LONG-TERM PROGRAMME IN ENVIRONMENTAL POLLUTION CONTROL IN EUROPE

- SOLID WASTE MANAGEMENT -

MODEL CODE OF PRACTICE FOR THE DISPOSAL OF SOLID WASTE ON LAND

Reviewed by a Working Group

Copenhagen
11-13 October 1972

REGIONAL OFFICE FOR EUROPE
World Health Organization
COPENHAGEN

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Note

This Model Code has been prepared by the Regional Office for Europe of the World Health Organization for distribution to the governments of Member States in the Region and to all who participated in the Working Group. A limited number of copies are available for persons officially or professionally concerned with this field of study from the WHO Regional Office for Europe, Copenhagen.

The Code is the result of the deliberations of participants in the Working Group and does not necessarily reflect the policy of the World Health Organization.

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This Model Code is also available in French and Russian.

CONTENTS

1. PREFACE

Solid waste arising from man' s domestic, social and industrial activities is increasing in quantity and variety as a result of increasing population, rising standards of living and developments in technology. In many countries the proper management of solid waste has been neglected because of failure to appreciate the potential environmental hazards resulting from inadequate management, or because of lack of technical and financial resources.

However, the public at large and the authorities are becoming more aware that present methods of storage, collection and disposal of solid waste are often grossly inadequate for today' s needs. Much of this awareness has been brought about by activities related to the control of water and air pollution, where disposal methods of solid waste can be important factors. Solid waste can also contribute to land pollution by creating unsightly conditions or by uncontrolled dumping of polluting wastes, but the effect of disposal practice on land cannot be considered in isolation and must be examined in relation to the overall objective of controlling pollution of water, air and land.

While new techniques of solid waste treatment and disposal will undoubtedly be developed, with greater emphasis on reclamation and recycling, it will continue to be essential to allocate and use land for the final deposit of solid waste. The need for sound operational practice in disposal on land, rather than a multiplication of restrictive regulations is therefore an essential part of solid waste management, and this Code is directed at this objective.

The WHO Working Group which was convened in May 1971[1] to discuss a variety of subjects related to solid waste management recommended the preparation of a Model Code of Practice for the Disposal of Solid Waste on Land. It emphasized that "there is an urgent need for a model code which could bring widespread improvements in disposal practices at relatively low cost".

The Code was drafted by Mr P. K. Patrick, General Manager, Refuse Disposal Division, Public Health Engineering Department, Greater London Council, and sent for review to over 20 specialists in Europe and the United States, and subsequently presented for final evaluation to another Working Group, convened by the Regional Office for Europe in Copenhagen from 11 to 13 October 1972. A list of the participants is given in Annex VI.

[1] World Health Organization, Regional Office for Europe (1971) Development of solid wastes programme, Report of a Working Group, Bilthoven, 4-6 May 1971, Copenhagen

This Working Group, when approving the final form and content of the Model Code, agreed that it should be a relatively simple document, as it was intended principally to help countries where there was little or no experience of controlled tipping practice.

It was further agreed that because different climates and social conditions in various countries affected the types of solid waste produced and the conditions under which disposal would take place, the Model Code should be sufficiently flexible to allow for such variations. Nevertheless, certain basic principles must be established and the Model Code should contain sufficient details to enable a competent engineer to plan and design a controlled tipping operation. Moreover, the Working Group felt that while the Model Code would be extremely useful for the development of good practices for disposal of solid waste on land in European countries it could equally serve countries outside Europe.

As part of its long-term programme in environmental pollution control and specifically in connexion with its activities in solid waste management, the Regional Office for Europe is preparing a Manual on Solid Waste Management to give guidance on various aspects of this subject. The Model Code presented here will be incorporated in this Manual. However, because it is considered that significant improvements in environmental conditions can be achieved in this field within a comparatively short space of time by implementation of this Model Code in all land disposal practice, it is being published separately in advance of the Manual.

2. INTRODUCTION

Many solid wastes, including most industrial, construction and demolition wastes, are suitable only for disposal on land. Domestic and other similar wastes can be disposed of on land without prior treatment, subject to certain constraints to prevent pollution of the environment. By far the greater proportion of all solid waste is now disposed of in this way, and this is likely to continue to be the most practical and economic method for many years, despite the development of new techniques of waste treatment and disposal, including recovery of certain components of the waste for re-use.

The practice of disposing of untreated organic waste direct to the land has often (with justification) given rise to public criticism arising from poorly engineered or operated tipping methods. The failure to ensure proper standards is sometimes attributable to poor management; very often it arises from lack of knowledge or understanding of the principles involved in sound tipping practice, but frequently it is due to unwillingness to meet the cost of their introduction.

The object of this Code of Practice is to give guidance on procedures which should be adopted for the safe and hygienic disposal of solid waste on land and to establish guidelines for the technique of controlled tipping. Controlled tipping is a method of disposing of solid waste on land in such a way as to avoid nuisance or risk to public health (see definition in Annex IV).

In addition to being a satisfactory method of disposal of solid waste, controlled tipping can make a positive contribution to the reclamation of derelict land and, in suitable circumstances, can be used for the formation of new landscape features.

The Code covers important factors likely to be met in European countries in planning the disposal of solid waste by controlled tipping. Since site conditions will differ widely in location, geological formation, climate, scale of operation and other relevant factors, each site must be engineered and operated in accordance with local conditions. Accordingly, some sections of the Code will not always be applicable, but it is sufficiently comprehensive to enable a site specification to be drawn up for any particular site and tipping operation.

