PROJECT "ISTEAC"

Integration of solid waste management tools into specific settings of European and Asian Communities

Common Applied Research
Under the ASEAN-EU University Network Programme

Project Documentation

Related to

Activity 3: Organic waste characterisation

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INTRODUCTION

In the frame of its activities for the common applied research project ISTEAC and according to the work plan concluded for it, the Department of Chemical Engineering, Hanoi University of Science (HUS) conducted the results of laboratory analysis on waste composition collected in some districts of Hanoi.

This research aims to create a view on organic waste characterisation in order to select the parameters under which the composting process will take place (e.g. moisture, carbon and nitrogen composition).

In addition, the ratio of useful and unuseful waste, which belong to the difference in urban structures and consumer behaviour were taken in consideration.

CASE STUDY

Hanoi is an ancient city which has been being constructed and developed in a new scale. Urban solid waste management is becoming more and more urgent because of rapid population growth due to rural to urban migration, urbanization and industrialization process.

Hanoi has an area of 918.5 km^2 . It consists of 7 urban districts (Ba Dinh, Hoan Kiem, Dong Da, Hai Ba Trung, Tay Ho, Thanh Xuan and Cau Giay) and 5 suburban districts with the population of about 2.9 millions in total. Recently, 2 of 5 suburban districts have been becoming district (Long Bien and Hoang Mai).

The urban area covers about 84.1 km^2, inhabited by 1.4 million people. The city population density is high with an outstanding 38 955 persons/km^2 in the old street. Narrow roads and high traffic density in urban centers are an impressive character of Hanoi.

The Hanoi Urban Environmental Company (URENCO) is the organization responsible for solid waste management. URENCO is capable to collect 85% household and street waste of the inner city area. Hanoi applies a two-steps collection/transport system comprising of manual collection with handcarts and transport with trucks. Refuse collection is done mainly during night time, whereas household waste is allowed to put on the curbside after 6 p.m.

URENCO has about 200 different specialized vehicles. These vehicles are equipped with hydraulic lifters to pick up handcarts and waste container. From transfer station trucks equipped with compaction equipment go to the landfill for discharge. Solid waste volume daily collected is 1200 tons.

Industrial waste is mostly collected and treated by the industrial establishments themselves before being transported to the municipal landfills. Industrial companies store their hazardous waste at their respective sites while waiting to be treated. Health care waste is contractually collected and treated by URENCO. The remaining waste is collected and treated by the health care establishments themselves.

In Hanoi 90% of household are using flood toilets, 8% using double-vault toilet and the remaining 2% using toilet bins. Each day URENCO also collects 250 tons of night soil out of the estimated total of 350 tons/day generated in the city. The remaining is composted by farmers.

The city sanitary activities are funded by the Hanoi people's committee with the average budget per year per urban capita was $US 3.3 in the year 2000.

For this case study samples were collected and their composition was investigated. Sampling was undertaken from 4 of 7 old districts: Hai Ba Trung, Ba Dinh, Hoan Kiem, and Dong Da, in which every 8 places were chosen according to the different urban structure. Samples of those places were collected mainly from vehicle (picture 2 & 3) continuously for 7 days and once per day. At the same date and at the above 8 locations the collection was implemented. Thereafter they were fresh sorted and characterized at the laboratory. There is the map of Hanoi city with sampling remark (picture 1).

Picture 1: The sites of solid waste collection in 4 urban districts of Hanoi city

The collected waste must be representative for all kinds of waste and its amount was at least 5 kg for one site. The composition was determined immediately after collection. The organic matter was dried in vacuum dryer to constant weight and store in closed bottles for analysis procedure.

The procedure of analysis is as follows:

- Composition of waste was calculated as % of fresh waste

- Humidity of organic matter was calculated as a % of weight lost after drying
- TOC was analysed with the method of oxidation organic matter into CO2 and TOC calculate by CO2 measurement
- TKN was analysed by standard TKN method

RESULT AND DISCUSSION

The above chosen districts are the ancient area; they are the 4 oldest districts of Hanoi city.

