



SHORT COURSE ON SOLID WASTES
COLLECTION AND DISPOSAL

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INTERIM REPORT ON THE EXISTING SYSTEM
OF REFUSE COLLECTION AND DISPOSAL
MUNICIPALITY OF DAMASCUS
SYRIAN ARAB REPUBLIC

by

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and

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INTRODUCTION

A ministerial Decree dated 29 June 1965 established a committee whose terms of reference were:

- (a) To study the existing situation relating to the collection and disposal of refuse in the Syrian Arab Republic;
- (b) To appoint a sub-committee for studying problems of refuse collection and disposal in the Municipality of Damascus; and
- (c) To instigate a pilot project of refuse collection and disposal in the Municipality of Damascus.

* WHO Sanitarian

** WHO Sanitarian Tutor

As part of its terms of reference, the committee was given the authority to collect all necessary information and could demand assistance from any Ministry or Municipality in the Syrian Arab Republic.

The inaugural meeting of the committee was held on 30 June 1965, and subsequent meetings of both the full committee and sub-committee were held on 6, 8, 17, 20 and 22 July 1965.

The Ministry of Municipal & Rural Affairs, being the responsible authority for the collection and disposal of refuse in the Syrian Arab Republic, co-opted to the Committee in addition to its own members, representatives from the Municipality of Damascus, Ministry of Health & Public Assistance, together with the writers. The appointment of the writers to take part in the study was approved both by the Ministry of Health & Public Assistance and by WHO Regional Office for the Eastern Mediterranean, through its Regional Adviser for Environmental Health (Mr. P. Stevens). The committee were able to call upon the services of Mr. P. Stevens for the first two meetings, who was able to indicate guide lines along which the proposed study should follow in the first instance.

Initially, the Secretary General of the Ministry of Municipal & Rural Affairs (Mr. K. Murallah) proposed that a study should be made of the existing facilities for refuse collection and disposal in the Municipality of Damascus. Stress was laid on the high cost of operating the existing service (amounting to approximately 20% of the Municipality's annual budget) and the need to provide a modern sanitary and efficient system of refuse collection and disposal, at the same time reducing the cost of the service.

Ensuing meetings were devoted to discussing practical problems encountered in collecting and disposing of refuse. A sub-committee was appointed, and relevant information was provided, as a result of a questionnaire which was prepared. In addition, the sub-committee visited all the central collection areas for refuse in the Municipality, as well as the refuse disposal site. Visits were also made to various parts of the city to see at first hand the operational side of refuse collection.

The writers were then requested to furnish the Committee with a report, outlining the existing situation, and indicating what further data would be required in order to secure an accurate report, that could be utilized when recommending an improved system of refuse collection and disposal for the Municipality of Damascus.

Bearing in mind that the Ministry of Municipal & Rural Affairs have approached WHO Regional Office for the Eastern Mediterranean, requesting the services of a short-term consultant to study the question of refuse disposal and refuse collection in the Municipality of Damascus. The writers have concentrated rather on presenting the facts, together with the available data; suggesting points that will require further study.

EXISTING SITUATION

The Municipality of Damascus which has an estimated population of 600 000, produces approximately 73 000 tons* (or 128 000 M3) of refuse per annum. With the exception of a small pilot project covering a population of some 5.000 persons (whereby refuse is collected from each individual housing unit by means of a rubberised container), all refuse is deposited by the householders onto the roadside. The method being employed is that of "dumping" all household refuse from the household container directly onto the roadside, for the refuse collector to collect and sweep up into "hand orderlies". The official times for householders to "deposit" refuse onto the roadside, are between 9 p.m. and 6 a.m. daily. Frequently, however, these times are not observed, and consequently the Municipality is faced with the problem of having to remove the rubbish from the roadside at all times of the day and night. This is done by employing refuse collectors on "round the clock basis", working three 8 hours shifts. As a result, over 1 200 persons alone are engaged as collectors, sweepers and drivers. This creates a heavy financial drain on the Municipality's financial resources, costing approx. S.L. 3 500 000 per annum (or S.L. 43.30 per ton).*

* Data supplied by Municipality of Damascus.

refuse, the existing method employed is quite in-sanitary, and does not conform to present day practices for refuse collection. For instance, it is observed that the rat and stray dog population of the city are well nourished from the refuse that is left lying around uncovered (even though the refuse is collected at frequent intervals), and this in itself is a potential health hazard to the community. It must be mentioned, however, that from observations made, the population appear to be satisfied with the present system, whereby refuse is just thrown out, and speedily collected. Apart from the potential danger to health, this system is an expensive luxury.