The economics of controlled tipping generally favour the use of large sites, where the initial cost of site preparation can be spread over the disposal of large tonnages of waste. This Code is drafted to take account of the likelihood of larger sites being used in future as a result in some cases of the regional planning of solid waste disposal. However, the principles of controlled tipping can and should be applied to any disposal operation by tipping on land, irrespective of the size of the site.

Whatever form of treatment may be applied to solid waste, land is required for final disposal of the treated material or residue. This Code deals with a technique of disposal for crude or untreated wastes direct to the land. Where pulverized refuse has to be disposed of, the same principles of controlled tipping should apply, although there will be less need for covering material.

A comparatively new method of waste treatment - high density baling - is being developed in the USA and Japan. This might considerably modify and simplify land disposal methods, but insufficient information is as yet available to enable firm conclusions to be reached.

A method of disposal which should also be mentioned is an "aerobic" method of tipping, which has been developed in the Federal Republic of Germany. This follows principles contrary to those of controlled tipping, as the technique requires minimum compaction of the waste and absence of soil cover, in order to achieve maximum aerobic decomposition. It is

considered that this method is only applicable in certain localities and conditions. (This method was described in a Working Paper (EURO 3402(1)/9) prepared for a WHO Working Group on Solid Wastes in May 1971.)[1]

The Code is not intended to be a substitute for specialist professional advice which may be required for particular aspects of the planning, design and operation of controlled tipping, but it is aimed at making the basic principles of hygienic disposal on land readily available to those directly concerned with solid waste disposal operations.

The principles in the Code must, of course, be applied in conjunction with the requirements of any relevant national or local public health and planning legislation. Definitions of some of the key terms used in this Code are given in Annex IV.

Although the Code is concerned primarily with health and environmental protection, it was thought that it would be helpful to append some notes on economic considerations in the selection and operation of controlled tipping sites and these are set out in Annex II. It is emphasized that controlled tipping must not be regarded as a "cheap" method of waste disposal. It is essential that adequate financial and technical resources are allocated to the planning, design, construction and operation of the project.

One of the most important factors in maintaining a high standard of operation is the level of supervision. Frequent checks on controlled tipping operations should be made by a responsible official with appropriate technical qualifications and experience; and, in order to assist the assessment of standards of operation, it is recommended that he should use a check list. A suggested form of list is shown in Annex III.

3. PLANNING AND SITE SELECTION,

Only sites where land improvement will result from the tipping of refuse should be chosen. Selection of a site should always be made in consultation with the local planning, health, and water-protection authorities. Ecological factors such as possible damage to bird and animal habitats should also be considered.

[1] World Health Organization, Regional Office for Europe (1971) Development of solid wastes programme, Report of a Working Group, Bilthoven, 4-6 May 1971, Copenhagen

The after-use of the land should be determined, so that an appropriate tipping plan can be formulated.

Potential sites include land marred by industrial activity such as subsidence through underground working, or land not serving a useful purpose but which could be improved by filling and contouring. Mud flats in some tidal reaches may be suitable for reclamation.

Subject to hydrogeological investigation in relation to the protection of ground and surface water proving satisfactory, mineral excavations of, for example, sand, gravel or clay may be suitable for disposal of solid waste. Refuse should not be deposited on fissured strata forming part of an aquifer from which public water supplies are drawn.

3.1 Road access

The site should have good road access from the collection area and the approaches should be adequate for the concentration of a large number of vehicles.

3. 2 Locality considerations

The proximity of inhabited buildings will be an important factor in deciding on the suitability of a site. No hard and fast rule can be given; much will depend on ground contours, likely duration of the tipping activity, number and type of premises and direction of prevailing wind. However, experience indicates that the boundary of a tipping site should, as a rule, be at least 200 m from the boundary of the nearest residential area.

Because birds may be attracted to tips and are a potential hazard to low-flying aircraft, the appropriate airport authority should be consulted where a site near to an airport is being considered.

3. 3 Site in relation to refuse collection area

If possible, the site should be within economic delivery range of the refuse collection vehicles. If not, the site should have sufficient tipping capacity to justify the capital and operating costs of a transfer station in the collection area.

3. 4 Hydrological and geological considerations

Full investigation of the hydrological and geological conditions at and in the neighbourhood of the site must be made, to determine if any action is necessary to protect ground water or watercourses against pollution from percolate or drainage from the tip. Preventive action will also be required where a risk exists of gases from decomposition of the refuse reaching adjacent property through fissures in surrounding ground.

3. 5 Availability of covering material

The availability of suitable covering material for the duration of the tipping operation is essential and this must be studied for each site. If suitable material is not available at the site it will have to be imported.

4. SITE SURVEY AND OPERATIONAL PLAN

4. 1 Survey

A comprehensive land or aerial survey of the site should be made and a site plan prepared. The scale of the plan should not be greater than 1 : 2500. All topographical features should be shown and, if water is present, the depth and calculated volumes should be recorded. The plan should cover an area large enough to indicate clearly the features of the land surrounding the site, with particular reference to roads, watercourses, buildings or other important features. The volume of covering material available at the site should be estimated and recorded.

A soil survey should be made to determine the soil strata underlying and adjacent to the site.

Rainfall for the area, which could affect the amount and rate of percolation from the tip, should be studied and a record kept.

4. 2 Site designation

An official name should be chosen for the site at the outset and the location designated by appropriate co-ordinates, for easy reference and to avoid risk of confusion. This name should thereafter be used in all documents and correspondence referring to the site.

4. 3 Contour map

If the site is to be raised above its original level by tipping, a contour map showing the final levels should be prepared. The contours should be in 2 m levels, each contour representing one layer of refuse. The total volume of space available for filling should be calculated and shown on the plan. The volume available for refuse after initial compaction will then be obtained by deducting the estimated volume of primary and final covering material required.