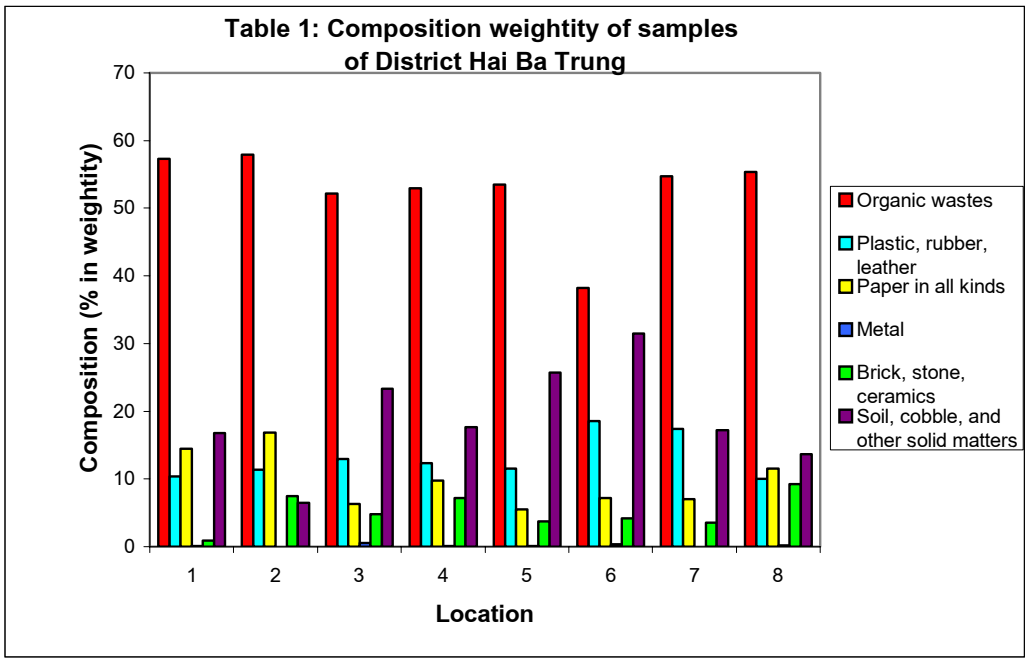
Hai Ba Trung district is situated in the South East of Hanoi city: The North is adjacent to Hoan Kiem district, the East is adjacent to Red river, the West is adjacent to Dong Da district and the South is adjacent to Thanh Tri district. Total area: 14, 5 km2, population: 356 500, population density: 24 589 pers/km2.

Ba Dinh district is in the North-West of Hanoi City and in the South of West Lake; The district to be bounded as follows: North is adjacent to the Tay Ho district and Red river, East is adjacent to the Hoan Kiem districts, South is adjacent to the Dong Da district and West is adjacent to the Cau Giay district. Total area: 9,3 km2, population: 202 700, population density: 21 797 pers/km2. Currently, Ba Dinh is a district in center of Hanoi Capital and belongs to the public centers system of the City. There is a Ba Dinh political center located with head offices of the Communist Party and the Government.

Hoan Kiem district is one of the central districts of the City. The North is adjacent to Ba Dinh district, the East is adjacent to Red river, the south is adjacent to Hai Ba Trung district, and the West is adjacent to Dong Da district. Total area: 5, 29 km2, population: 171 400, population density: 32 339 pers/km2. Hoan Kiem district contains historical street area, old street area, Hoan Kiem Lake and the area outside Red river dyke.

Dong Da district is in the South West of Hanoi city and its boundaries are as follows: the West is adjacent to Cau Giay district, the East is adjacent to Hoan Kiem and Hai Ba Trung districts, the North is adjacent to Ba Dinh district, and the South is adjacent to Thanh Xuan district. Total area: 9, 94 km2, population: 336 000, population density: 33 804 pers/km2. Dong Da district is a convenient area to develop and improve residential houses as well as develop representative offices, companies, researching institutes, universities and vocational schools.

Experiment data about waste weighty composition are gathered in table 1 - 4. Every district has the waste data of 8 locations. Samples after collection were divided to 6 different components which presented in 6 columns respectively: organic waste; plastic, rubber, leather; paper in all kinds; metal; brick, stone, ceramics and soil, cobble, other solid matters. The last one is considered as unusual waste.

