Environmental effect

An effective solid waste management system is necessary to avoid public health disasters, spread of disease by insects and vectors and adverse effect on water and air (Phelps, et al., 1995). Solid waste workers are the most exposed to the risks of parasitic infections and accidents, and therefore, a SWM system must include proper mechanisms to avoid these incidences. To the direct and indirect risks through accidents, exposure and spread of disease, we must add the effect of visual pollution caused by litter and nuisance created by smoke and dust at disposal sites.

Public health effect

The volume of waste is increasing rapidly as a result of increasing population and improving economic conditions in various localities. This increased volume of wastes is posing serious problems due to insufficient workforce and other constraints in disposing of it properly. What are the consequences of improper management and handling of wastes? Consider the following:

(i) **Disease vectors and pathways:** Wastes dumped indiscriminately provide the food and environment for thriving populations of vermin, which are the agents of various diseases. The pathways of pathogen transmission from

wastes to humans are mostly indirect through insects – flies, mosquitoes and roaches and animals – rodents and pigs. Diseases become a public health problem when they are present in the human and animal population of surrounding communities, or if a carrier transmits the etiological agent from host to receptor.

(ii) **Flies:** Most common in this category is the housefly, which transmits typhoid, salmonellosis, gastro-enteritis and dysentery. Flies have a flight range of about 10 km, and therefore, they are able to spread their influence over a relatively wide area. The four stages in their life-cycle are egg, larva, pupa and adult. Eggs are deposited in the warm, moist environment of decomposing food wastes. When they hatch, the larvae feed on the organic material, until certain maturity is reached, at which time they migrate from the waste to the soil of other dry loose material before being transformed into pupae. The pupae are inactive until the adult-fly emerges. The migration of larvae within 4 to 10 days provides the clue to an effective control measure, necessitating the removal of waste before migration of larvae. Consequently, in warm weather, municipal waste should be collected twice weekly for effective control. In addition, the quality of household and commercial storage containers is very significant. The guiding principle here is to restrict access to flies. Clearly, the use of suitable storage containers and general cleanliness at their location, as well as frequent collection of wastes, greatly reduces the population of flies. Control is also necessary at transfer stations, composting facilities and disposal sites to prevent them from becoming breeding grounds for flies. Covering solid wastes with a layer of earth at landfill sites at the end of every day arrests the problem of fly breeding at the final stage.

(iii) **Mosquitoes:** They transmit diseases such as malaria, filaria and dengue fever. Since they breed in stagnant water, control measures should centre on the elimination of breeding places such as tins, cans, tyres, etc. Proper sanitary practices and general cleanliness in the community help eliminate the mosquito problems caused by the mismanagement of solid waste.

(iv) **Roaches:** These cause infection by physical contact and can transmit typhoid, cholera and amoebiasis. The problems of roaches are associated with the poor storage of solid waste.

(v) **Rodents:** Rodents (rats) proliferate in uncontrolled deposits of solid wastes, which provide a source of food as well as shelter. They are responsible for the spread of diseases such as plague, murine typhus, leptospirosis, histoplasmosis, rat bite fever, dalmonelosis, trichinosis, etc. The fleas, which rats carry, also cause many diseases. This problem is associated not only with open dumping but also poor sanitation.

(vi) **Occupational hazards:** Workers handling wastes are at risk of accidents related to the nature of material and lack of safety precautions. The sharp edges of glass and metal and poorly constructed storage containers may inflict injuries to workers. It is, therefore, necessary for waste handlers to wear gloves, masks and be vaccinated. The infections associated with waste handling, include:

- skin and blood infections resulting from direct contact with waste and from infected wounds;
- eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations;
- diseases that result from the bites of animals feeding on the waste;
- intestinal infections that are transmitted by flies feeding on the waste;
- chronic respiratory diseases, including cancers resulting from exposure to dust and hazardous compounds.

In addition, the accidents associated with waste handling include:

- bone and muscle disorders resulting from the handling of heavy containers and the loading heights of vehicles;

- infecting wounds resulting from contact with sharp objects;
- reduced visibility, due to dust along the access routes, creates greater risk of accidents;
- poisoning and chemical burns resulting from contact with small amounts of hazardous chemical wastes mixed with general wastes such as pesticides, cleaning solutions and solvents in households and commercial establishments;
- burns and other injuries resulting from occupational accidents at waste disposal sites or from methane gas explosion at landfill sites;
- serious health hazards, particularly for children, due to careless dumping of lead-acid, nickel-cadmium and mercuric oxide batteries.