4. 4 Ground water level

The level of the water table, if high enough to be of consequence, together with the direction and rate of flow, should be ascertained and recorded on the site plan. At sites where tidal conditions exist, details of these should also be recorded.

4. 5 Watercourses and site drainage

Any watercourse on the site must be diverted or culverted before tipping commences.

In order to minimize the amount of water percolating through the tip, surface-water drainage from any surrounding higher land should be diverted from the tipping site, and the tip levels should be planned to throw off rainwater.

All drainage work in connexion with the site should be planned in consultation with the appropriate authorities. Information on site drainage works which may be necessary either before tipping starts or after completion should be entered in the site specification (see 4. 7).

4. 6 Sites containing water

Waste, other than inert material, should not be deposited in water, as pollution of ground water or watercourses may occur and decomposition of the refuse in the water will give rise to offensive smell.

4. 7 Site specification

A site specification should be prepared (see Annex I) showing the following: all relevant details of the site; tipping plan; plant and equipment required; types of waste excluded (if any); methods of pest and weed control; covering material source and storage; water monitoring arrangements (if any); final restoration requirements and any special factors relevant to the site (see Annex I); and provision of an emergency tipping area for use in bad weather.

5. PREPARATORY WORKS AND FACILITIES

5. 1 Roads

It will be necessary to provide a road or roads within the site and in certain cases an access or service road from the public highway to the site entrance.

5. 1. 1 Access roads

If access to the site is directly off the public highway and large numbers of vehicles will be using the tip, it may be advisable to construct a service road from the highway to the site entrance in order to avoid risk of large vehicles obstructing the highway when entering the site. If a service road is not necessary, the pavement crossing at the entrance should be wide enough to allow vehicles to turn in without causing obstruction. Substantial and lockable gates should be installed at the entrance, which should be at least 7. 5 m wide. The gates should be located at least 12 m from the highway and the layout should provide good sight lines for vehicles leaving the site.

5.1.2 Site roads

A permanent kerbed road, preferably of double-vehicle width, should be provided within the site from the entrance gates at least as far as the site control centre, which should be located far enough from the entrance to allow vehicles to queue within the site and not on the highway.

Depending on the size and shape of the site, one or more roads should be provided to enable vehicles to reach the tipping face without travelling excessive distances over the tip surface and these must be suitable for use in all weather. Where such roads are only of single vehicle width, they should be widened at intervals to allow vehicles to pass.

Road repair material should be stockpiled for maintenance of the site roads.

5. 2 Site security and facilities

5. 2. 1 Fencing and screening

The whole site should be enclosed by fencing. If, in exceptional cases, this is not practicable, the entrance and adjacent area which may contain the weighbridge, employees' amenity building, garage, stores and fuel supply should be enclosed by fencing of a sufficient standard to give security to the installations and for safety reasons.

Where inhabited buildings or a busy highway are near to the site, measures should be taken to prevent nuisance from litter and noise, and as far as practicable to screen the operation from view. These may include the construction of earth banks (including stripped top soil and subsoil) and tree or shrub planting.

5. 2. 2 Site identification and information boards

A site identification board, giving the name and ownership of the site, should be displayed at the entrance. A site information board should also be provided giving the following information (where relevant):

(1) opening and closing hours;

(2) refuse disposal charges;

(3) material specifically excluded, or a statement reserving the right to exclude certain material;

(4) any other relevant information;

(5) information on the future development of the site.

The boards should be of durable material and finish.

5. 2. 3 Services

Water, electricity and telephone services should be provided where this can be done at reasonable cost.

5. 2. 4 Lighting

If the tip is likely to be used during the hours of darkness the entrance area and site roads should be provided with road lighting. In climates where fog is prevalent, or where tipping operations will be carried out during the hours of darkness, portable light units and fog flares will be necessary. Particulars of the numbers and type required should be entered in the site specification.

5. 2. 5 Wheel cleaning

A wheel-washing machine or other wheel-cleaning equipment should be installed alongside the site road near the exist, to prevent mud being carried on to the public highway by vehicles leaving the site.

5. 2. 6 Movable screens

Movable litter screens of wire netting, with a mesh size of not more than 50 mm and at least 3 m high, should be provided.

5. 2. 7 Containers for the use of the public

Depending on locality, it may be good practice to provide containers inside the site, near to the entrance area, where bulky items, such as old furniture, and other material brought to the site by members of the public, may be deposited for subsequent disposal in the tip.

5. 3 Weighbridge and control centre

Provision of a weighbridge is highly desirable to provide the management with information on the quantities and types of waste received at the site, and for costing purposes. The weighbridge office will normally serve as a control centre for management of the site. If a weighbridge

is not installed, accommodation, which may consist of a small portable office, should be provided for the use of the site supervisor.

5.4 Facilities for employees

Facilities should be provided on the site for the welfare of employees. A trailer or other temporary building suitably equipped will normally be adequate. This should contain toilet and washing facilities, clothes lockers, a stove or cooker for heating food and providing hot drinks. Toilets should, if practicable, be connected to a sewer; if not, a properly constructed cesspool is preferable to a chemical toilet.

First-aid equipment should be provided and at least one employee trained in first aid.

5.5 Service and stores area

Within the control area facilities should be provided for plant servicing and equipment which should include:

(1) fuel storage tank (this can be mobile),

(2) tool store,

(3) fire appliances,

(4) high-pressure washing point.