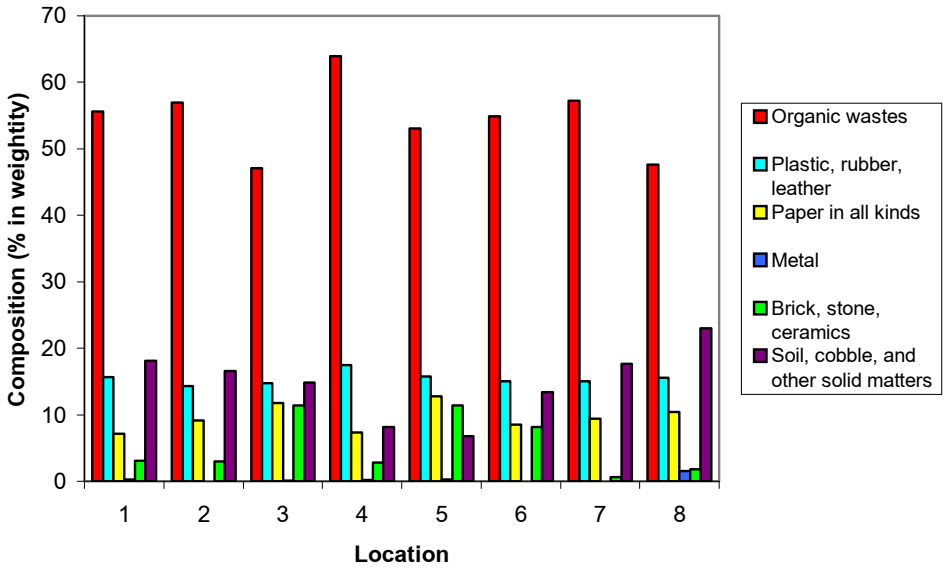


Location:
1: Hoa Ma
2: Hang Chuoi
3: Bach Khoa
4: Thanh Nhan
5: Quynh Mai
6: Vinh Tuy
7: Linh Nam
8: Yec - xanh

In the figure metal and paper component appear in a very low level especially the metal items. These two components are mostly collected by scavengers, which usually go around the city by bicycle. In other districts there is almost the same situation. Vinh Tuy is at the border of this district, more resident construction is being in function. The ratio of usual and unusual waste of Vinh Tuy location (No. 6) is therefore rather low.

The following pictures belong to district: Ba Dinh, Hoan Kiem and Dong Da:

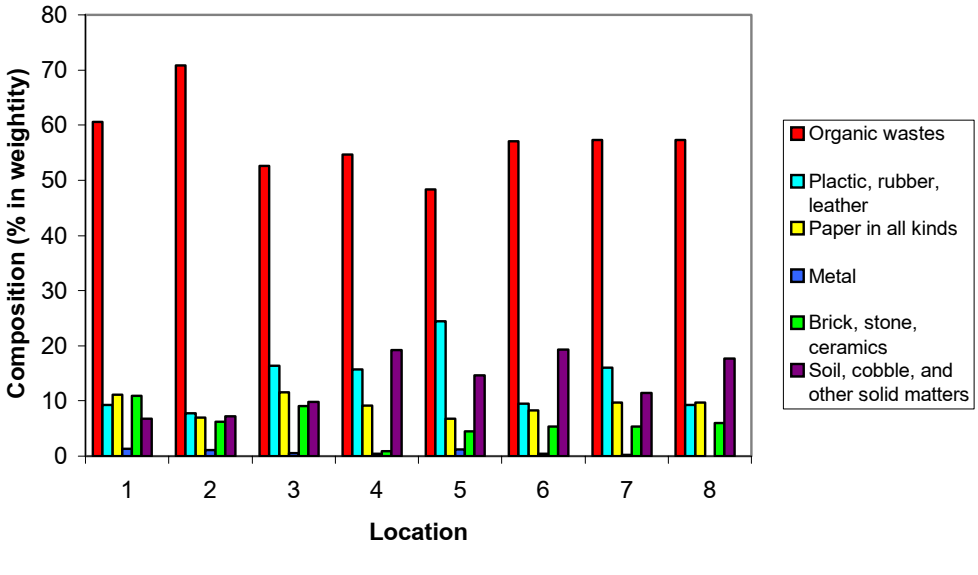
Table 2: Composition weightity of samples of District Ba Dinh



Location:

