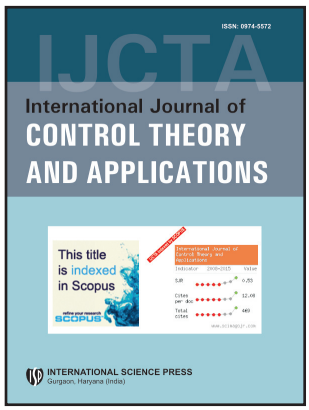

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Design of a Solid Waste Collection System in the Market Zone of the City of Barranquilla, Colombia

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Abstract: The solid waste generated in the marketplaces of the city of Barranquilla has turned these areas into pockets of pollution which represents a major environmental problem for the community. In the year 2014 in the area of center and market were collected about 3000 tons of waste, between home collection and collection of dumps or critical points in the area. This paper proposes a design of a solid waste collection system in the market area of the city of Barranquilla, in which the characterization of the waste generated in the study area is initially broken down, in order to define the possible Alternatives of treatment and/or final disposition of the same, later the process of collection of the waste is detailed, establishing possible routes of collection of the ordinary waste in order to guarantee the provision of an efficient service with continuity and quality to the population of the zone , To eliminate the sources of vector generation, contributing to the general welfare of the community and to develop the interest of the competent authorities of the municipality and the private operator in the development of the proposed project.

Keyword: Solid waste, collection, final disposal, utilization, waste characterization, microroute.

1. INTRODUCTION

The generation of solid waste has become a growing problem, not only because of the population increase but also because of the dynamics of consumption that the societies in the world present. Colombia takes into account the problem of waste in all stages of the production system, from the rationalization of material resources, cleaning of production, forms of marketing, transportation, use of products and final disposal of Waste, as fundamental aspects to give a comprehensive solution to the problem. Cities and towns grow, for this reason increases the generation of waste in the different sectors that comprise them; Marketplaces are a special area because of the high speed at which solid waste is produced, this being a key aspect that creates the need for a daily and efficient cleaning service in a population. The country generates about 25,079 metric tons of domestic solid waste per day, according to information reported to the [1].

The Superintendency of Home Public Services (SSPD) determined that the generation of these wastes is distributed as follows: 40.79% (10,031 t/day) of the total volume of waste produced at the national level

corresponds to the four large cities of the country, Of this percentage 23.48% occur in Bogotá DC, followed by Cali with 8.00%, Medellín with 7.16% and Barranquilla with 2.15%. 18.7% of the national total (4,690 t/day) is generated in 28 capital cities and 40.5% (10,156 t/day) is generated in the remaining 1,069 municipalities. ([2], [3]). In the year 2014 in Barranquilla, approximately 500,000 tons of waste were collected in the sanitary landfill "Los Pocitos" environmental park, of which 8% come from the downtown area and market of the city [3].

Currently the public market in the city of Barranquilla does not have 100% coverage of the sewerage service, therefore you can see how wastewater runs uncontrolled in certain streets until reaching the "ahuyama" channel where they are transported to Rio Magdalena, this situation exacerbates the problem of waste because these are mixed with them making their collection more difficult. On the other hand, the road conditions in the market affect the mobility of the collecting vehicle, making it impossible to access certain roads, as well as the invasion of public space by stationary and street vendors aggravates the situation.

2. METHODOLOGY

Work was done with direct observation as a result of the reality, and field visits were made to the area of interest, to the operations base of the company providing the public toilet service.

For the collection of the information, the following were used as instruments: interviews with the people of the sector, interviews with the employees of the public service provider company; besides the consultation in different bibliographical sources as instruments of secondary collection [4].

For the selection of an optimal route of waste collection, it was necessary to verify the mobility conditions of the area with a field visit to the area, as well as the number of users that are in the area, because with this number Determined the production of waste from the area, with these data the optimal route is defined in addition to taking into account the road meanings, the capacity of the vehicles that were used and the mapping of the area; To determine the optimum route.

3. RESULTS

In order to establish improvements in the solid waste collection systems of a community it is necessary to know the characteristics such as density, composition, among others, and thus be able to establish the type of treatment to be given to them.

Figure 1 shows the amount of waste collected daily and the density of the waste calculated on each of the sampling days.