(vii) **Animals:** Apart from rodents, some animals (e.g., dogs, cats, pigs, etc.) also act as carriers of disease. For example, pigs are involved in the spread of diseases like trichinosis, cysticerosis and toxoplasmosis, which are transmitted through infected pork, eaten either in raw state or improperly cooked. Solid wastes, when fed to pigs, should be properly treated (cooked at 100°C for at least 50 minutes with suitable equipment).

Environmental effect

Besides causing health disorders that we have touched upon inadequate and improper waste management causes adverse environmental effects such as the following:

(i) **Air pollution:** Burning of solid wastes in open dumps or in improperly designed incinerators emit pollutants (gaseous and particulate matters) to the atmosphere. Studies show that the environmental consequences of open burning are greater than incinerators, especially with respect to aldehydes and particulates. Emissions from an uncontrolled incinerator system include particulate matter, sulphur oxides, nitrogen oxides, hydrogen chloride, carbon monoxide, lead and mercury. Discharge of

arsenic, cadmium and selenium is to be controlled, since they are toxic at relatively low exposure levels. Polychlorinated dibenzofurans (PCDFs), commonly called dioxins and furans, are of concern because of their toxicity, carcinogenicity and possible mutagenicity.

(ii) **Water and land pollution:** Water pollution results from dumping in open areas and storm water drains, and improper design, construction and/or operation of a sanitary landfill. Control of infiltration from rainfall and surface runoff is essential in order to minimise the production of leachate. Pollution of groundwater can occur as a result of:

- the flow of groundwater through deposits of solid waste at landfill sites;
- percolation of rainfall or irrigation waters from solid wastes to the water table;
- diffusion and collection of gases generated by the decomposition of solid wastes.

The interaction between leachate contaminants and the soil depends on the characteristics of the soil. Soil bacteria stabilise biochemical oxygen demand (BOD), i.e., the amount of oxygen required by micro-organisms to degrade organic matter, by anaerobic action, if toxic substances are in low concentration. The carbon dioxide produced keeps the pH level low, causing the water to dissolve minerals in the aquifers. Consequently, the change in groundwater quality may take place depending on the characteristics of the aquifer. Contamination can spread over considerable distances from the landfill, if the aquifers are of sand or gravel. In clayey soils, the rate of movement is greatly reduced. The capacity of clay to exchange ions restricts the movement of metal ions by capturing them in the soil matrix. Changes in its chemical characteristics are due to hardness, iron and manganese compounds.

(iii) **Visual pollution:** The aesthetic sensibility is offended by the unsightliness of piles of wastes on the roadside. The situation is made worse by the

presence of scavengers rummaging in the waste. Waste carelessly and irresponsibly discarded in public thoroughfares, along roads and highways and around communal bins (i.e., makeshift containers, without lids, used for the storage of residential, commercial and institutional wastes) gives easy access to animals scavenging for food. The solution to this social problem undoubtedly lies in the implementation of public education at all levels – primary, secondary, tertiary and adult, both short- and long-term, and in raising the status of public health workers and managers in solid waste management.

(iv) **Noise pollution:** Undesirable noise is a nuisance associated with operations at landfills, incinerators, transfer stations and sites used for recycling. This is due to the movement of vehicles, the operation of large machines and the diverse operations at an incinerator site. The impacts of noise pollution may be reduced by careful siting of SWM operations and by the use of noise barriers.

(v) **Odour pollution:** Obnoxious odours due to the presence of decaying organic matter are characteristic of open dumps. They arise from anaerobic decomposition processes and their major constituents are particularly offensive. Proper landfill covering eliminates this nuisance.

(vi) **Explosion hazards:** Landfill gas, which is released during anaerobic decomposition processes, contains a high proportion of methane (35 – 73%). It can migrate through the soil over a considerable distance, leaving the buildings in the vicinity of sanitary landfill sites at risk, even after the closure of landfills. Several methods are available for control of landfill gas, such as venting, flaring and the use of impermeable barriers.

Evalution methodology for generated solid waste involves analysis of landfill performance, the unit weight and compressibility, economic viability, MSW constituents, equations for evaluating MSW, data acquisition, source of evaluating that is study plan, demographic study, Questionnaire design to know who, what, where and why and statistics generation to analyse planning data.

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