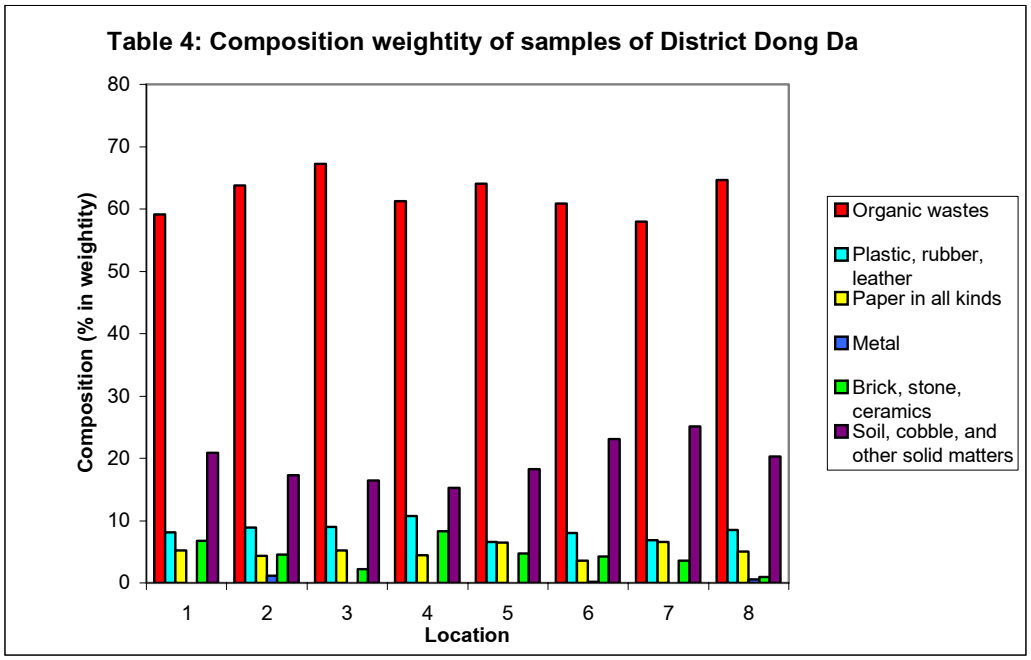
1: Tran Huy Lieu
2: Kim Ma - Doi Can
3: Lieu Giai - Doi Can
4: Duong Buoi
5: Kim Ma - De La Thanh
6: Phao Dai Lang
7: De La Thanh
8: Giang Vo

Table 3: Composition weightity of samples of District Hoan Kiem



Location:

1: Duong Thanh
2: Dang Thai Than
3: Bao Khanh
4: 51 - Ly Thuong Kiet
5: 54 - Tran Hung Dao
6: 39 - Nguyen Huu Huan
7: 73 - Phu Doan
8: Hang Khoai



Location:

1: Dai hoc Thuy Loi
2: Dong Tac
3: De La Thanh
4: Phuong Mai
5: Dau Ngo Van Huong
6: Ngo Van Chuong
7: O Cho Dua
8: Nam Dong

Districts Ba Dinh and Hoan Kiem are at the center of the city, construction processes are strictly controlled. They are rather stable in construction where the ancient architecture needs to be maintained. It reveals therefore clearly with the ration of usual and unusual waste in comparison with those of the others. The above investigation has been summarized at the following figures, with them the difference in urban structures and consumer behavior could be taken in consideration.