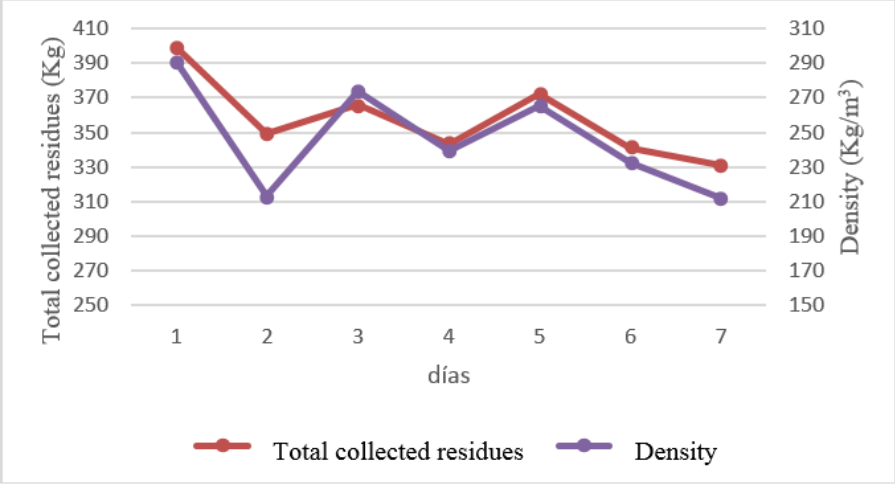

Figure 1: Total amount of waste collected daily and density of waste

Finally the physical constitution of the residues was determined, in Figure 2 the percentage composition of the various components of the residues generated in the area is shown.

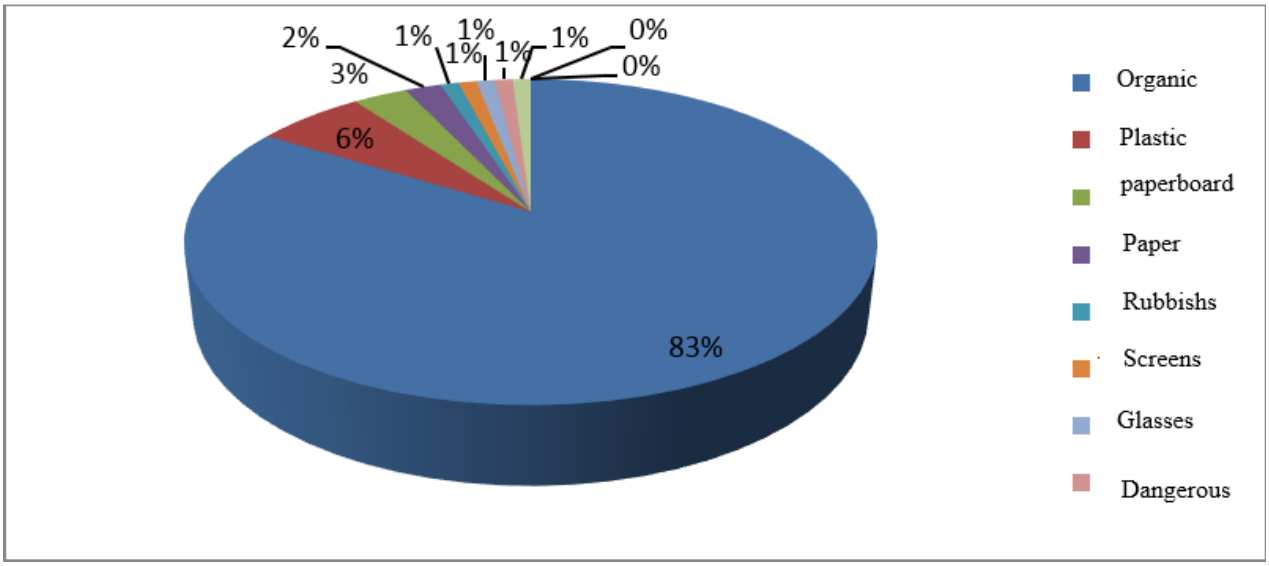

Figure 2: Physical composition of waste

The results obtained indicate that the greatest amount of waste generated in the center and market area is organic waste, which is consistent with the economic activity of the area, followed by plastic, which, although smaller, also reflects activity commercial; from these results will proceed to determine the possible treatment or final disposal of waste in the area.

Route Design

Features of the Area

When traversing the study area, roads were identified through which the transit of the vehicle was impossible due to the invasion of the public space and the width of the same, these roads are defined as restrictions when designing the Microroute.

Due to the above, it is necessary to establish manual collection points, so that the collection operators with the help of a wheelbarrow evacuate the waste from these roads and are deposited in a common point, which will be provided with a stationary box to avoid dispersion Of the residues and the presence of vectors in them, this method of collection is the combination of the curb and containerization method, since the operators must go door to door to collect the waste and they are the ones who deposit them in the containers.

The collection points will be located in strategic places not to interfere with the work of the inhabitants of the zone and the mobility and will be located in: Street 31 between races 43 and 44, Street 10 with race 45 corner, Carrera 42 with street 4B corner, Carrera 41 between Street11 and 28; And, Street 9 between runs 43 and 43B. Each of these points will be under the care of the sweepers and pickers of the area in order to prevent unscrupulous people from misusing them [5], [6].