Refuse collectors are provided with "hand orderlies", consisting of 2 covered bins on a metal frame with wheels that have rubber tyres. In practice these "orderlies" carry from between 2 to 3 times as much refuse as they are intended to. This is effected by removing the bin covers, and increasing the capacity by means of inserting long sheets of tin or cardboard, - a practice at which the collectors are very adept. So that in effect, refuse is carried through the streets in open containers. This method has to be adopted if all the refuse is to be collected in the time available, as the "hand orderlies" would soon become full, necessitating additional visits to the central collection points, thereby reducing the time available for actual collection of refuse.

In the Municipality, there are 8 central collection points for refuse. To these centres all refuse is brought by means of hand orderlies. With the exception of one centre, all the collection points are open sited (not enclosed or covered). At these sites, refuse is loaded by hand into covered refuse vehicles (side loading type). For this purpose 15 lorries (5 M3 capacity) and 2 lorries (2 M3 capacity) are employed; in addition 6 landrovers with trailers are also used. As the frequency of collection from the central collection points to the refuse disposal site is frequent, little or no nuisance arises from these sites. No rats were observed in the vicinity of these sites.

The average distance that the refuse collecting vehicles have to travel from the central collection points to the refuse disposal site is approx. 12 kms. The site is located to the South West of the City. A good surfaced all weather road is available right up to the site. A staff of some 10 persons

are employed at this site, for the purpose of emptying, burning, and levelling of refuse, and an attempt is made at some form of controlled tipping. However, the lack of mechanical levelling equipment makes it impossible to achieve controlled tipping, as only occasionally is mechanical equipment made available at the site. The tip was observed to be continually smouldering, and the presence of persons "seavenging the tip" for bottles, paper, rags, bones, etc. was observed. Little or no attempt is made at covering the refuse with soil. The tip is used to some extent as a source of compost for farmers, and the Municipality allow farmers to utilize the compost from the tip free of charge.

SUGGESTED METHODS OF REFUSE COLLECTION AND DISPOSAL

(a) Refuse from household to roadside

The first consideration will be that of ensuring that refuse is deposited by householders into covered refuse containers, from which the refuse will be collected. On health grounds alone, the present system whereby refuse is indiscriminately thrown onto the roadside should be discontinued.

It being agreed that a container should be provided, a decision has to be taken upon:

- (i) Whether each individual family should be required to provide a sanitary refuse bin; or
- (ii) Whether the Municipality should provide each individual family (householder) with a sanitary dustbin, either free of charge or at an annual charge; or
- (iii) Whether it would be better to provide bulk refuse containers, sited close to dwellings and capable of containing refuse for approx. 5 families (30 persons). (The responsibility of providing bulk containers would be that of the Municipality); or
- (iv) Whether a combination of these proposed methods will be necessary, depending on the locality, type of buildings, width of streets (accessibility), terrain (hilly districts), etc.

An important consideration when making the decision as to which method will be employed, is that of deciding whether the present system of daily

collection will be continued, or whether a system of collecting refuse on alternate days should be instituted. This decision in itself will have an important bearing on the cost of the scheme, and will influence the size of the receptacles to be used. As a point of interest, it is understood that for the past few months, no new plans for apartments submitted to the Municipality have been approved unless they have made provision for a dust or refuse chute.

(b) Refuse from roadside to site of disposal

In determining the method to be utilized in collecting refuse from the household/roadside, and conveying same for final disposal, we again are faced with alternative methods that might be employed:

(i) Should individual family bins be adopted, it might be feasible to continue using an increased number of "hand orderlies". The orderlies when full being emptied into "Dempster" type containers (6 or 8 M³ capacity). These large containers would have to be strategically sited throughout the city. The number and size of Dempster containers would depend on the volume of refuse collected daily. If this system were adopted, and assuming an 8 hours working day was instituted instead of the present 24 hours system, it would result in not so many personnel becoming redundant, as would be the case if refuse vehicles were used to collect the refuse from the road side. However, instead a saving would be effected by using fewer vehicles.