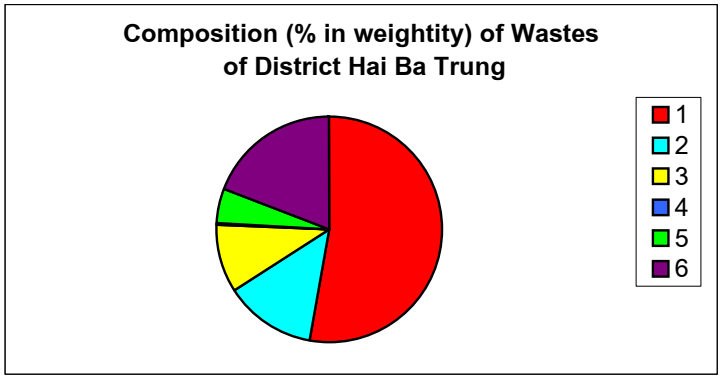


Figure 1

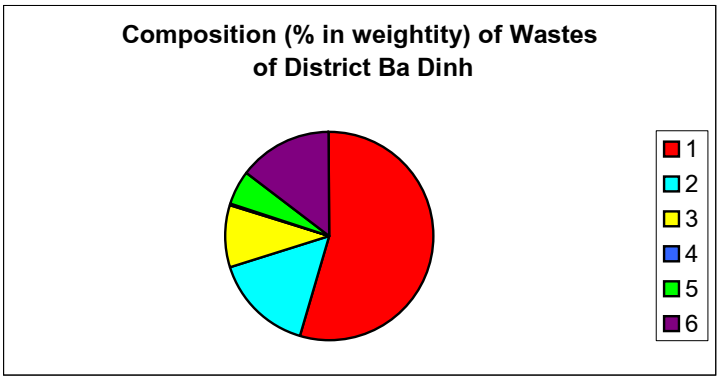


Figure 2

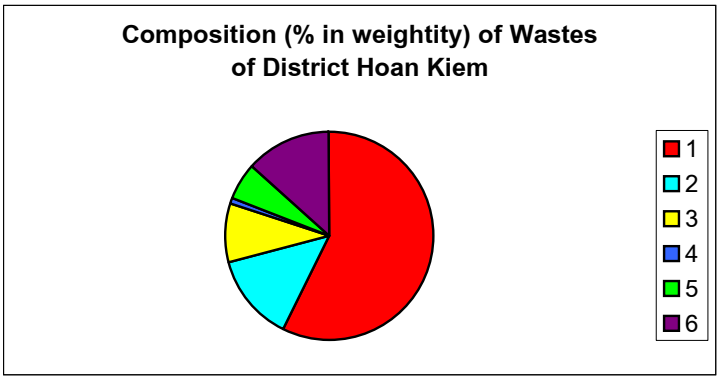


Figure 3

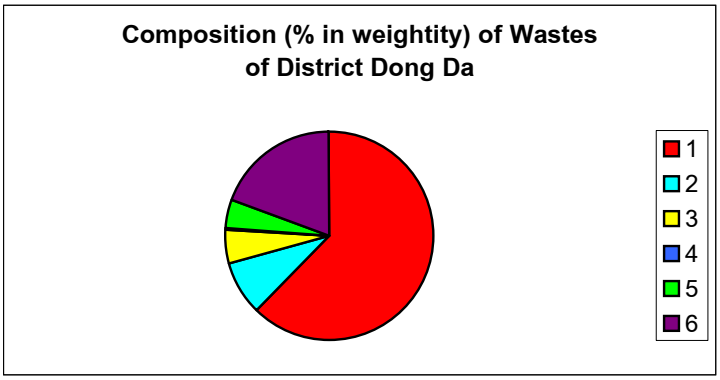
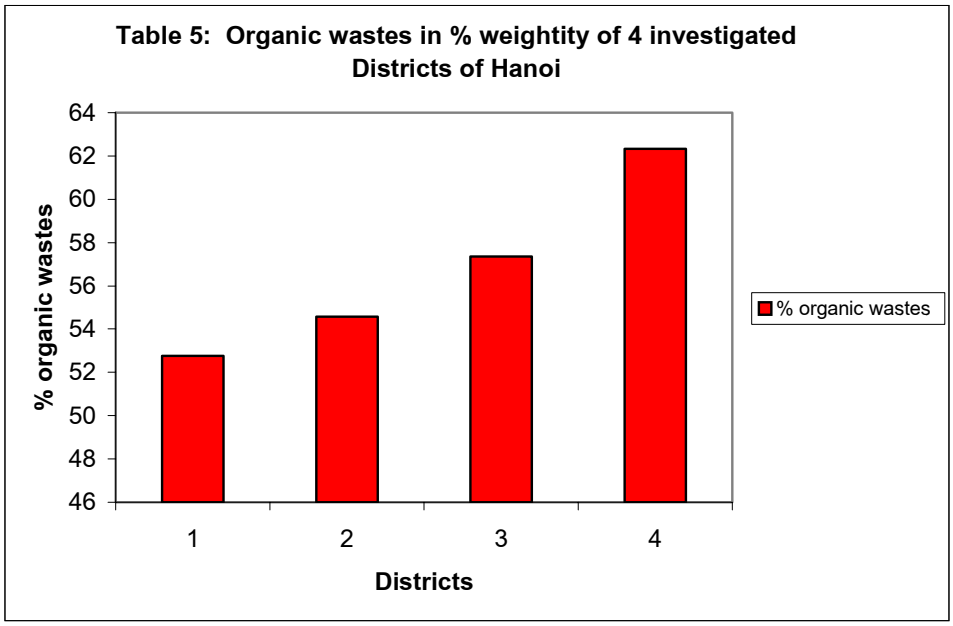


Figure 4

Figure 1 - 4:

1: % Organic wastes
2: % Plastic, rubber, leather
3: % Paper in all kinds
4: % Metal
5: % Brick, stone, ceramics
6: % Soil, cobble, and other solid matters

The study however concentrate to investigate the organic waste composition, which shown in table 5. It seems to be the high content of organic matter belong to the high population density (district Dong Da).



