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Domestic Solid Wastes Production and Containers Application in Temporary Storage in Khartoum State, Sudan

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ABSTRACT

One of the most pressing ecological issue in Khartoum State is domestic waste material storage with the absence or improper treatment of daily produced solid wastes from households in the state. This matter hasn`t been resolved in Sudan with providing the proper solutions addressing establishment of waste storage system through variable types of waste containers.
The main outcomes of this study are the revelation of the nature of domestic waste materials and containers used at household level which is the most important stage in waste management and systemization of the proper handling of domestic waste products.
This study was conducted with the aim of studying the nature of current domestic solid waste produced and containers used at house-hold level in Khartoum State, as well as studying the current system of waste storage containers through the sources of secondary data, covering the different locations in its three provinces.
The methodology of this research is based on a field research questionnaire in addition to field visits and visual inspections of current situation of processing the domestic waste materials inside and outside houses and they were distributed in the targeted quarters. The results were analyzed and discussed accordingly using Statistical Package for Social Science (SPSS) program.
It has been found that, the organic nature of domestic waste materials produced in Khartoum State is dominant and containers used for temporary storage of domestic waste materials at house hold levels is through plastic bags.

Keywords: domestic solid wastes, containers, garbage, plastic bags, barrels, food leftovers.

1. Introduction

1.1 Domestic Waste Materials

Domestic waste materials are the garbage and wastes discarded nearly every day in the shape of Food residues, glass, vegetables and fruits, ash, earth and dust, wood, papers, minerals and plastic. And they are the solid byproducts resulting from the day-today human activities.

It is important to mention that the domestic and food waste materials represent all wastes produced by families and housing complexes as well as food leftovers of houses, flats and restaurants resulted from food handling and processing (P. Aarne Veslind, *et al* , 2002).

The important properties of this type of waste material is their aptitude to putrefaction and organic disintegration during summer season resulting in offensive odour that facilitate propagation of flies and other insects. (Maria Muller, 2001)

1.2 Categorization of Solid Waste materials

One of the most important categories according to the waste materials contents is as follows:

a. Describing the waste materials according to the material type or source.
b. Describing the waste material according to type's analysis and the possibility for processing such as:

- Burnable and fertilizable materials
- Organic waste materials from the kitchen, fruit wastes in its all types, papers and paperboards and hay.
- Bones and tissues after decomposition
- Burnable materials: wood, solid paperboard, skin, rubber and plastic.
- Non-fertilizable or burnable materials
- Glass, porcelain, stones and bricks
- Iron and other minerals
- Small particles burnable and fertilizable materials (P. Aarne Veslind, 2002)

Table 1-1: Shows waste materials categorization according to particles size and its situation after sieving.

Category	Classification	Size mm
First	Small size waste material	Less than 8
Second	Medium size waste material	8 - 40
Third	Coarse waste material	40 - 120
Fourth	Sieve remains waste material	More than 120

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The most important waste properties are as follows:

- Material properties (particles size, contents, usage and purity)
- Natural properties (waste contents, moisture, particle size, chemical contents, biological properties) these properties affect the designation of collection, processing and disposition systems of waste materials as well as managerial frameworks of units and their performance.
- Containers, in general, are vessels used to store the variable waste materials temporarily sooner to be disposed of. And waste materials containers are all types of vessels used for garbage collection from its sources, whether domestic, commercial or industrial till being transported and disposed of in the specified locations.

1.3 Assessment of Waste materials contents

1.3.1 Quantity assessment through element determination

The waste material quantity can be assessed using the statistics of the industrial and commercial production through input method by knowing the gross production and deducing that all products should be discarded or recycled. This method is viable for assessing the elements quantity in the waste material and determines it when data and statistics acquisition is facilitated by organizations and firms that have the financial, managerial and technical capabilities to undergo the routine task of data collection (Ecology, 2005).