Briefly, the Dempster system consists of large metal containers, with loading doors situated at the front back or top. These containers which range in size from 6 M³ to 12 M³ are easily picked up by a vehicle and taken to the refuse site where the contents are dumped. The vehicle returns the empty containers to the collecting site. All this operation can be undertaken by one man (the driver of the vehicle). One such vehicle is capable of transporting several containers daily to the refuse disposal site. This is a comparatively new system, and is being successfully employed in many parts of the world.

(ii) Individual family bins could also be collected by refuse vehicles from the roadside. This being the most common practice of refuse collection used today. The main consideration in deciding whether refuse vehicles would be the answer for Damascus is:

- (a) The type and capacity of the vehicle; i.e. side loading, rear loading, with or without compression. Optimum capacity in relation to the amount of refuse that can be collected in a normal working day (weight/volume). With or without automatic loaders.
- (b) Capital outlay (i.e. number of vehicles required), and whether a saving would be effected by operating refuse vehicles.
- (c) The social problem faced by having to reduce drastically the number of staff presently employed.

Rear loading is now generally accepted as essential for refuse collecting vehicles, as it is impossible to get maximum "body filling" with side loading vehicles. Narrow streets also present a problem to side loading vehicles.

(iii) With the use of bulk refuse containers being provided jointly for separate families, the immediate problem faced is in deciding how many containers would be required, size of container, and most important of all the siting of containers. The latter consideration will require a detailed survey of the city, in order to secure reasonably accessible siting of the containers. Another factor that must be mentioned is education of the public which must go hand in hand with the scheme of bulk refuse containers, - as in many instances it will be easier for the public to deposit the refuse at the nearest point outside their premises rather than walk a short distance to the container. This practice will be difficult to combat, as this has been the official way of depositing refuse in Damascus, and the public will see no wrong in continuing the practice.

It is felt that if the bulk refuse container is adopted for Damascus (or part of the city), they should be of the dustless type, i.e. having hinged lids and used in conjunction with special "dustless" loading vehicles. Summarized are the advantages and disadvantages of a system of dustless refuse collection:

Advantages

- i. Permanently covered storage for refuse (having hinged lid)
- ii. Reduction in fly nuisance

- iii. No spillage of refuse or dissemination of dust around the bin stance at time of collection
- iv. Provision of standardized dustbins in lieu of a wide variety of containers
- v. No exposure of refuse during collection
- vi. Cleaner working conditions for refuse collectors, with a reduction in damage to uniform clothing
- vii. Higher loading rates, no lid to take off

Disadvantages

- i. Substantial initial outlay
- ii. Greater weight of special bins where steel bins are used
- iii. Increased administration (if no municipal bin- scheme is in operation.

Where dustless loading is required using special bulk refuse containers, a totally enclosed hopper and continuous loading mechanism are essential features of body design for the refuse collecting vehicle. A popular vehicle of this type would have a rear loading body of nominal capacity of up to 25 M³ with compaction mechanism which would enable some 40-50 M³ of refuse to be loaded. Most compaction devices are "continuous-loading", i.e. a loading/compression plate is actuated by a reciprocating hydraulic ram at a rate of 6 strokes per minute. Owing to the larger size of refuse container used it would probably be necessary to fit bulk container loading equipment to the vehicle.

From the foregoing, it can be seen that refuse can be taken to the disposal site:

- (i) By vehicle carrying "Dampster" containers, one such vehicle could carry several such containers daily to the disposal site during the course of a working day;
- (ii) By the refuse vehicles every time they become fully loaded.

(c) Disposal of refuse

At present the existing refuse disposal site presents little problem, as although very accessible to the city, it is situated in rural surroundings.

Such difficulties that exist could easily be overcome with the provision of a bulldozer type machine, and a vehicle for carrying top soil coverage. These measures together with planning of extension of controlled tipping measures would solve the immediate problem of disposal of refuse, and could be undertaken at relatively little cost to the Municipality.