In order to determine the number of containers to be installed, macroroute associated with each of the collection points were defined in order to cover the largest number of policies taking into account the production per capita of the area, this information is recorded in Figure 3.

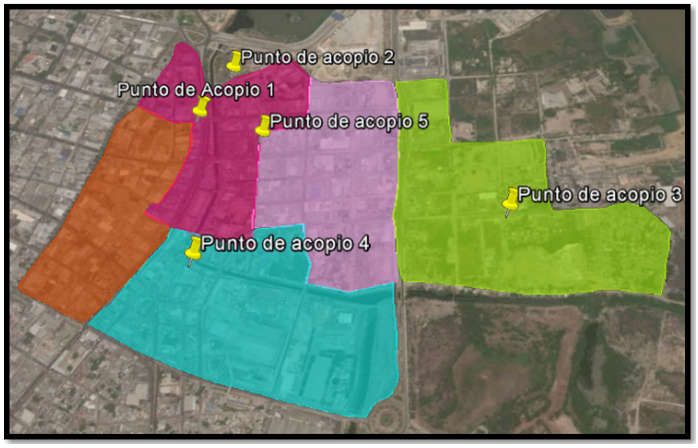

Figure 3: Macroroutes of collection points

Taking into account that each point covers about 700 farms and that the average number of inhabitants per establishment is 5 inhabitants, the expected waste production for each point will be 3,465 kg. The compacting vehicles with which the company has the collection are endowed Of a winch (rear tug accessory) that allows them to collect stationary boxes up to 6yd3, that is 4.6 m3, multiplying this value by the density of the waste (246.55 kg/m3) would obtain the capacity for each box, Or 1,133.9 kg, therefore 3 stationary boxes will be required at each point.

In order to design the micro route, it is necessary to take into account the frequency of collection that will be defined for the collection of the waste, that is to say the number of times per week that the vehicle will pass to collect the waste. Taking into account the nature of the activity in the center and market area and the climate of the city of Barranquilla is warm it is necessary to establish a daily frequency of waste collection in order to prevent the proliferation of vectors due to the effects of Decomposition of the waste generated there.

According to the production of waste from the center and market area, the frequency of collection established and that the type of vehicle with which the company collects is a truck compactor of $25Y^3$ proceed to perform the design of the microroute, Will be taken into account the operating time 10 hours a day to avoid incurring additional expenses. For the design of the microroute, the Google Maps tool was used in order to identify the road meanings and the variation of vehicular traffic. Figure 4 shows the delimitation of the study area (Macroroute) there [7].

Figure 4: Macroroute Center and market of Barranquilla

With all the information collected, the microroute is plotted taking into account the parameters mentioned above, which is presented in Figure 5.

Figure 5: Selected microroute

The harvesting company has an International chassis vehicle (9600) and Fanalca compaction box with capacity for $25Y^3$ ie 19 m^3, in order to calculate the value in kilograms it becomes necessary to know the density of the compacted waste, in this case we will take The value of 750 kg/m^3 [8], thus the capacity of the vehicle would be 14,250 kg, by dividing the amount of waste generated in the area on the capacity of the vehicle, this gives a value of 4.9 Say that 5 trips are required, therefore two vehicles will be needed which will make 2 trips in the day shift and in the night shift 1 will be done; Thus the monthly generation of the zone is of 2,134,627,5 Kg, that is to say, 2,134,62 Tons approximately. Figure 6 shows the variation of the tons collected in the study area during the months of January to June 2015, which averaged 2,188.7 tons.