1.3.2 Product analysis method (output)

For the local level, the most suitable method for assessing the quantities of waste materials and elements determination is output analysis method and undergoing case studies for manually collected samples and photographic ones (through a part of waste material and photo analysis) (Justine Anschutz, 2001)

1.4 The Physical Properties of Waste materials

The physical properties of waste materials affect designing the devices used in keeping wastes and garbage, transport, processing and purification. The most important properties are weight, thermal value, angle of repose (rest), moisture content, mineral intensity, particle size distribution and density.

1.4.1 The single contents

Table 1.2 shows the optimum contents found in waste materials and any number of these contents can be chosen but those mentioned in the table are easy to be determined as stated in textbooks and references about waste materials. Also, they are considered as sufficient to determine the waste materials properties for relevant processes.

1.4.2 Volatile solids

They are found through loss upon burning and crushing of solid material. Then the sample is flamed to 550 °C for 4 hours. The lost part of weight is represented by the volatile materials that include fragmented and non- fragmented organic materials.

1.4.3 Angle of repose (rest)

It is the horizontal angle that made the materials piled and aggregated without being slipped. The sand has angle of repose 35° depending on the moisture content. And for waste materials, it is 45°- more than 90° depending on the changes in density, particle size and moisture content.

Table 1.2: Shows the water materials properties

	Percentage mass	
Content	**Range**	**Optimum**
Food leftovers	6 -26	14
Papers	15 -45	34
Board papers	3 - 15	7
Plastic	2 -8	5
Textiles	0 -4	2
Rubber	0 - 2	0.5
Skins	0 - 2	0.5
Garden shrubs	0 -20	12
Wood	1 - 4	2
Mixed organic materials	0 - 5	2
Glass	4 -16	8
Tins	2 - 8	6
Non-iron minerals	0 -1	1
Iron minerals	1 - 4	2
Dirt, ash and bricks	0 - 10	4

1.4.4 Moisture content

The moisture content of the waste materials is needed to be known for analyzing the burial fluid production and designing of transportation systems materials to burial place. The moisture content changes from dustbin to the vehicle in regard to time. The newspapers and publications contains 7% moisture content weight upon laying them on waste receiver device but their moisture content surpass 20% upon taking

them out from garbage vehicle. The moisture content is referred to for its importance in burning of waste materials and obtaining gaseous burns or upon directly incinerate them. (P. Aarne Veslind, 2002)

Table 1-3: Shows the moisture content of the domestic waste materials changes considerably

	Moisture content	**Percentage mass**
Content	**Range**	**Optimum**
Tins	2 - 4	3
Board papers	4-8	5
Particles (Earth ..etc)	6-12	8
Food leftovers	50-80	70
Glass	1-4	2
Grass	40-80	60
Skins	8-12	10
Non-iron minerals	2-4	2
Leaves	20-40	30
Papers	4-10	6
Plastics	1-4	2
Iron minerals	2-6	3
Rubber	1-4	2
Steel cans	2-4	3
Textiles	6-15	10
Wood	15-40	20
Square sweeps	30-80	60
Garden shrubs	30-80	60

The moisture content of the waste material changes inside the garbage vehicle due to moisture transference operations among contents. It is observed that the paper assimilates most of dirt liquids raising its moisture content. This reality change the moisture content of the waste materials compared to its value before collection and compaction in garbage vehicle.

1.4.5 Particle size

The particle size of waste materials is important for materials reclamation, especially upon using the mechanical methods such as sieve and magnet. Also, the particle size of waste material entering the burial affects handling, transportation and processing. The particle size is difficult to be determined and classified for the waste materials that are attributed to irregular shapes of particles in the wastes mix. For good management of waste materials, it is important to know the change in particles percentage in terms of number and quantity. The particle size depends on the average particle size which is known as the diameter when 50% from particles (in weight) is less than this diameter. (P. Aarne Veslind, *et al*, 2002)

1.4.6 Bulk and material density

The bulk and material density is useful to assess waste material quantity in some cases and to assess health burial coverage materials. The waste and garbage alternating density that is dependable on the applied compaction. E.g. the fragmented wastes as disposed by owner has material density within 90 to 150 kg for cubic meter. Upon being dump into the dustbin, it may reach 180 kg/m^3. and inside the garbage vehicle where it is compacted, it may reach 350 kg/m^3 and 420 kg/m^3 when it is laid on the dump area, the density rises to 700 kg/m^3, 1000 kg/m^3 for the area of healthy embankment that has good compaction. The waste materials density decreases upon increase of the economic development level from 400 to 200 kg/m^3 due to the little paper density and increasing food leftovers and ash.