A building for servicing and repairing earth-moving machines will only be required at sites handling very large tonnages of refuse (1000 tons per day or more) and where many years of operation are planned. Prefabricated buildings may be adequate for the purpose. An inspection hut and adequate heating and lighting should be provided. At smaller sites servicing and minor repairs can be carried out by visiting maintenance personnel.

5.6 Water protection

The percolate from a controlled tip can be highly polluting. Where there is a risk that water sources may be polluted, measures must be taken to prevent the percolate from reaching the ground water, or entering a river or stream.

At some sites an impermeable lining such as puddled clay or hard plastic sheeting has been interposed between the refuse and the ground and a drainage system provided to collect the percolate. While there is no evidence to suggest that these measures are inadequate in protecting ground water, more experience is required to assess their ultimate effectiveness.

Where such methods are adopted, arrangements must be made to collect percolate in the base of the tip through a system of land drains, or to collect it at the lowest point and pump it away. The percolate should be discharged into a foul sewer or, if this is not practicable, suitably treated before being discharged into a watercourse.

Where the site is located within a water protection area, and where there is a risk of water pollution, the quality of the ground water should be determined by standard methods and recorded before tipping begins, to establish a standard of comparison for future monitoring. Monitoring should continue during the operational life of the site and until the temperature and gas-sampling tests show that the refuse has become chemically and bacteriologically inert.

5.7 Soil stripping and stockpiling

A decision on whether or not to strip top soil and subsoil before tipping commences will depend on the ultimate use of the land, and the need to use the material as primary or final cover. In some cases it may be beneficial to leave the soil undisturbed in order to make use of its absorptive and filtering capacity in removing pollutants from the tip percolate. If it is intended to strip top soil and subsoil and store it for subsequent use, the storage areas should be defined on the site plan. If a large area is to be stripped, it may be desirable not to remove all the material at one time, as soil stored for long periods tends to deteriorate and will be subject to loss through erosion. Furthermore, stripped ground will become a nuisance from weed growth if left too long. Top soil should be stored separately from subsoil so that it can be used for final reclamation. Storage areas should be planned to minimize subsequent transportation and handling.

6. TYPES OF WASTE ACCEPTABLE FOR DISPOSAL IN CONTROLLEDTIPS

In addition to domestic wastes, many types of industrial waste, including some sludges, may be safely disposed of in controlled tips, but wastes which introduce hazards of toxicity or flammability should be excluded. Wastes of high toxicity may slow down or prevent the normal biological decomposition of refuse in a tip or increase the risk of water pollution.

Some wastes such as clinker or demolition wastes may be suitable as primary covering material. Other industrial wastes should be mixed with domestic refuse or otherwise dealt with by the procedures recommended in this Code.

Wastes which are considered suitable for disposal in controlled tips include the following:

(1) domestic refuse and similar wastes arising from trade or commercial premises;

(2) clinker and boiler ash;

(3) spoil from mining operations;

(4) iron and steelworks slag;

(5) construction and demolition wastes;

(6) old motor tyres;

(7) sludges from water-treatment plant and industrial process wastes;

(8) de-watered sewage sludge;

(9) agricultural wastes.

Many wastes of a toxic nature can be accepted in a land disposal site, provided that the quantity is small in relation to the total amount of waste disposed of at the site. The appropriate water protection authority must be consulted before any waste of that type is accepted.

7. OPERATIONAL PRACTICE

Tipping should be carried out to a preconceived overall plan, although the tip supervisor must be allowed to exercise discretion in day-to-day operations to cope with changes in weather or emergencies.

7. 1 Tipping plan

A tipping plan should be drawn up and entered on the site specification setting out details of layer construction, depth of cover, etc. (see Annex I).

In formulating the plan, regard should be paid to the direction of the prevailing wind. Where applicable, separate summer and winter tipping areas should be provided, in order to avoid tipping near occupied buildings in summer and to provide a tipping area in winter or bad weather as near as practicable to the site entrance. An area should also be designated for emergency use, e. g. , in case of fire.

7. 2 Earth-moving machines and equipment

Depending on the scale of operations, a variety of equipment will be required for spreading and compacting the refuse; excavating, transporting and spreading covering material; and maintaining site roads.

For spreading and compacting the refuse, a crawler tractor with bull-dozer blade is the machine most commonly used. Wheeled compactors with special wedge-shaped teeth on the wheels or rollers achieve a higher degree of compaction, but are much more costly and do not have the versatility of a crawler tractor. Where the quantity of refuse to be handled would provide full-time work for a wheeled compactor in spreading and compacting, the additional cost of such a machine might be justified.

A scraper or front-end loader will be required for digging and spreading covering material, and in dry periods a water tank should be available for sprinkling site roads.

As a guide to requirements, one dozer (crawler tractor or wheeled compactor) of about 200 h. p. can handle 500 tons of refuse per day or more. An additional crawler-tractor will be required for spreading covering material, and, if this material is to be excavated at the site, a scraper will be required. For smaller sites, one crawler tractor and part-time use of a scraper will normally be sufficient, if supplemented when necessary by other machines.

7. 3 Formation and control of tip

In order to minimize the risk of nuisance and to achieve a satisfactory standard of site reclamation, it is essential to adhere closely to recommended principles of controlled tipping, as follows.

(1) Tipping should be concentrated in one *area at a* time.