Allowing for the growth of Damascus both in population and area, it may then be desirable to discontinue using the present tipping site, instead utilizing another method of disposal. Methods to be considered would include:

- (i) Incineration of refuse
- (ii) Composting.

For some time now, the Municipality has been interested in the possibility of composting refuse, and a site has already been allocated. The plan is to situate the composting plant in close vicinity to the proposed site for the Damascus Sewage Plant, also close to the proposed new abattoir. This would appear to be a very sound scheme, but a consideration that must be fully investigated is the economy of such a plant, i.e. whether there would be a market for the sale of compost in order to justify the capital outlay of constructing such a plant. Otherwise, the composting plant would become a liability to the Municipality, and a costly method of disposing of refuse.

OBSERVATIONS MADE ON DATA PROVIDED

From information supplied, the Municipality of Damascus have to collect and dispose of 200 tons of refuse per day, which is equal to 333 gms per person per day. The average size of a family in Damascus is 6 persons, therefore if a dustbin were to be provided for each family, each individual container would have to be large enough to contain at least 2 kilos for a daily collection or 4 kilos for alternate day collection. From figures supplied, the weight volume ratio is 100 kgs/0.175 M³. Therefore a family would be expected to discharge approx. 2 kilos/0.00350 M³ per day. This is an extremely high weight to volume ratio. However, if these figures are correct, a family dustbin (normal size) of 0.06 M³ would deal with refuse from one family for one week. This, however, would not be practicable owing to the odour nuisance

that would arise during the hot season, when refuse was kept for several days. On the other hand, collecting such small amounts of refuse per day would be an expensive luxury (as it is at present).

It is suggested therefore, that in the first instance, the figures relating to the amount of refuse collected in relation to the volume should be very carefully checked. The check should be a physical one, and it is suggested that the weight and volume of 150 full loads, using the existing vehicles of 5 M³ capacity should be instituted. Without accurate information on this subject, all calculations and consequent suggestions would be valueless, and highly misleading. Similarly refuse collected in hand orderlies should be checked, so as to arrive at a figure of weight/volume per thousand persons.

The writers believe, that if a system of individual dustbins for every family were instituted, collection of refuse on an alternate day basis could be possible without causing any undue nuisance or inconvenience to the householder. In the first instance, however, it might be advisable to operate this system on a trial basis in the form of a pilot project. It has been found that when the question of deciding whether the dustbin should be provided by the householder or the Local Authority, the latter course (while incurring a high initial capital outlay) is the most effective, as by this means, it is ensured that every householder is provided with a regulation type covered dustbin, this immediately reduces theft to a minimum. To offset the initial capital outlay involved, the Municipality might consider the possibility of instituting a statutory annual rental charge for the dustbins. For example, a charge of upto L.S. 5 per annum is instituted by many local authorities in Britain. A life expectancy of 3 years would not be considered excessive. It would be the responsibility of the Municipality to provide replacement dustbins, in cases of loss, damage and normal deterioration.

Assuming that the system of providing individual dustbins was adopted, some 100 000 dustbins would have to be provided for families alone, in addition, institutions, schools, business premises, would have to be catered for (say an additional 10 000 dustbins). A reserve supply of dustbins (say 10%) should also be produced, making in all a total of say 120 000 dustbins. While the

cost of dustbins are not yet to hand, let us assume the price of each small dustbin to be L.S. 20, the total cost would amount to L.S. 2 400 000. If a charge of L.S. 5 per annum was instituted by the Municipality, the actual cost to the Municipality for purchasing bins (assuming the life expectancy of a dustbin to be 3 years) would be in the region of L.S. 600 000. A decision would have to be taken whether bins should be manufactured in the Syrian Arab Republic, or whether tenders should be invited for the supply of dustbins from abroad. Whether the Municipality decides to provide dustbins or insist that householders provide covered dustbins (of approved specification), dustbins should be of uniform standard and size.