Table 1-4: Shows waste material bulk density

Waste state	Density	(kg/m^3)
Fragmented waste materials (not compacted …etc)	90-180	130
Inside waste materials compaction vehicle	350-600	300
Bale refuse	700-900	800
Health dumping wastes (uncovered)	450-750	480
Food leftovers	120-480	290
Paper	30-130	85
Paper board	30-80	50
Plastic	30-130	65
Textiles	30-100	65
Rubber	90-200	130
Skins	90-260	160
Garden shrubs	60-225	105
Wood	120-320	240
Mixed organic mix	90-360	240
Glass	160-480	195
Tins	45-160	90
Non-ironic minerals	60-240	160
Ironic minerals	120-1200	320
Dirt, ash and bricks	320-960	480

1.5 Mechanical properties

It is beneficial knowing the mechanical properties of waste materials to evaluate the alternative operations and options of resuming energy concentrating on pressure strain, strain curve, reaction of some materials and elasticity coefficient.

1.6 Chemical composition of waste materials

Knowing the chemical composition of waste materials is beneficial for economics of material and energy reclamation. The methods used to determine the chemical composition of waste materials are as follows:

1. Proximate analysis: For determining the organic volatile materials and fixed carbon in waste materials.
2. Ultimate analysis: It depends on the components of elements. The marked difference and change are noticed in waste and that is due to its inhomogeneous nature, geographic and temporal changes.

The volatile solids could be assessed upon inflammation to 550°C for long hours then cooling in drier. The lost part in volatile organic material weight including the fragmented and non- fragmented organic materials.

Table 1-5: Represents optimum data of ultimate analysis of optimum waste material contents from locality wastes of burnable contents

	Percentage in mass (upon dry basis)					
Component	**Carbon**	**Hydrogen**	**Oxygen**	**Nitrogen**	**Sulphur**	**Ash**
Food leftovers	48	6.4	37.6	2.6	0.4	5
Paper	43.5	6	44	0.3	0.2	6
Board paper	44	5.9	44.6	0.3	0.2	5
Plastic	60	7.2	22.8	-		10
Textiles	55	6.6	31.2	4.6	0.15	2.5
Rubber	78	10	-	2		10
Skins	60	8	11.6	10	0.4	10
Garden shrubs	47.8	6	38	3.4	0.3	4.5
Wood	49.5	6	42.7	0.2	0.1	1.5
Mixed organic materials	48.5	6.5	37.5	2.2	0.3	5
Dirt, ash and bricks	26.3	3	2	0.5	0.2	68

1.6 Heat value

The heat value is beneficial for resources reclamation. It is elaborated in kilojoules/kilogram and assessed in calorimeter where the sample is burned and the increase in temperature is recorded and through knowing the sample mass and produced heat from burning, the heat value is calculated.

1.7 The Biodegradability

It is one of the most important biological properties of respiratory activity and ability of gas production. Generally, 45% of waste materials is easily to decompose. Thus, processing frameworks should be thought of for biologically

non-degradable materials to be disposed suitably and beneficially (Arnold van de Klundert, *et al*, 2001).

For determining the waste materials properties, the methods illustrated in the standard characteristics including sampling and preparation as well as experimentation to know the property under test. For the practical life doesn't cope with sample taking within measurement perspectives and field reality. Table 1-6 shows examples for some requirements.