(2) The refuse should be formed into a layer as soon as possible after tipping, by means of a bull-dozer or tractor equipped with a suitable blade. Refuse should be deposited on the surface of the tip behind the face and partially compacted by the bull-dozer before being pushed over the face (fig. 1). An alternative method is for the refuse to be tipped on the ground forming the base of the site, or previous layer, and for the bull-dozer to form the layer by pushing the refuse upwards and running over it (fig. 2). Where much bulky material is received this method will give better compaction. Bulky material should be crushed or broken down before being put in the tip in order to prevent voids which could form gas pockets, and to promote even settlement. Fig. 3 shows a sectional view through consecutive layers of the tip.

(3) The depth of the layer after initial compaction should not exceed 2. 5 m. To permit settlement and dispersal of gases, as long a period as practicable should elapse before a further layer is added.

FIG,1. FORMING TIP LAYER–METHOD,1.

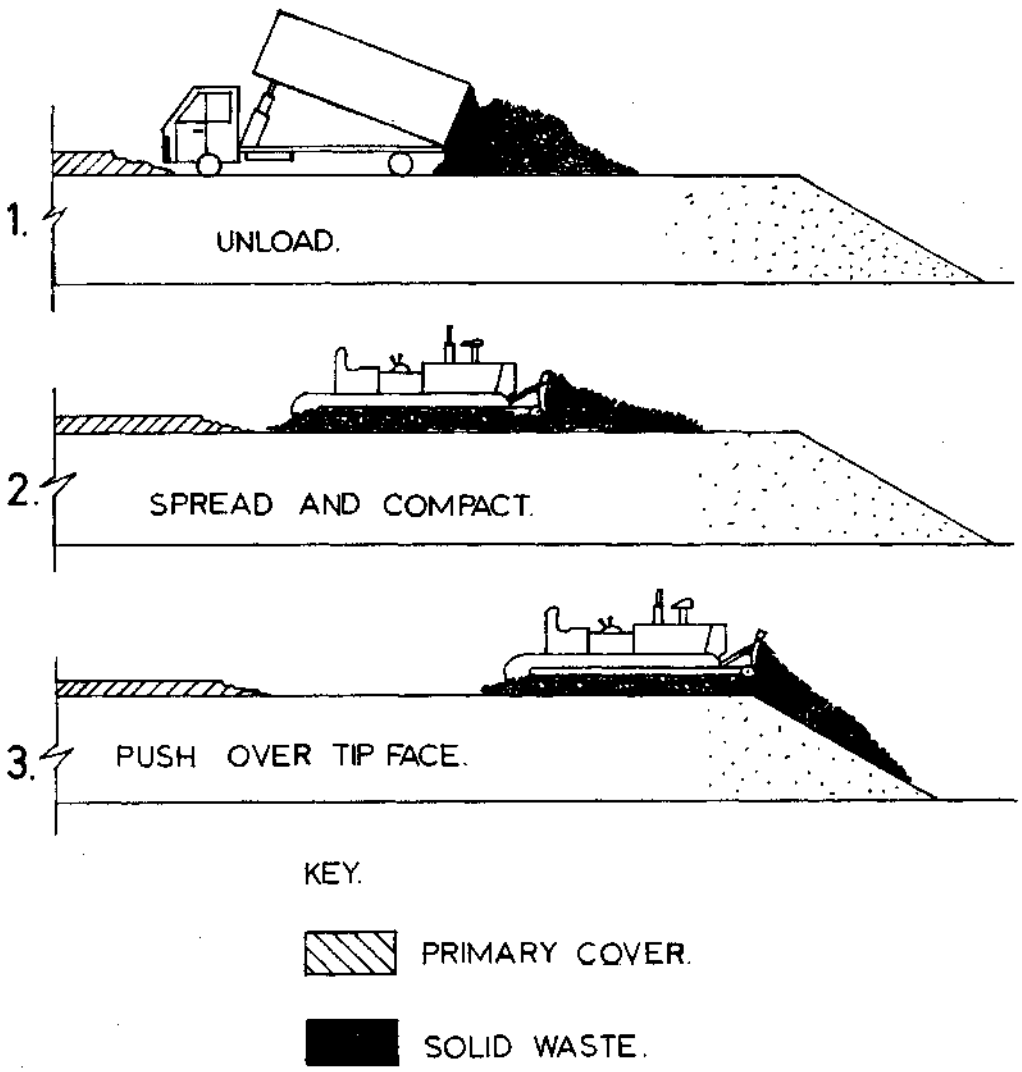


FIG. 2. FORMING TIP LAYER–METHOD 2.

