

TECHNICAL GUIDELINES ON WASTES COLLECTED FROM HOUSEHOLDS (Y46)

Introduction

1. Household wastes are not normally regarded as hazardous, since they consist almost entirely of materials which have been handled by individuals before being discarded. However, such wastes can be extremely variable in their composition, depending to a large extent on the lifestyle of the generator. For example, it can be expected that in those countries where almost everything bought is associated with wrapping materials, the packaging waste very often comprises a significant part of household waste. There will also be foodstuffs adhering to it or unusable material derived from foods preparation, such as vegetable peelings, meat scraps and bones, which make it unattractive for recycling. Also present in waste collected from households are such items as batteries and other electrical components, some of which may contain mercury, containers in which are present residues of oils, paints, pool chemicals, caustic materials, sterilizing agents, bleaches, medicines, etc. Although these constitute a small portion of wastes collected from households, they are particularly problematic due to their hazardous characteristic, variability in chemistry and associated high recovery costs. There may be in addition, aerosol canisters, caustic materials, sterilizing agents, bleaches, medicines, disposable baby's nappies or diapers, animal faeces and its associated litter along with discarded foodstuffs which rapidly degrade and become offensive by virtue of their smell. Such wastes are attractive to vermin, flies and scavenging animals and birds.

For all these reasons there is a need to control and give special consideration to household wastes and carry out practices which demonstrate environmentally sound management. Such wastes could also be generated in offices, commercial establishments, hotels, etc.

Environmental Impacts of Household Waste

2. Inadequate collection, transport or improper disposal of household waste can have adverse environmental impacts, such as:

- Air pollution and unpleasant odours;
- Potential health hazards from accumulation of polluted water, which provide breeding grounds for mosquitoes and attract flies, vermin. Also, injuries from infected sharps;
- Loss of productive land due to the presence of non-biodegradable items;
- Contamination of soil, ground and surface waters by leachate with resultant environmental effects or health hazards;
- Contamination of the marine environment through direct or indirect discharge of waste.

Waste Avoidance and Minimization

3. One of the leading principles of waste management is the source reduction principle, by which, the generation of waste should be reduced to a minimum in terms of quantity and/or hazard potential. Therefore, the problems associated with waste disposal would not be so significant if materials did not need to be discarded as waste in the first place. The marketing of goods in reusable containers which could be returned to the supplier and be reused is one example. Waste generation could sometimes be reduced if commodities were available in bulk quantity to a retailer who would sell the goods in smaller quantities, thereby eliminating the need for as much packaging. Packaging of goods for aesthetic reasons could be discouraged as could the supply of a small item in a large package for marketing reasons. Of course packaging often serves important functions such as controlling spoilage and otherwise facilitating the distribution and marketing of goods.

Segregation at Source

4. It is essential to segregate the domestic waste into various components such as combustibles, material, reusable material, recyclable material, organics, etc. at household level. Combustible material includes paper, cardboard, dry leaves and twigs. Reusable material could be bottles, cans and plastic bags. Recyclable material could be paper, plastics, glass and metal scraps. Organic material includes vegetable and fruit peelings and other food wastes.

5. To promote recovery operations, and to prevent household waste causing pollution or damage to human health, it is most important to segregate recoverable and hazardous waste, if present, already at the source of generation. Segregation can also occur downstream. In developed countries, with possibilities to introduce separate collection schemes, this is a major challenge in relation to the proper management of household waste. In developing countries, it is a more common practice to separate and reuse all valuables from household waste.

Collection and Transport

6. Households usually keep waste to be discarded in designated containers. These may be metal or plastic dust-bins or plastic and paper bags. In large buildings and apartment blocks, centralized containers are sometimes provided into which occupants place their waste. In most developed countries, it is usual for household waste to be collected from premises on a regular basis since food waste, in particular, decays rapidly.

7. In cities and urban areas, waste is collected for disposal in specially designated vehicles fitted with compaction equipment to increase the payload, which can be transported, often over significant distances to sanitary landfill site. In large conurbations, it has been found economically viable to transfer the collected waste to railway containers for transport to a landfill site; large barges are also used for transport on water. In some instances, waste is bailed to facilitate mechanical handling.

Recovery Operations

8. The next important principle in respect of waste avoidance and minimization, is recovery of recyclable components to the greatest possible extent. In many industrialized countries, sophisticated recovery programs have been introduced for household waste. Nevertheless, too much valuable resources are still wasted from inadequate separation, collection and recovery systems, most often due to the unsustainable market for several recovered waste materials.

9. In some developing countries, components of waste streams are usually segregated and used. Combustibles may be used as fuel either as such, or after densification. Paper may be used in small scale paper/cardboard making and plastic wastes can also be reused in applications not requiring high quality and clean material.