Table 1-6: Shows requirements for sampling (3)

Test	Sample quantity	Sample preparation requirements
Assessing the dry leftover and moisture content	No fixed value but it is suitable obtaining 0.5gm from the dry leftover. For practical reasons, obtaining 25gm or more up to 500 gm to repeat the experiment for many times.	● Primary drying is not needed ● Water should not be lost during sample preparation
Elements detection through digestion by acids	Less than 5gm. For practical reasons, obtaining 400gm or more up to 500 gm from the dry material	● Least size of particles especially melting resistant samples ● Drying is allowed to 40C as maximum ● Evading the loss of volatile elements
Soil wash response test	Approximately 100 gm from the dry material	● No drying ● Evading the loss of volatile elements upon drying ● Crushing and mincing is allowed for obtaining the right particle size.

1.8 Domestic waste materials containers

It is any item that contains subjects and the waste materials contains garbage from its variable sources temporarily till being discharged in the specified locations. These containers can be domestic ones such as plastic bags or any plastic or suitable size metal containers to store the domestic waste materials for three or four days. (Ecology, 2005)

There are many types of containers used to store street, market, factories and other institution waste materials according to the need and size.

1.8.1 Modern containers

With the development of the town and increase in its buildings, the containers in their previous shape have become unsuitable and practicable to accommodate the waste materials produced from its variable sources. So, it is a necessity to find suitable alternatives coping with the development in the field witnessed regionally and globally.

1.8.2 Globally used waste materials containers

There are many types and sizes of containers used globally and regionally and they have become insisting requisite for towns cleaning in the eve of enormous development witnessed in modern technologies. The manufacturing of such containers with their versatile shapes, colours and capacities made additive value to houses, streets and institutions. Many amendments were added to them to present spillage of waste materials, propagation of insects and emission of offensive odours and disparagement of town public scenery.

Tacit movement and discharge were taken into consideration in manufacturing these containers to become highly effective. They start from merely plastic bags for houses, plastic or metal containers in attractive shapes and easy to use.

Figure 1-1: Shows the plastic waste containers used per houses and streets

- Using such containers ensure sorting from the source and consequently facilitate the post collection operations of waste materials in terms of recycling.
- In case of multi-storey buildings, some containers were invented to be laid under the building in suitable engineering way to accommodate the dumped wastes easier and timely.

There is no typical shape of such containers but it depends on the design of corporation performing waste materials management. However, the common measurement is 6 square yard, towards the suitable size for the quantity of sorted waste materials.

In the streets of institutions, many containers have invented to suit the purpose of manufacturing and they have attractive shapes and colours, besides they are easier to use and discharge in small offices. This is in addition to baskets with variable capacities.

In hotels and large financial institutions, more advanced types of containers are used and the aesthetical aspect of them is common and practicably plays the same role of other regular containers.

Figure 1-2: Shows the waste containers used per streets

Figure 1-3: Shows the waste containers used in parks

In parks and beaches, containers are used to aesthetics and to prevent animals from tampering with its contents.

In the streets, many types of containers are used such as bags in a very simple and practical way and some of them is very good for accommodating all types of street waste materials. The sizes of these containers start with the housing 40 liter containers to even the huge installed capacity of up to more than $30m^3$, and some of these containers are like intermediary stations where appliances for compressing waste materials are installed to reduce its size and some of them are discharged through compressors and other through hooks and other through tractors. (Justine Anschutz, 2001)

1.8.3 Evaluation of using containers

Needless to say that the container has become necessary and the best way to deal with waste in all stages and locations of its production, is it used for the temporary storage and helps reduce labor and prevent scattering of waste and reduce health risks. Before starting the use of containers, waste materials were accumulated in dump places of mounds of rubble and dust subjected to being scattered by the wind. And some form was a gathering of stray animals besides distorting the view of the city. It became a fertile ground for the breeding of flies, insects and vermin (Dulac, 2001)

1.8.4 Estimating the required number of containers

For the work to return back on its track. The work through the container system should be readopted and accurate detailed study of neighborhoods and residential areas, streets, institutions and markets and factories to determine the appropriate container types with their appropriate forms and sizes utilizing from their maximum potential .And new containers should be requested matching work. Some misuse of containers and the problems that could be overcome through the following:

1. If the work is strictly committed to and labours provide good service.

2. Containers should be placed in suitable places that are easily accessible and in usable forms.
3. Periodical system for washing the containers to prevent odors should be laid out.
4. Periodical pesticide spraying system to prevent breeding and multiplication of harmful insects should be laid out.
5. Strict legislation to urge citizens to properly deal with these containers and not to ignite the fires out and throw waste outside or scattering their contents should be laid out
6. Performing campaigns for guidance and health education to deepen the culture of cleanliness amid citizens.