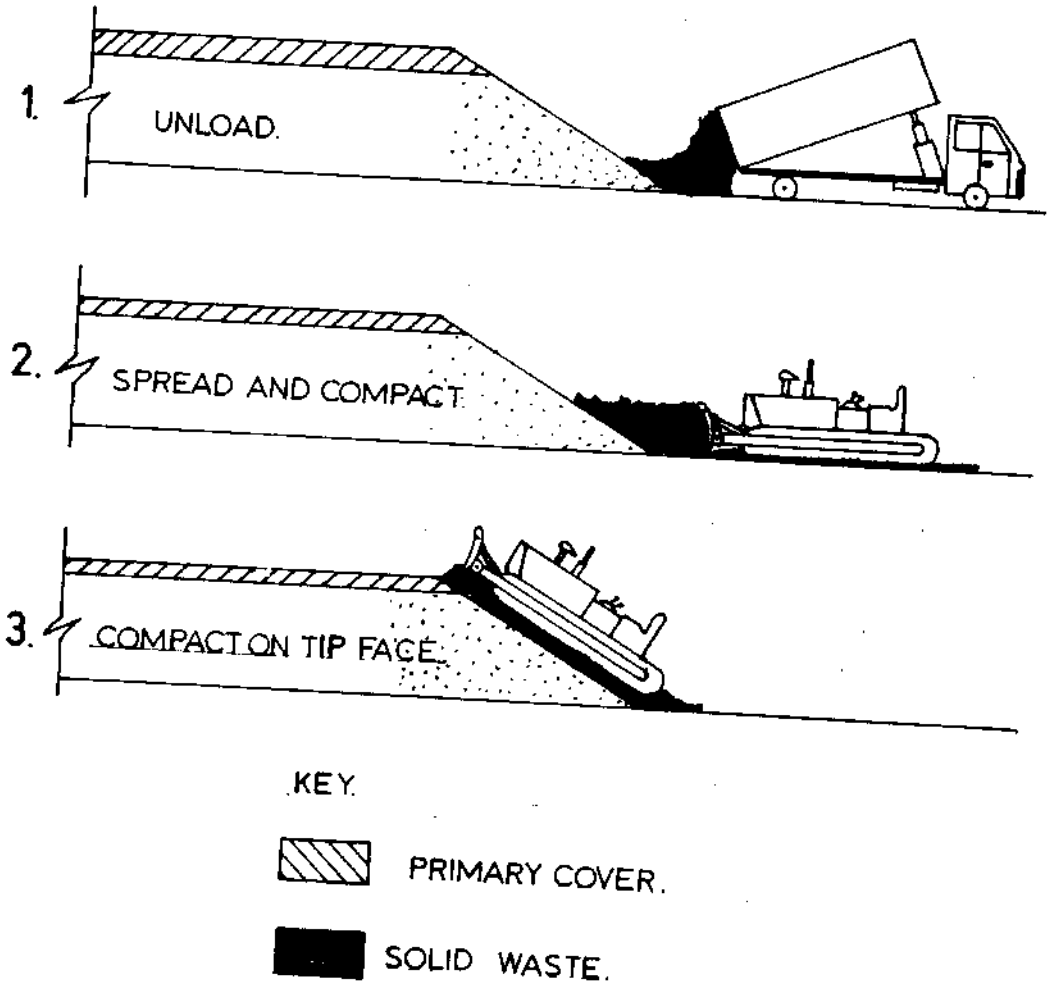
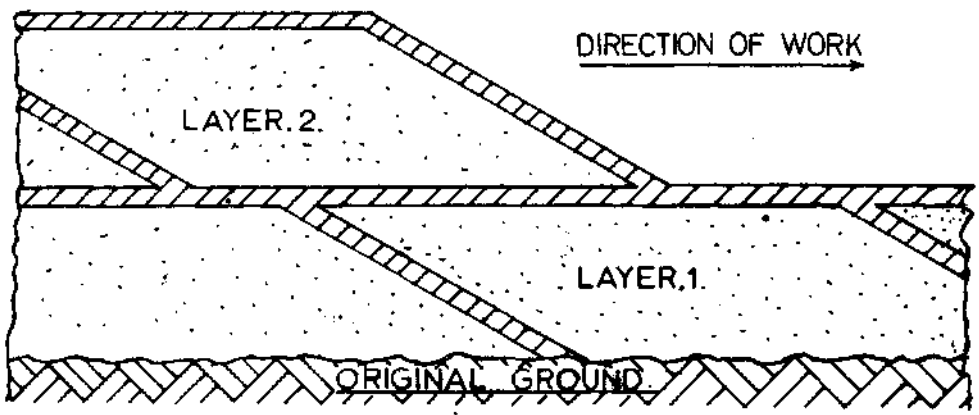


FIG. 3, FORMATION OF LAYERS—SOLID WASTE COMPACTED AND COVERED ON ALL EXPOSED SURFACES EACH DAY.



KEY.

PRIMARY COVER.

SOLID WASTE.

At sites where there may be a risk of water pollution, more rapid formation of subsequent layers would reduce the amount of percolate. In such cases the diffusion of the gases of decomposition may be retarded unless special measures are taken to ventilate the tip (see 7.3 (11)).

(4) The width of the tipping face should be sufficient to allow vehicles to discharge at peak periods without undue delay and without interference with the activities of the bull-dozer or other machines. In all cases the width should be restricted as far as is consistent with this requirement.

(5) As tipping proceeds the flanks and face of the tip should be consolidated to form gradients not steeper than 30 degrees by driving the bull-dozer up and down the flanks and tip face.

(6) Movable screens should be positioned near the tipping face to control wind-blown paper, according to the prevailing wind direction. The screens should be cleared of paper periodically.

(7) The tipped material should be progressively covered with suitable material on all exposed surfaces, including the face and flanks, by the end of each day. The object is to prevent flies from depositing their eggs on exposed putrescible material, to discourage vermin, prevent odours and to give the site a tidy appearance. Suitable materials include ash, sandy silt and soil or subsoil, not of a clay texture. The required depth of the primary covering layer will depend on the nature of the material, but should not be less than 15 cm.

(8) Each layer of refuse and covering material should have a slight slope to help rainwater to drain off.

(9) Large articles such as furniture or hollow containers should be tipped ahead of the tip face and crushed or broken up before being covered by other refuse. Scrap tyres should be laid flat on the base of the tip and subsequently filled and covered with other refuse.

(10) Refuse consisting wholly or mainly of animal or fish waste, condemned food or other obnoxious material, should be tipped in front of the tip face and immediately covered with other refuse so that the obnoxious material is not within 1 m of the surface or 2 m from the flanks or face.

(11) Where there is a risk of tip gases penetrating to adjacent land through fissured strata, this can be prevented either by interposing a barrier of impervious material between the refuse and the land or by forming a ventilating trench of gravel or other suitable material.

