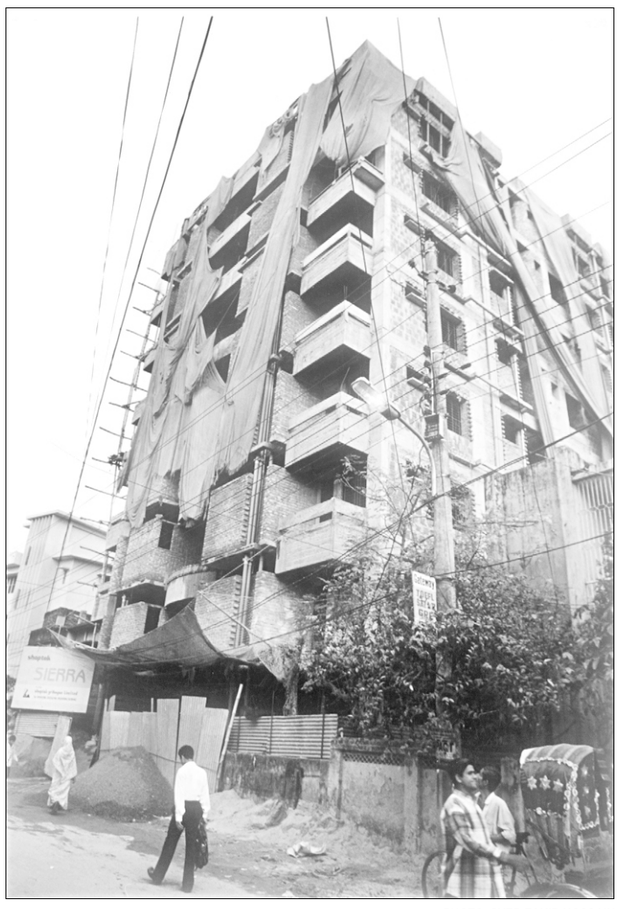

PHOTO: SYED ZAKIR HOSSAIN

Each of the parties directly concerned with the project may have their own quality and safety inspectors, including the owner, the engineer/architect, and the various constructor firms. These inspectors may be contractors from specialised quality assurance organisations. In addition to on-site inspections, samples of materials will commonly be tested by specialised laboratories to ensure compliance. Inspectors to ensure compliance with regulatory requirements will also be involved. Common examples are inspectors for the local government's building department, environmental agencies, and occupational health and safety agencies.

The US Occupational Safety and Health Administration (OSHA) routinely conducts site visits of work places in conjunction with approved state inspection agencies. OSHA inspectors are required by law to issue citations for all standard violations observed. Safety standards prescribe a variety of mechanical safeguards and procedures; for example, ladder safety is covered by over 140 regulations. In cases of extreme non-compliance with standards, OSHA inspectors can stop work on a project. However, only a small fraction of construction sites are visited by OSHA inspectors and most construction site accidents are not caused by violations of existing standards. As a result, safety is largely the responsibility of the managers on site rather than that of public inspectors.

While the multitude of participants involved in the construction process require the services of inspectors, it cannot be emphasised too strongly that inspectors are only a formal check on quality control. Quality control should be a primary objective for all the members of a project team. Managers should take responsibility for maintaining and improving quality control. Employee participation in quality control should be sought and rewarded, including the introduction of new ideas. Most important of all, quality improvement can serve as a catalyst for improved productivity. By suggesting new work methods, by avoiding rework, and by avoiding long term problems, good quality control can pay for itself. Owners should promote good quality control and seek out contractors who maintain such standards.

In addition to the various organisational bodies involved in quality control, issues of quality control arise in virtually all the functional areas of construction activities. For example, insuring accurate and useful information is an important part of maintaining quality performance. Other aspects of quality control include document control (include changes during the construction process), procurement, field inspection and testing, and final checkout of the facility.

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