1.8.5 Advantages of two-yard container

They are emptied by the pressing vehicle. Considering that number of compressors is large and therefore they accommodate all containers needed for the residential sector (Dulac, 2001).

They can be placed in places such as the residential sector and government institutions, small shops and also in small markets.

1.8.6 Disadvantages of two-yard container

Their wheels are prone to damage by fire or through any faulty usage which leads to difficulty in unloading or scattering of waste materials

- Emission of foul odors if they are not discharged in a timely manner
- Some individuals throw waste outside containers causing a nuisance to neighbors.

1.8.7 Historical background of using waste materials containers in Sudan

Upon early establishment of Khartoum town, the containers were not well known then as it is the case today. For the matter was just choosing a suitable site outside the house to dump garbage in to be later transported to another suitable location. Then using top and bottom opened metal containers where the garbage was dumped in and later development occurred in building red brick containers to accommodate the waste materials and being discharged regularly.

1.8.7.1 German loan

In the early 70's, with loan allocated from the Republic of Germany, 3 meter containers and agricultural cranes were brought from Germany to make a very important qualitative transformation and this experience has broaden the scope of officials operating in the field about the possibility of being abreast with the scientific development in this viable field.

1.8.7.2 Japanese Donation

In the 1980s, to rehabilitate the equipments and machineries of the German loan, Japan offered a donation for Sudanese government to establish comprehensive business for handling waste materials in the nation capital. And from that donation, 3 meter containers and agricultural cranes were brought to take wastes outside the town and used according to study made in this field forming a remarkable qualitative transformation at that time.
But the experience was subjected to a dangerous setback that was attributable to depreciation of the equipments and bad use by the citizens. So, other suitable waste materials handling alternatives became important to be made.

1.8.7.3 Duration of German Loan and Japanese donation

This period has lasted for 15 years incurring a remarkable transformation in the concepts of employees and labours working in waste sanitation business. Nevertheless, the misusage of waste containers and unsettled work due to machineries break down have reflected bad impression about applying containers in garbage collection and that is greatly attributed to the following reasons:

1. The cessation of vehicles and irregular transfer of the containers made waste materials a breeding ground for the proliferation of flies, insects and sources of unpleasant odors
2. The lack of qualified workshops for the maintenance of vehicles and containers.
3. The number of containers is very few and capacity limitedness to accommodate all waste inside.
4. In the mid-nineties, all vehicles stopped almost entirely, making the sites of some of the containers as if they were final dumping area.

Amid this total collapse, the work began in the emergency project in 2001 before the arrival of the machineries and equipment designated according to the study, which was made and approved by the Council of Ministers of Khartoum state and ordered to be implemented. The equipment and machineries used to collect waste from house-to-house has achieved remarkable success in the city's residential system.

Although the study of Khartoum State cleaning project has revealed clearly that it is necessary for the work to include collection and storage of waste materials in all stages by using containers. The compressing vehicles arrived before containers. So, compressing vehicle replaced hired trucks operating in the same way, from house to house. Upon arrival of the containers, their number was small and demands of sanitation projects were more compressing trucks to replace the hired ones in reduction of costs borne by the three major projects at that time. When the first batch of containers has arrived, its distribution among the residential sector was rejected by some of the staff and some of the workers in charge because the unfavorable experience of $5m^2$ containers and the collapse of its machineries were in mind. This lead to consequent health problems and serious deviation in work performance. Also, the above may be attributed to insistence of some to adopt the system of work transferring waste from house to house, requesting more containers. And the option of manufacturing new suitable ones was dismissed. Thus, compressors and machineries suffered operating major problems portrayed in streets during the autumn as well as fractures of water supplying pipes and work pressure.