Considering the case for bulk refuse containers, it is thought that one large dustbin (covered) having a capacity of 0.3 M³ would be a suitable size for 5 families. The larger container is favoured by the Municipality. It is estimated that in the region of 30 000 such containers would have to be provided by the Municipality. Again no costs are yet available, but assuming the cost per container to be L.S. 50, the cost to the Municipality would be L.S. 1 500 000. The cost of this would have to be borne solely by the Municipality, as it would be impractical to charge for refuse bins that are used on a communal basis. Such bulk containers although having a capacity of 0.3 M³, could only be safely spaced to deal with 5 families on an average, who produce 0.025 M³. To have a container any smaller would be inviting it to become "lost". Therefore such containers would only be 1/10th full every day.

In estimating the number of vehicles that might be a need to operate a daily scheme of refuse collection, a typical vehicle might be one having a rear loading body of nominal capacity of 25 M³, with compaction mechanism which will allow some 40 M³ of refuse to be loaded. From the data supplied by the Municipality, it must be assumed that 1 ton of refuse = 1.75 M³. The nett weight (maximum) that could be carried by such a vehicle would be 10 tons. Therefore the maximum amount of refuse by weight that could be collected would be the equivalent of $\frac{10\ 000\ \text{kilos}}{0.3\ \text{kilo}} = 30\ 000$ persons.

Therefore in fact, a vehicle having a capacity of 10 tons would be able to carry by weight the equivalent of refuse from 30 000 persons, which by volume

would be equivalent to 17.5 M³. So if these figures are correct, no compaction would be necessary.

Taking this hypothesis a stage further, let us assume that one vehicle having a staff of 1 driver, 2 loaders and 2 collectors (5 staff in all) are able to collect 40 bins per man hour, then one vehicle will collect 160 bins per hour or 1280 bins per day of 8 working hours. Allowing for the fact that the vehicle will make one journey to the refuse disposal site, one hour should be deducted from the collection time, with the consequent reduction of bins that can be collected in one day (of 7 hours) to about 1 000. Therefore assuming the amount of refuse in a "single family" dustbin to be 2 kilograms, the amount of refuse that could physically be collected in one day is 2.2 tons or 3.85 M³, or put in another way, the equivalent of refuse from 6 600 persons.

If these figures were correct, it would require about 100 vehicles to collect 200 tons of refuse. The very results given serve as a good reason why further research should be made to obtain the most accurate data available.

DATA PROVIDED BY THE MUNICIPALITY OF DAMASCUS

Population of Damascus Municipality (1960)	491 398
(1963)	544 712
This represents an annual increase of 31/2%	
Estimated population of Damascus Municipality (1965)	600 000
Number of families	101 632
Total number of buildings	80 000
Total number of hotels and pensions	308
Total number of restaurants (all kinds)	1.249
Total number of food shops	6 602
Total number of pharmacies	83
Total number of hospitals	20
Area of Municipality	101 Km ²

Number of staff engaged on refuse collection and disposal

Collectors	695
Sweepers	176
Drivers	40
Workers at disposal site	10
Administrative personnel	8
Others (sick, on leave, unemployed)	300

Number and type of hand vehicles used

Cycle type orderlies	45
Hand orderlies	324

Number of motorised vehicles used

Covered 3 ton lorries (5 M ³ capacity)	15
Uncovered 1 ton lorries (2 M ³ capacity)	2
Covered Land Rover vehicles with trailers	6
Number of central collecting points	8
Average distance of refuse disposal site from central collecting points	12 Kms
Income derived from collection of refuse	nil
Average number of tons of refuse collected daily	200 tons
Cubic capacity of refuse collected daily	350 M ³
Cost of collection per ton	L.S. 43.30
Cost of Collectors and sweepers salaries	L.S. 3 185 956.
Drivers salaries	L.S. 142 355
Fuel costs	L.S. 66 297
Maintenance and repair costs	L.S. 52 000
Oiling and lubrication	L.S. 5 400
Brushes, protective clothing	L.S. 40 000

Composition of refuse % by weight of items

Vegetable matter	54
Paper	5
Rags	3
Metals (ferrous and non-ferrous) .. .	2
Kitchen waste	15
Bones	3
Glass	12
Dead animals	1
Unclassified debris	5

<u>Composition of Refuse</u> (by weight)	%
Moisture	52
Inert materials	29
Combustible materials	19
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	100%
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