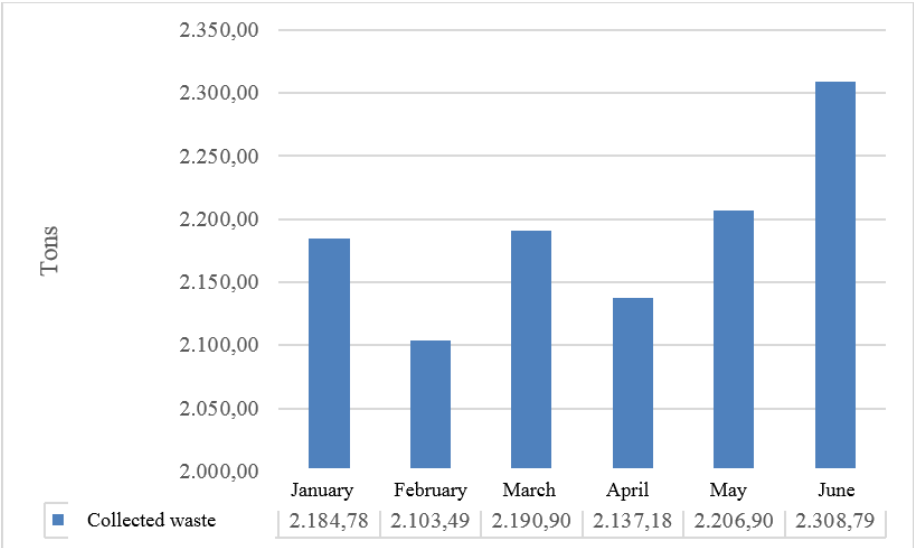

Figure 6: Tons collected company providing the toilet service

Operation of Waste Collection

After obtaining the design of the route, it is proceeded to determine the strategy of operation of the same, the process of collection of waste the operation begins with the departure of the vehicle collector of the base of operations of the company that provides the toilet service, in This site is made ready for pick up (vehicle operating conditions, tools, EPP, etc.), the crew is formed (1 driver, 2 operators) and information is provided in the dispatch register of the company providing it; Afterwards, the crew moves to the starting point of the route, being there diligence the starting time, mileage of the vehicle, among other requested data, proceed to start the execution of the route taking into account the established in the micro-route previously designed, at Finish the microroute are directed to the sanitary landfill where are disposed solid waste collected [9], [10], [11], [12], [13].

The above is presented in Figure 7 Operation diagram of the solid waste collection and transport route in the central and market zone.

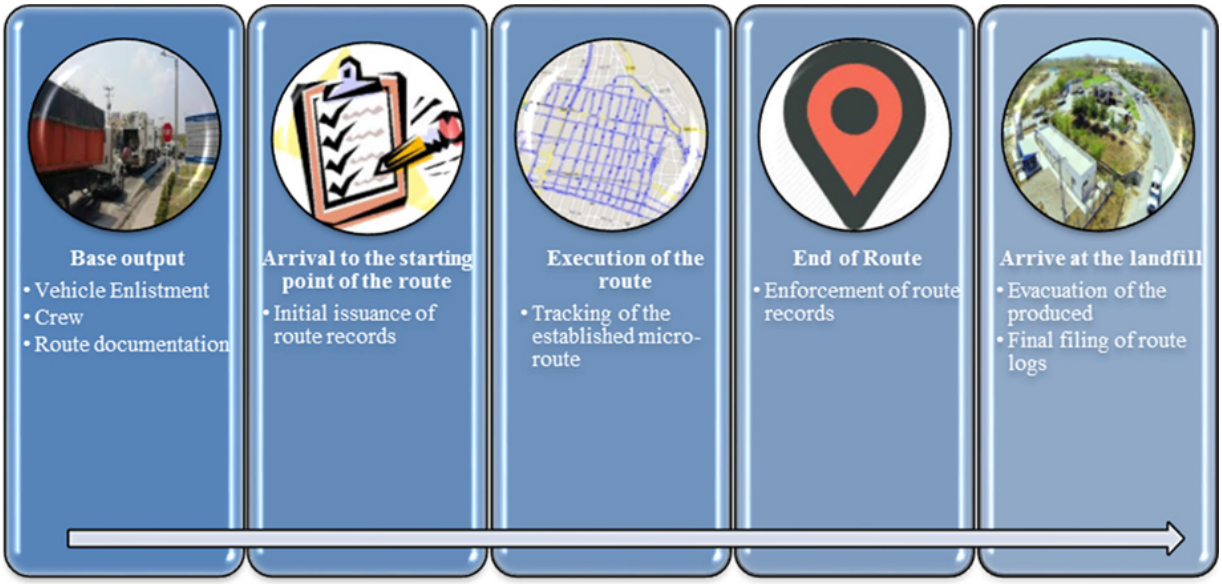

Figure 7: Operation diagram of the solid waste collection and transportation route in the central and market zone

4. CONCLUSIONES

The per capita generation of waste in the study area is 0.99 kg/habitant/day, a quantity consistent with the RAS 2000 title F, since for a high level of complexity (> 60,000 habitants) that Barranquilla has, this value can be varied between 0.44 and 1.10 kg/habitants/day. With the characterization of the residues generated in the center and market zone, it was possible to show that in the composition of the residues the organic component predominates with 83%.

As for the density of the residues, an average value of 246.55 kg/m^3 was obtained in the results, which makes sense when compared to what is stated in the guide for the design, construction and operation of manual sanitary landfills. Which establishes that for the Latin American and Caribbean countries, the specific weight or density of loose waste reaches values of 125 to 250 kg/m^3 [14], [15] and [16].

Regarding the design of the route, it was of vital importance to carry out the field trips, as it allowed the identification of road conditions that could affect the correct realization of the designed route.

It is observed that the transit of the study area most of the time the transit in the sector is slow, reason why the solid waste collection is slower than the one that is presented in other zones of the city.

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