2. Methodology

2.1 The area of study

2.1.1 Khartoum State

Figure 2-1: Khartoum Urban Territorial Level

Since the earliest of the 19th century Khartoum was known as the first administrative center in Sudan due to its geographical location. The increasing care devoted to political, educational and administrative fields encouraged the growth of trade and industry and it facilitated emigration from the rural areas to Khartoum. Khartoum is a dry hot State; the temperature ranges between 43 degrees in June and drops to 14 degrees in December. The rainy season starts from June through October with scat rated rainfalls Khartoum being in the semi arid area is considered as one of dustiest areas in the world. Khartoum executive capital of Sudan with 2,8 million inhabitants (Aviation, 2004), situated at the junction between the Blue and the white Nile. Together with Omdurman to the west and Khartoum North to the north, form Khartoum Sudan's dominating urban center. (Embassy, 2005)

Omdurman serves as the legislative capital of Sudan. Khartoum is very poor, with few exclusive areas. Few streets are paved, but the center is well planned, with tree- lined streets. Khartoum is the administrative, economical and commercial centre for whole of Sudan. Among the city's industries are printing, food processing, textile and glass manufacturing. The population of Khartoum is made up of all the peoples living in Sudan, making it relatively one of the least Arabic cities in the northern half of Sudan. Khartoum has rail lines from Egypt, Port Sudan and El Obied. The river traffic on the Blue and White Nile Rivers are very important. (Embassy, 2005)

2.1.2 The Climate of the City of Khartoum

The city of Khartoum (lat.15 36N long. 32 33 at. 38) is a rapidly expanding city with semi desert climate. It's affected by the rivers its sits at their confluence of the blue and white Nile, it is expanding along the rivers bark in a north south direction. The climate in winter is very pleasant with dry northerly winds from October to April and relative humidity below 30%. During this period there is no rain. The mean rain for October of7.8mm November 0.7 the rest of the months almost zero rain. The mean monthly temperature is lowest in Jan. About 23C, and highest in April and October about 32C. The temperature drops steadily from October by about 4C every month from January it rises slowly during February by 1.5C and then by 4C every month until April. Jan. and Feb. are the coldest months. The coldest temperature recorded was 7.5C in Jan. From April the temperature rises to 27.5 in June. May and June are the hottest months in the city the maximum can reach 47.5C and the mean maximum is above 41 C, by Jun the rain will be established to the south of the city and and the city is under frequent dust storms with gust wind. During July the rain starts and the climate is modified according yet July remains venerable to the highest temperature every other year. August and September the city enjoys rainy condition the temperature is suppressed slightly. Relative humidity is above 40% for July August and September the mean rain for July is 29.6, August 48.3 and September 26.7mm.

And sunshine hours drop to 8 hours during these rainy conditions. Outside this period sunshine hours are more than 9 hours. (Embassy, 2005)

2.2 Data Acquisition

Data acquisition in the study was solely based on a field research questionnaire prepared targeting sample of 83 persons in variable quarters in the three provinces of Khartoum states , in addition to filed visits and visual inspections of current situation of processing the domestic waste materials inside and outside houses.

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The above had facilitated acquisition of primary qualitative data relevant to contents of domestic solid waste materials produced by households in the area of study as well as containers used. Also, this was coupled with field visits executed to the different residential quarters in the research area of study and photos taking, personal interviews and reporting were adopted as field study to current processing of domestic waste materials.

Equally important, the secondary data was acquired by going through reports, references, magazines, periodicals, newspapers and websites were referred to for some information about waste containers system background applied in Khartoum state and the current situation in this research.

2.3 Data Analysis

The acquired primary data was analyzed accordingly using Statistical Package for Social Science (SPSS) program.