10. The segregation, recycling and reuse of domestic waste is important. Segregation, recycling and reuse of household waste can have a major impact on the economies of some developing countries. People involved in waste segregation can be brought into the formal sector and remunerated for their work. Valuable items, 'pickings' can be sold through intermediaries to small recycling entrepreneurs. The entire recycling activity, including transportation, generates employment. The economic status of all those employed in recycling is improved.

11. It is possible to produce a compost from the putrescible fraction of household waste. The waste is piled in a heap formed in rows and the waste is turned over or windrowed at regular intervals. Also, it is possible to put the sorted waste into a horizontal perforated drum, resembling a rotary kiln, which has been fitted with flight tubes and rotate the drum very slowly such that the passage of the waste to the other end of the drum takes several days. Both these processes rely on aerobic biodegradation taking place to produce a product resembling compost. The presence of contaminants both organic and inorganic in compost mainly if it originates from unsegregated materials can make the compost unusable. Threshold values of concentrations of such contaminants must be assessed.

Disposal Operations

12. Historically, household waste has been disposed of by land filling. As communities became larger and more premises were built, usually at a higher density, particularly in urban areas, the area needed for the disposal of waste increased. Also, as society has developed, there have been significant changes in the composition of wastes collected from households, particularly with a change in the fuel used for heating purposes. This led to designated areas of land being set aside which became the local waste disposal site. In addition to decomposition, predators and fires on such sites reduced the volume of waste considerably. Nowadays, because of ever increasing volume of waste requiring disposal and an increasing need to protect the environment, sophisticated means of collection, transport, treatment and disposal need to be used. At the landfill site, the waste is deposited in layers in prepared cells and compacted to decrease its volume. It is then covered, at least daily, with a suitable soil-like material to deter vermin, flies and birds and other scavengers but also to prevent injuries from sharps.

13. Some biodegradation of the putrescible fraction in the household waste will have commenced before it was collected and will continue during its transportation. Its further processing by, for example, wet pulverization also will promote enhanced degradation. Some countries prohibit the addition of liquids to landfills for the purpose of accelerating degradation, being more concerned with the increased production of leachate resulting from such practices. Once in a landfill site the rate of degradation will increase rapidly, particularly in the presence of moisture. However, if the density of the waste is increased significantly to assist its handling and transportation, the ease with which moisture can gain access to the waste mass is decreased, which can result in a delay in the onset of degradation. Initially, the degradation is aerobic producing hydrogen and carbon dioxide as the principal by-products. As the oxygen in the mass of waste is used up, anaerobic conditions become established and the principal by-products are methane and carbon dioxide. Since methane is a highly flammable gas and in confined spaces can be explosive, special measures are needed to vent it from the landfill. At sites where the quantity of landfill gas produced is significant, harnessing it for use as a fuel is practised. It is possible to obtain usable gas quantities for several tens of years.

14. At the same time as landfill gas is produced, other organic compounds are formed. Many of these are soluble in water and become dissolved in any surplus moisture in the landfill site to produce a liquid mixture termed leachate. Leachate can be highly polluting. Some countries strike a balance between high volumes of gas production and low pollution potential of leachate and the reverse to control the pollution by leachate. In any case it is necessary to prevent leachate migration away from a landfill site since it can continue to produce landfill gas away from a landfill site. Also, it is necessary to prevent it from contacting and mixing with ground and surface water.

15. To ensure that waste deposited in a landfill site is more rapidly degraded it can be pulverized before landfilling. The process is usually carried out under wet conditions to reduce dust and, since the waste needs to be wet to promote maximum production of landfill gas, biodegradation occurs quickly after the waste has been landfilled.

16. In parallel with the landfilling of household waste, since many of its constituents are combustible, incineration is another option. Its attraction lies in the fact that large land areas are not removed from use for other purposes for an indefinite period of time, and surplus heat can be produced. Because household waste contains a large variety of materials, including those which are not combustible, plant used to incinerate such waste needs to be rugged and versatile to cope with a highly variable feedstock both in terms of waste composition and calorific value.

17. Because the waste is not easy to feed to and through an incinerator it is usual practice to use furnaces based on either the chain or rocking grate principle or to a lesser extent a rotary kiln. To ensure high combustion efficiency the temperature range at which the furnace is operated and burns waste and the time during which the waste reaches and is maintained at furnace temperature and turbulence within the furnace chamber, all need to be strictly controlled. the so-called "3T's Principle" - Temperature, Time and Turbulence exemplifies this requirement for good combustion.

18. Waste delivered to an incinerator by a collection vehicle usually discharges its load into a large hopper from where the waste can then be removed by grab crane or bucket conveyer and fed to the incinerator furnace at a controlled rate. Ideally, the furnace should be operated on a continuous basis, thus ensuring that waste is not left in the hopper for an extended period of time. As indicated above, decomposition of the waste can take place in the hopper which rapidly produces hydrogen, methane and carbon dioxide to give a gas concentration which is hazardous. Also, it provides a suitable breeding ground for vermin and particularly flies, the eggs of which will in all probability have been laid in the waste before it was collected from a household.