Another method is to insert perforated pipes into the refuse through the cover layer.

7. 4 Methods of dealing with special types of waste

7. 4. 1 Medical waste

Medical waste should not normally be received at controlled tips. However, in exceptional cases where no other method of disposal is available, it may be safely disposed of if contained in closed bags which should be deposited on the tip and immediately covered, as described in 7.3 (10) above.

7. 4. 2 Animal carcasses

The carcasses of small animals can be disposed of in the tip in accordance with the recommendations in 7. 3 (10) above.

7. 4. 3 Industrial waste

Where industrial waste is received at a site also receiving domestic and general municipal refuse, it should as far as practicable be incorporated with the refuse in forming the tip layer.

7. 4. 4 Radioactive waste

In certain cases small quantities of radioactive waste may be disposed of in a controlled tip, but this must only be done by special authorization from the appropriate authority and under the supervision of authorized personnel.

7. 5 Pest and odour control

Disposal of refuse in accordance with the recommendations of this Code will normally prevent problems associated with flies and other insects, odour and rats, and minimize nuisance from birds which may be attracted to a controlled tip.

7. 5. 1 Insects

The surface of the tip should be maintained in a level condition to avoid ponding which could give rise to the breeding of insects. If, in exceptional circumstances, it is necessary to employ insecticides, these should be used sparingly and according to prescribed procedures. Particular attention should be paid to exposed refuse and to any area where cracks have appeared in the covering material.

7.5.2 Rats

Tip operatives should be trained to recognize signs of rat infestation. At the commencement of a tipping operation arrangements should be made with the local public health authority for rat control procedures so that safe and effective methods may be practised.

7. 5. 3 Birds

Birds are sometimes attracted to waste disposal tips. Apart from being a nuisance, they can be a hazard to low-flying aircraft, particularly in the vicinity of an airfield (see also 3. 2).

Although special measures have been tried to frighten birds away, the most consistently effective measure lies in good tip control procedure, and covering all exposed waste as quickly as practicable.

7. 6 Fire precautions

No material should be burnt on or near the tip. Fires in tips should be regarded as emergencies and dealt with immediately. Any waste containing hot ashes when tipped should be segregated and quenched or covering material should be ploughed into it by the bull-dozer.

If a deep fire is discovered the affected area should be isolated by trenching and blanketing with inert material. It may be necessary to open up the affected area, by excavation and heavily douse the burning waste with water.

7. 7 Site maintenance

Site roads should be maintained in serviceable condition by filling in potholes regularly from stockpiled material. In dry weather, roads should be sprayed with water to suppress dust.

The site should be kept clean and tidy. Litter and loose material should be cleared regularly from the tip surface and surrounding area. Movable screens should be cleared frequently of paper.

Weeds should be cut down before they reach the seeding stage to prevent their spread to neighbouring land.

8. COMPLETION OF TIPPING AND FINAL RESTORATION,

8. 1 Final layer of waste material

In depositing the final layer of refuse, consideration must be given to the ultimate land-use. If restoration is intended for agriculture, the final layer should be free from bulky material or waste which might discourage vegetation, and compaction of the layer should be reduced to a minimum.

8. 2 Settlement

Before top soil or other final covering material is added, the tip should be allowed to settle. The time required for settlement will depend on the depth of tipping, nature of the material in the tip and amount of rainfall in the area.

When the final layer of waste and primary cover is in place an intermediate layer of subsoil (if available on site) may be added and subsequent depressions filled in with more subsoil. Uneven settlement should be made good to prevent drainage difficulties after final restoration.

8. 3 Top soil

If the site is to be used for open space or agricultural purposes a final layer of top soil will be required. For grassing, a thickness of 15-25 cm is sufficient, depending on the type and thickness of the underlying primary cover; if crop growing is intended a greater depth will be necessary and specialist advice should be sought. Where the supply of top soil is insufficient, it may be possible to use composted refuse, or de-watered sewage sludge mixed with top soil.

8. 4 Planting for site maintenance

While awaiting re-use, the surface should be sown with suitable grasses to prevent weed growth and soil erosion, and in very large sites this may be undertaken on completed plots before tipping on the whole of the site is completed.

CONTROLLED TIPPING SITE SPECIFICATION

(Name of municipality or operator)

1. Name of site:
2. Address and telephone number:
3. Location (ordnance co-ordinates):
4. Plans and contour maps attached:
5. Intended after-use:
6. Maximum ground-water level:
7. Site drainage:
8. Water protection measures:
9. Method of disposal or treatment of percolate:
10. Boundary fencing:
11. Site information boards:
12. Fixed installations:
13. Tipping plan:
    (1) volume of space available:
    (2) approximate daily intake of solid waste:
    (3) direction of working:
    (4) maximum width of tipping face:
    (5) bad weather or emergency tipping areas:
    (6) number of layers and depth of layer after initial consolidation:
    (7) thickness of primary cover:
    (8) thickness of final cover:
14. Types of waste excluded:
15. Instructions for disposal of special wastes:

16. Litter screens:

17. Lighting equipment:

18. Fire fighting arrangements:

19. Pest control measures:

20. Weed control:

21. Water sampling and monitoring arrangements:

22. Site security arrangements:

23. Final restoration:

24. Special instructions:

ECONOMIC CONSIDERATIONS IN THE SELECTION AND OPERATION OF CONTROLLED TIPPING SITES

Although the economics of disposal by controlled tipping are not directly public health considerations, it is considered appropriate to make some references here to economic factors which should be taken into account in selecting and operating a site, in order to achieve the best environmental results for a given financial investment.