3. Results

The statistical analysis was concentrated upon the frequency tests for the qualitative data acquired from the answers of questionnaire prepared targeting sample of 83 persons in variable quarters in the three provinces of Khartoum states about contents of domestic solid waste materials produced by households in the area of study as well as containers used , and that was as follows:

Table 3.1: Shows the variable mixes of domestic solid waste contents produced by the targeted groups

Valid	Frequency	Percent
cardboard	5	5.7
cardboard-earth	1	1.1
food leftover	1	1.1
food leftover-cardboard- earth	12	13.8
food leftover-cardboard- other	1	1.1
food leftover-cardboard-glass-earth	1	1.1
food leftover-cardboard-leather-ceramic-glass-mineral	1	1.1
food leftover-cardboard-plastic	1	1.1
food leftover-cardboard-plastic- glass-bones	11	12.6
food leftover-cardboard-plastic- ragged cloth-glass	1	1.1
food leftover-cardboard-plastic- rubber	1	1.1
food leftover-cardboard-plastic- rubber - glass	2	2.3
food leftover-cardboard-plastic- rubber-leather	5	5.7
food leftover-cardboard-plastic-bones	1	1.1
food leftover-cardboard-plastic-bones - earth	3	3.4
food leftover-cardboard-plastic-earth	1	1.1
food leftover-cardboard-plastic-glass	1	1.1
food leftover-cardboard-plastic-glass-bones	2	2.3
food leftover-cardboard-plastic-glass-minerals	1	1.1
food leftover-cardboard-plastic-glass-other	1	1.1
food leftover-cardboard-plastic-leather	2	2.3
food leftover-cardboard-plastic-leather-wood	1	1.1
food leftover-cardboard-plastic-minerals	1	1.1
food leftover-cardboard-plastic-other	1	1.1
food leftover-cardboard-plastic-ragged cloth-glass	1	1.1
food leftover-cardboard-plastic-rubber	1	1.1
food leftover-cardboard-plastic-wood	2	2.3
food leftover-cardboard-ragged cloth	2	2.3
food leftover-earth	1	1.1
food leftover-other	2	2.3
food leftover-plastic	2	2.3
food leftover-plastic-bones - earth	3	3.4
food leftover-plastic-earth	1	1.1
food leftover-plastic-glass	4	4.6
food leftover-plastic-other	4	4.6
food leftover-plastic-ragged cloth	1	1.1
food leftover-plastic-rubber	1	1.1
food leftover-wood-earth	1	1.1
other	2	2.3
Total	**87**	**100**