19. To meet increasingly more stringent limits on the concentration of gaseous and particulate emissions released to atmosphere from an incinerator, it is necessary to clean the off-gases before they are released into the atmosphere. At one time electrostatic precipitators were considered to provide sufficient removal of particulate matter in the gas stream. However, to deal with acidic constituents it is necessary to now use equipment that controls acid gas, such as dry lime injection prior to passing the gases through an electrostatic precipitator or wet (chemical) scrubbing. In addition to such control equipment, the height of the chimney from which the gases are released may need to be increased to aid their dispersion and ensure that ground level concentrations of constituents in the gases are environmentally acceptable.

20. An incinerator which is operated efficiently should produce a furnace ash (bottom ash) which contains inorganic materials only. However, in practice, it can be expected that some organic carbonaceous material will be present at trace concentrations also. Normally, the ash is landfilled at a site from which releases of leachate to ground and surface water are prevented. This is required because any water soluble materials in the ash can be dissolved in leachate and could result in concentrations of pollutants in ground and surface water.

21. In addition to solid wastes, household liquid waste is an environmental problem. Liquid wastes disposed to sewer drains into surface water courses. This causes pollution of the aquatic environment with resulting health hazards. Therefore municipal waste water must be collected and properly treated before discharging to surface water courses.

Household Waste Management Options

22. It is possible to segregate waste, either with the co-operation of the waste generator or after collection. Wastes which are not suitable for recovery and hence segregation will need to be collected and disposed of in approved facilities.

23. The biodegradable fraction contained in wastes collected from households may, depending on its storage conditions, decompose in its storage container or collection receptacle. For health, hygiene and aesthetic reasons there has been a move towards the use of plastic or paper sacks in which the waste is kept to await its collection. At the same time this means of waste storage is advantageous to those employed in collecting the waste since then they no longer have direct contact with it. Further, its subsequent handling, be it at a transfer station, incineration plant or landfill site, will be easier and more hygienic.

24. In respect of transfer stations, used principally for bulking and packaging wastes for onward road or rail transport to a disposal facility, in most climates the waste will be degrading to an extent which will require it to be handled by mechanical means for health and safety reasons. Likewise, there should be no direct physical contact with the waste by plant operators at its final destination.

Conclusions

25. Wastes collected from households consist almost entirely of materials which have been handled by individuals before being discarded, and would not normally be regarded as possessing hazard properties. However care needs to be exercised over such materials soon after they are discarded, and are regarded then as wastes, since hazardous materials may be present in small quantities.

26. The presence of biodegradable constituents in household waste demands care in their recovery treatment and disposal. Until the pathogens present in the waste have been either destroyed or die, there is always the possibility of the waste presenting a threat to human health (toxicity) and the environment (ecotoxicity) by virtue of their presence.

27. With respect to management of household waste practices may vary widely among countries. Care should be taken to ensure compliance with domestic requirements.

28. Problems associated with recovery, treatment and disposal of household waste, include:

- Lack of available sites for sanitary landfill;
- Inadequate data on type and quantity of waste generated;
- Separate collection and treatment of liquid waste is expensive, and when disposed of to sewer without treatment can cause harm to the environment;
- Residues remaining after the treatment of municipal wastes require disposal with particular care.

Note on Sewage Sludge

While it is accepted that sewage is waste produced by households, only very rarely is it collected on a regular basis for disposal elsewhere. In many instances, and almost always in urban areas, it is discharged into a sewerage system through which it is conveyed to a sewage treatment works. The treatment processes there produce sewage sludge and a liquid effluent the quality of which needs to be controlled to allow its discharge to natural waters.

For premises not connected to a sewerage system, in many instances they are connected to sewage digestion tanks outside the premises, usually buried in the ground, in which the sewage collects. Its liquid content is allowed to seep away into surrounding land. From time to time the tanks need to be emptied of their solids content. The **sewage sludge**

collected is normally transported to a sewage works and combined with the sludge produced by the sewage treatment process at the works.

In many areas industrial effluents are discharged into sewerage systems and thereby cause contamination of the sewage sludge produced at the treatment works. The disposal of sewage sludge normally can be expected to occur within the country of its production where, provided contaminants such as heavy metals are at an acceptable concentration (not to harm health and the environment), it may be used as a fertilizer on agricultural land, otherwise it is landfilled.

Increasingly, consideration is being given to the incineration of sewage sludge, usually after partial dewatering, possibly in association with wastes collected from households, to enable its surplus energy to be utilized as a means of both evaporating its moisture content and destruction of the organic matter present in the sewage sludge.

Sewage sludge is not a material which directly falls within the scope of the Basel Convention, and therefore its environmentally sound management has not been considered by the Technical Working Group.