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*solid waste management
and disposal – practical
considerations*

INTRODUCTION

"Hot countries" differ tremendously in character and range from arid desert to tropical rain forest; in consequence the nature, yield and composition of domestic solid wastes vary enormously, the most important differences being those of organic and moisture content. The percentage by weight of organic matter can range from 25% up to 85%, and there are often wide seasonal variations.

The only uniform factor throughout "hot countries" is the effect of high ambient temperature on the rate of decomposition of the wastes and consequently on rapid infestation with insect and other pests.

Appendix 1 outlines the life history of the fly and the control measures which this requires, and it illustrates the acceleration of breeding rate due to temperature effects.

The essential objective of solid waste management is the promotion of public health. Unsatisfactory methods of storage, collection and disposal of solid waste create ideal breeding facilities for flies and other pests, which are themselves the vectors of many endemic diseases. The fly population CAN be substantially reduced by proper methods.

The fundamental practical approach to sound solid waste management in hot countries (however poor the community) is the application of systems which will ensure the elimination of conditions which are conducive to the propagation of insect and other pests.

BASIC PRINCIPLES

1. Waste must NOT be deposited on the ground surface, or in open dumps, in order to prevent the infestation of the waste and also the subsoil. Waste should ALWAYS be deposited into metal or plastic receptacles (and ideally these should have tight fitting lids). They should be emptied regularly (preferably daily) and be kept clean at all times.
2. Conveyance of waste from the storage receptacle to the collection vehicle should be either direct, or by the use of carry containers or sheets of impervious material, designed to ensure the waste is completely covered during transit, and capable of easy cleansing.
3. Transport of waste to disposal site should be in covered vehicles (or in closed containers carried by open vehicles).
4. Disposal, which is usually to land, should be in accordance with sound methods of sanitary landfill. This requires the IMMEDIATE covering of deposited and consolidated waste with an adequate thickness of sealing material. The open burning of waste is insanitary as combustion is ineffective, and results in a smouldering mass of decomposing waste, which forms an ideal media for fly infestation.

The foregoing principles can be applied in many different ways according to local circumstances and the facilities available.

STORAGE AND COLLECTION

Large towns and cities usually consist of mixtures of old and new development, with extensive areas where facilities for on-site storage are very limited. This often results in open dumps on vacant land (and even deposit of waste in streets and lanes). Individual bins for each property are a rare occurrence. Street cleansing therefore becomes an important task, but this is often carried out in a primitive manner. Access to older premises (especially in hilly areas) is often by steep stairways and narrow streets and passages, which are inaccessible to vehicles. The waste has therefore to be manually carried for long distances to vehicle collection points, where it is often deposited in another dump to await collection. In small villages there are usually communal dumps which may be removed at infrequent intervals.

Even in the poorest community it is desirable that WHEREVER POSSIBLE

1. Individual storage receptacles be available to each property OR
2. Proper covered metal storage containers of appropriate capacity be provided to replace open dumps (including those at vehicle collection points). Where possible these containers should be mechanically emptied into proper collection vehicles, or with large capacity containers, be lifted and transported by special handling vehicles.
3. In small and poor village communities pit trenches (suitably located to avoid contamination of water) should be used in a similar manner to trench latrines. Great care should be taken to secure the covering of the waste with excavated soil after it is deposited.

The proper use of the modern container systems can save considerable time, labour and cost by the elimination of double and treble handling of waste. Containers vary in size from $\frac{1}{2}$ - $4\frac{1}{2}$ cubic metre capacity when used for mechanically emptying into standard collection vehicles, and up to 12 cubic metres capacity when a special handling vehicle is used. The large containers are in effect demountable vehicle bodies, and they are used on an exchange basis (empty for full).

DISPOSAL

Disposal to land is the common method and will remain so, although in some cases it may be pre-treated.

Cost considerations in many places restrict disposal of waste to simple methods of land disposal, BUT THE ONLY ACCEPTABLE SANITARY SYSTEM is controlled landfill. This requires the deposit of waste in shallow layers which are consolidated as firmly as possible, and then covered with at least 15 cm of soil or other inert material IMMEDIATELY after the wastes have been deposited and consolidated.

Where the land can be readily excavated, and there is an adequate area available, the CUT and FILL method is appropriate. Great care is necessary to avoid water contamination by careful siting. In wet tropical areas with a high subsoil water table, surface deposit in the form of windrows is advisable; this method can also be applied where there is a rocky subsoil and there are no natural or man-made excavations to fill. Suitably formed and COVERED windrows will quickly ferment and in a period of a few months will convert the wastes into a composted material. Where cover material is scarce, this composted material will provide ideal covering material for new wastes.