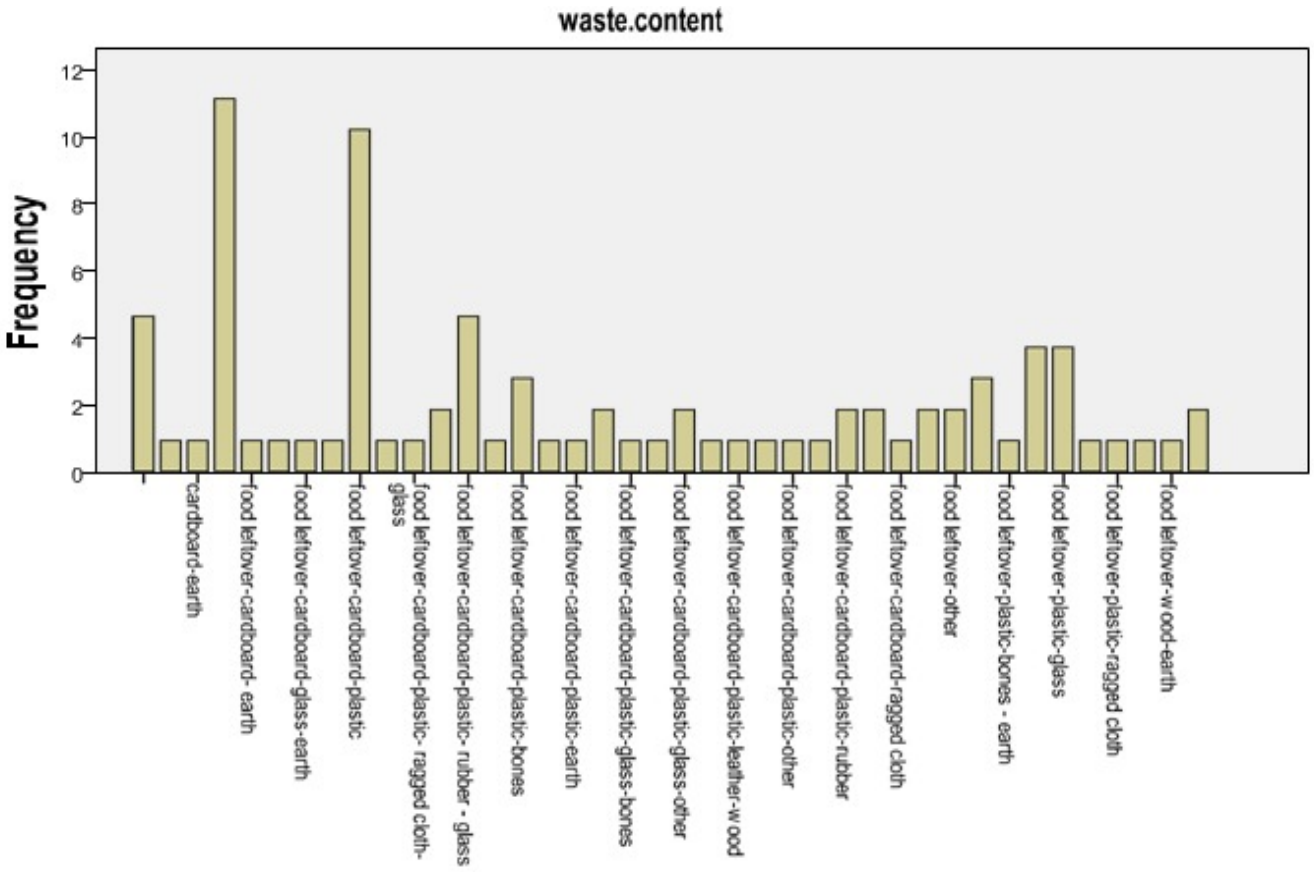

Figure 3.1: Shows the variable mixes of domestic solid waste contents produced by the targeted groups

As it`s shown in table (3-1) and figure 3-1, the dominant mixes of domestic solid waste contents produced at domestic level in Khartoum state is mainly food leftovers (12%) followed by the mix of food left over, cardboard and plastic (11%).

Table 3.2: Shows waste containers types adopted at domestic level by the targeted groups

Valid	Frequency	Percent
Barrels	5	5.7
Plastic	17	19.5
Bags	64	73.6
Sacks	1	1.1
Total	87	100

Figure 3.2: Shows waste containers types adopted at domestic level by the targeted groups

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As it`s shown in table (3-2) and figure 3-2, the dominant waste containers types adopted at domestic level for solid waste collection is through the plastic bags (73.6%) followed by barrels (19.5%).

4. Discussion & Conclusion

4.1 Discussion

It appeared from interviews and questionnaire that the major content produced in the domestic waste materials in Khartoum is food leftover (table 3-1) which is accompanied by other contents materials in variable mixes. According to the study, the researcher has furnished 30 mixes alternatives of other content materials of domestic wastes such as cardboard, plastic, ragged, cloth, glass etc. and from analyzing the obtained results it is suggested that the dominant nature of domestic waste materials produced in Khartoum state is more organic rather than other industrial and physical types.

Also, the dominant containers used for temporary storage of domestic waste materials at house hold levels is through plastic bags (table 3.2) followed by the barrels and at the bottom comes the sacks and this suggests an increased degree of awareness about using the modern house hold containers for temporary waste storage.

The secondary data analysis revealed that containers were to apply in all the stages of wastes collection and storage so as to reduce cost and maintenance of sanitation for the citizen's interest.

4.2 Conclusions

It is apparent from the results reached that the dominant nature of domestic waste materials produced in Khartoum state is more organic rather than other industrial and physical types and containers used for temporary storage of domestic waste materials at house hold levels is through plastic bags and this suggests an increased degree of awareness about using the modern house hold containers for temporary waste storage.

For improving the system of domestic waste materials storage in Khartoum State, containers were to be apply in all the stages of wastes collection and storage so as to reduce cost and maintenance of sanitation for the citizen's interest.

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