District:

1: Hai Ba Trung	3: Hoan Kiem
2: Ba Dinh	4: Dong Da

The following figures (Figure 5 - 8) show the water content of the 4 districts respectively. At the investigation period water content changes in a range of 80 - 90 %. It was in April time. Since raw compost should have a water content of approximately 55 % this organic waste therefore needs a pre-treatment first.

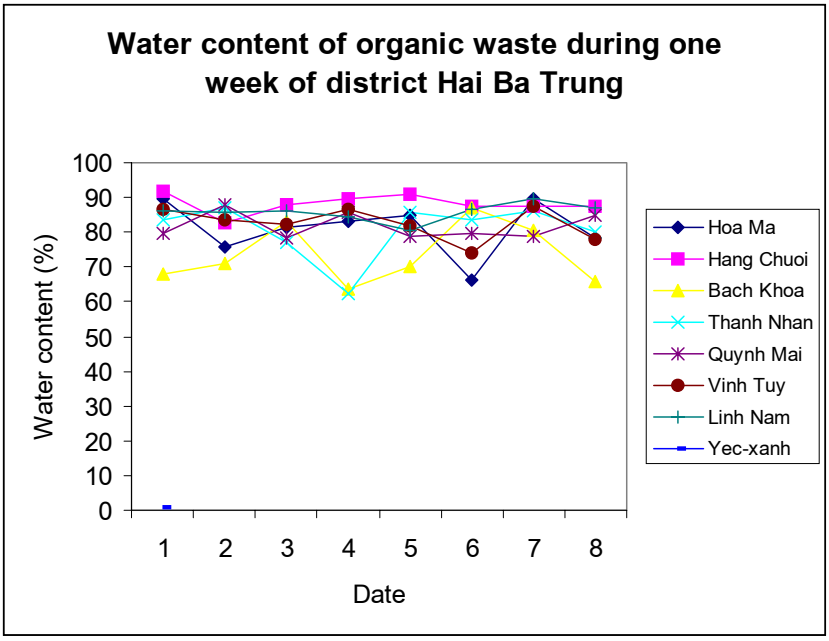


Figure 5

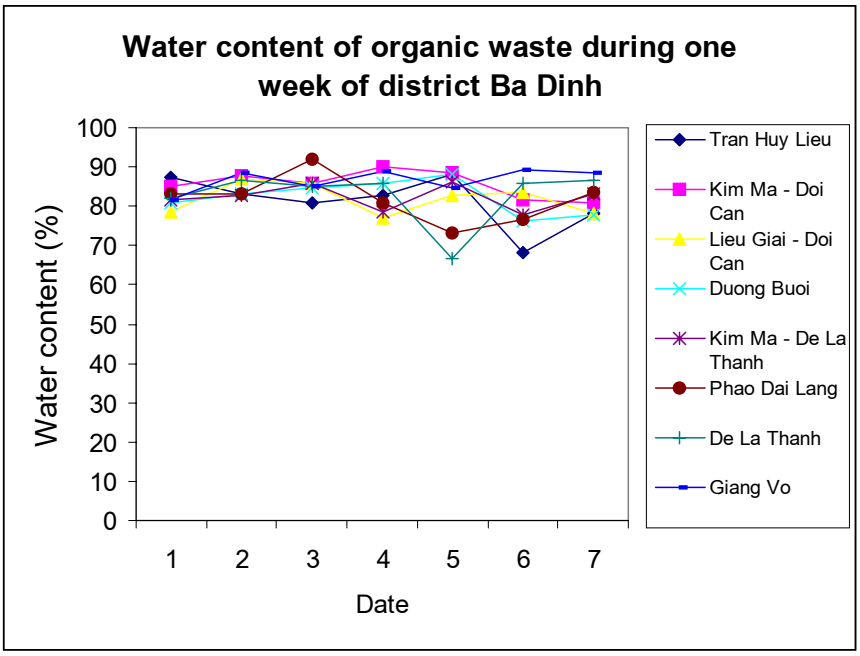


Figure 6

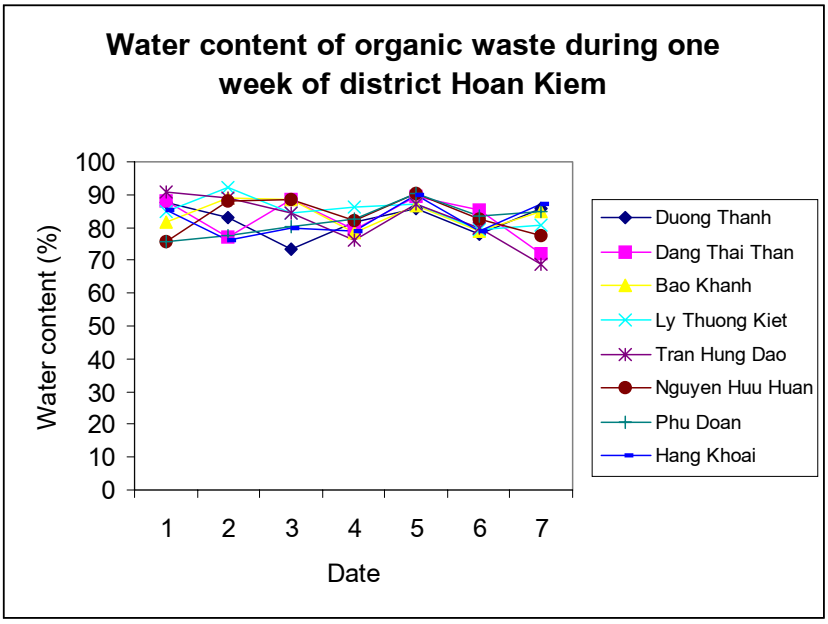


Figure 7

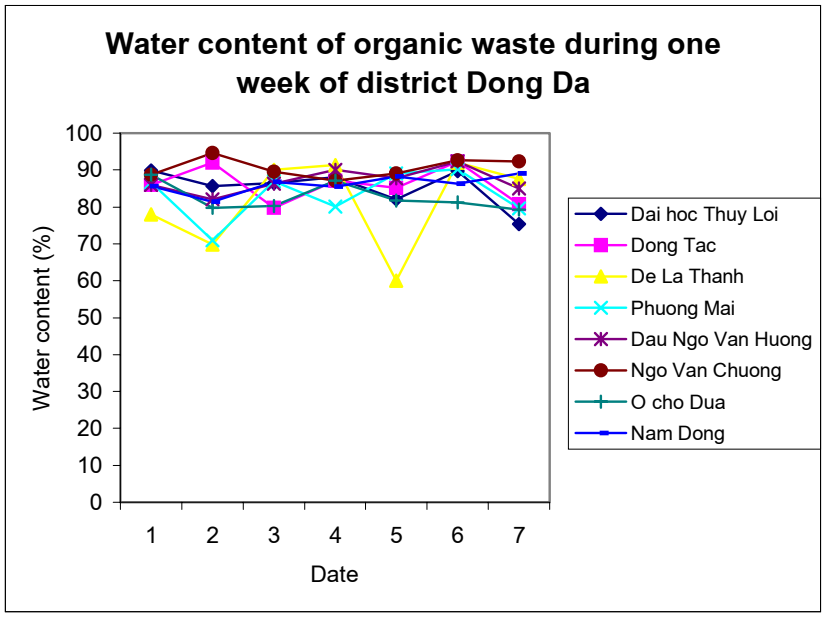


Figure 8

For composting especially important is the ratio of carbon and nitrogen (C/N ratio). The raw materials for aerobic decomposition should have an optimal C/N ratio of 35 to 1. However, our research has shown the following rations: 63, 69 (due to district Hai Ba Trung), 64, 55 (due to district Ba Dinh), and 149, 31 (due to district Hoan Kiem). They have a very big difference. The optimal C/N ratio can be achieved by mix together and adding the equivalent amount of kitchen waste (C/N = 25). The composition of dried organic waste of the 3 districts are presented as following figures (one is missing at the moment - district Dong Da):