Costs to be considered in planning and establishing a controlled tip may be summarized under the following main headings:

(1) site acquisition (purchase or lease);

(2) costs of investigation and preparatory site works;

(3) haulage costs of refuse collection vehicles (or in some cases, transfer and bulk-haulage costs);

(4) tip operating expenses;

(5) final restoration costs.

Account should also be taken of the increased value of land improved by controlled tipping, e.g., creation of a public park or recreational area.

Site acquisition

The site may already be owned by the disposal authority (in which case it may be given a notional financial value) or it may be purchased or leased. In estimating overall disposal costs, the cost of the site may be spread over the total estimated tonnage which the site is calculated to take.

Initial site works

Substantial costs may be incurred in preparing the site for use: road works, weighbridge, water protection, etc. These costs may be amortized over the life of the tip and its total estimated tonnage of solid waste. The capacity of the site for disposal purposes must be sufficient to justify the costs of site preparation. The economics of controlled tipping therefore generally favour the use of large-capacity sites.

Haulage costs

Haulage costs are involved in transporting the collected wastes to the disposal site, and as they will depend on the location of the site they should be regarded as part of the overall disposal cost for planning purposes. However, haulage costs must be kept separate from site disposal costs. Where alternative tipping sites are available, the more distant site could be more economical if initial site costs and final restoration

costs were likely to be much lower than those of a nearer site. Furthermore, the ultimate value of the land improved or restored by tipping may be a factor to be related to haulage costs.

Where the distance or journey time to the tip site for refuse collection vehicles is too great to be economic, a transfer station will be required. Savings in haulage costs will result from the use of large-capacity vehicles from the transfer station to the tip, but transfer activity will only be economically justified if the total operating cost (including capital charges) of transfer and bulk transport is less than the additional costs involved in transporting the refuse direct in collection vehicles.

Tip operating expenses

These are the direct and indirect expenses of operating the tip and include wages, plant operating costs, materials, lighting, heating, insurance, local rates, etc. In some cases, operating expenses may be partly offset by income received for the disposal of trade or industrial wastes.

Final restoration costs

These may include purchase and spreading of topsoil, removal of fixed installations and maintenance of the site (including making good any subsidences) for a fixed period, and any special requirements contained in the planning consent or conditions of lease.

Although restoration costs may not have to be met for many years ahead they may form a significant part of the total costs and should be taken into account when evaluating potential sites.

Records

Details of records to be kept in connexion with a controlled tipping operation will depend on local requirements, but some basic records are essential for the ascertainment of costs and for management control purposes. Examples of the type of basic records which could be used at the site are shown in Forms 1 and 2.

DAILY VEHICLE WEIGHT RECORD

Form 1

Site_____ Date: / /____

Signature_____

Vehicle No.	Time	Wastes		Weight in	Weight out (tare weight)	Amount delivered	
		Source*	Type**			Solid Waste	Cover material
Total							

Instructions; To be completed for each vehicle each time it makes a delivery. If a weighbridge is not available, an estimate of cubic metres is to be made.

* R = residential, I = industrial, C = commercial, A = agricultural, etc.

** H = household refuse, D = demolition/construction wastes, T = tyres, B = bulky waste - furniture, refrigerators, etc.

DAILY ACTIVITY SUMMARY

Form 2

Site_____ Date: / /____

Signature_____

Date	Solid waste		Cover material				Man hours	Machine hours		Site hours
	Loads	Tons	Begin	Rec'd	Used	Remain		Use	Down	
Total										

Instructions: To be completed by tip supervisor at the end of each day. Record cover material in either tons or cubic metres. Today[1] s beginning cover material equals yesterday[1] s remaining.

CHECK LIST FOR EVALUATION OF CONTROLLED TIPPING OPERATION

	Satis-factory	Not satis-factory	Remarks
1. Operational plan and site specification prepared			
2. Site preparation and equipment in accordance with plan and specification			
3. General method of working in accordance with plan and specification			
4. Site security			
5. Condition of site roads			
6. Control of tipping area and width of face			
7. Compaction and formation of layers to specified depth			
8. Depth of primary cover			
9. Primary cover completed each day			
10. Measures for handling special wastes			
11. Litter control			
12. General site tidiness			
13. Arrangements for bad weather or emergency working			
14. Employees' amenities			
15. Fire precautions			
16. Pest control measures			
General remarks			

ANNEX IV

DEFINITION OF SOME TERMS USED IN THIS CODE

(the terms are also given in French and Russian)

Controlled tipping (décharge contrôlée; Russisch—Russisch)

A technique for disposing of solid waste (including some sludges) on land in such a way as to avoid nuisance or risk to public health during the operation and after its completion. The technique (also known as "sanitary landfill") is based on the principle of compacting the waste in layers and covering each layer with suitable material as tipping proceeds.

Solid waste (déchets solides; Russisch)

All solid waste material (including sludges) arising from domestic and commercial premises, industrial processes, water and sewage treatment, requiring disposal on land.

Refuse (résidus urbains; Mycop)

Household, shop and commercial solid wastes normally collected by municipal authorities or authorized private collectors.

Pulverization (broyage (fragmentation); Russisch)

A mechanical process to reduce the average particle size of solid waste and render it more homogeneous.

Primary cover (couche primaire; Russisch)

Soil or other suitable compactible material spread on a layer of solid waste in order to prevent odour, insect and rodent infestation, and wind-blown litter. The primary cover also helps to limit the spread of fire, should this occur, and to reduce water percolation through the tip.

Final cover (couche finale; Russisch)

A layer of soil applied on top of the primary cover of the final layer of waste, to prepare the site for final restoration.

ANNEX V

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