Where money is available, there is great advantage to be derived from the pre-treatment of waste by mechanically shredding or pulverising. Properly done in a suitable plant, the waste is converted into a material of a homogeneous nature, free from voids. The milled material is largely free from pest infestation, as the eggs and larvae are destroyed in the milling process, whilst food and organic material is thoroughly broken up, contaminated and coated with dust so as to render it non-attractive for reinfestation or as an animal food. Shredded waste can be readily ploughed into agricultural land, it can be converted to good compost by windrow methods, or it can be disposed of more easily by sanitary landfill methods. New processes are in development which can enable it to be converted into useful fuel briquettes.

The handling of wastes at large disposal sites requires proper and suitable equipment. The most useful machine is a suitable loading shovel, mounted on four-wheeled drive pneumatic tyred tractor and fitted with a scoop bucket to which is attached a clam shell crab lid. The versatility of such a machine excels the output of the normal crawler machine. It must, however, be of a make and type designed especially for solid waste handling.

APPENDIX 1

THE IMPORTANCE OF FLY CONTROL

- 1.1 The fly is one of the most prolific pests of man. It can carry disease organisms causing typhoid, cholera, gastro-enteritis, diarrhoea, dysentery, eye disease, hepatitis and tuberculosis, as well as intestinal worms.
- 1.2 The fly can only swallow liquid food, and in order to use solid foodstuff, it uses saliva and regurgitated fluid from already digested food to dissolve the solid into a kind of broth which it sucks up through its proboscis.
- 1.3 During breeding it goes through four stages: egg - larvae - pupa - adult fly.
- 1.4 It requires certain conditions for the deposit of its eggs such as moist fermenting or decomposing vegetable or organic matter. The female seeks a suitable breeding site by sense of smell, and deposits her eggs into the mass of breeding material in order to prevent them being destroyed by the sun, and by being dried out in other ways. The batches of eggs number up to 150, and an adult fly will lay several batches during her short life.
- 1.5 The full cycle - egg to adult - depends on weather and temperature. Under ideal conditions it can be less than seven days. In hot countries the fly lives about one month.
- 1.6 The eggs quickly incubate, and produce a small maggot or larvae which burrows into the food to avoid light and to feed on the material. During this larval stage it remains below the surface, but it will eventually move to just below the surface and it may migrate some distance horizontally. In this position a pupa is formed (a small bean-shaped object up to 7 mm long). Excavation of infested soil around a refuse dump will reveal at about a depth of 5 cm considerable numbers of larvae and pupae. These can total over ten thousand per square metre.
- 1.7 In due course the adult fly emerges from the pupa and makes its way to the surface. Here it walks about on the surface for some time until its wings fully expand and its air sacs are filled, when it commences to fly. The adult fly can travel many kilometres from its breeding site.
- 1.8 When already inoculated material is buried and covered with clean material the larvae which hatch out eventually move upwards and outwards to pupate just below the ground surface, and in due course the adult fly emerges at the surface.
- 1.9 If larvae are already present in the material which is buried, pupation takes place in that material, but the live fly can penetrate upwards through very thick compacted layers of clean material. It has been found that this emergence can occur through 45 cm of hard packed soil.
- 1.10 It is clear that the usual covering of clean material as used in sanitary landfill can do little to prevent the emergence of flies from waste which has been previously infested with eggs or larvae. The heat of fermentation of the waste will, however, destroy considerable numbers, but nevertheless many adult flies will escape.

The drier the ground conditions and the slower the rate of temperature built up from fermentation, the greater will be the number of flies that will emerge.

- 1.11 The fact that the newly emerged fly must remain on the surface for some time after it emerges indicates that for control purposes treatment of the surface with an insecticide which has residual toxicity is necessary.
- 1.12 The most effective means of control is to prevent eggs being laid in waste before it is collected. This clearly indicates the need for impervious covered storage containers. Open dumps cause infestation of the ground. It is extremely important to keep waste off the ground to avoid infestation, and as it is always difficult to completely cleanse the surface after removal of waste, there is usually sufficient organic matter left behind in which flies can lay more eggs. Residuals of waste in bins, containers and collection vehicles also encourage the deposit of eggs and later infestation of other waste placed in the receptacle. For this reason thorough and regular cleansing of the receptacles is important.
- 1.13 Where sanitary landfill is practised, it is important that incoming waste is placed into position, levelled off, and covered with the greatest speed, to prevent further laying of eggs in the mass, and also to create fermenting conditions as rapidly as possible.