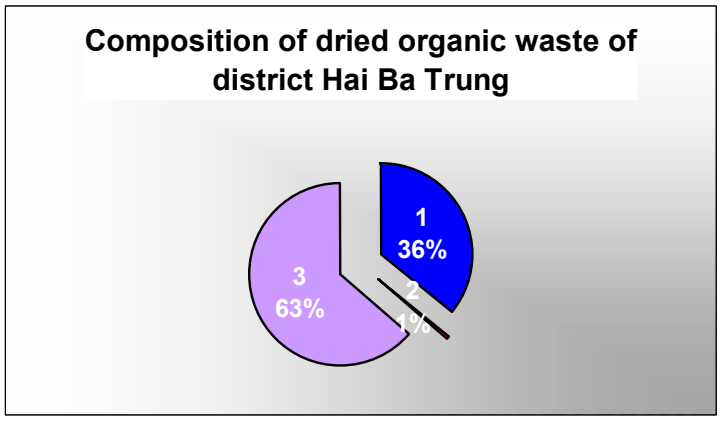


Figure 9

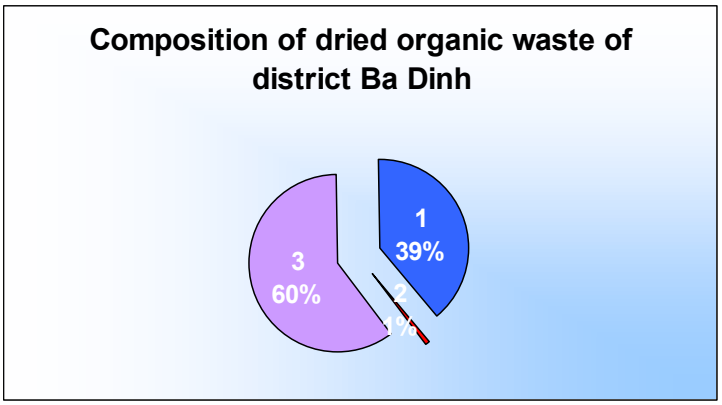


Figure 10

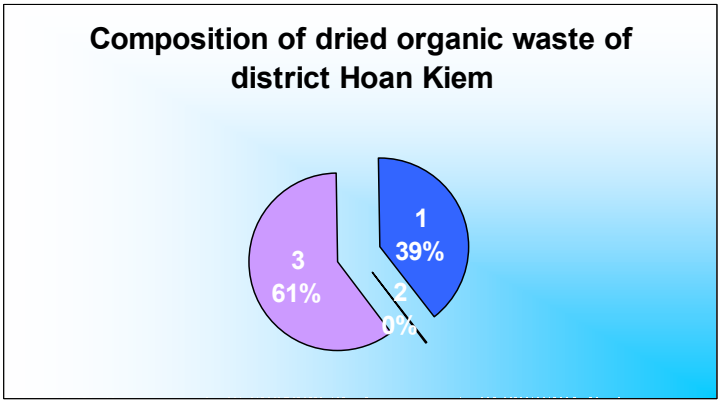


Figure 11

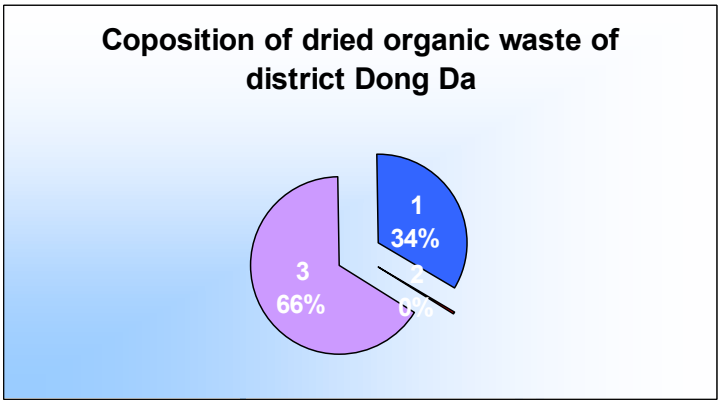


Figure 12

Figure 9 - 11: 1: % Carbon 2: % Nitrogen 3: % Unwanted

Picture 2: From there sample was collected

Picture 3: From there sample was collected

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