Diagnosis of solid waste management in the petrochemical-plastic sector of Cartagena de indias, Northern Colombia

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Abstract— **In the production of most petrochemical products there is a generation of associated solid waste. The objective is to diagnose solid waste management in a company in the petrochemical-plastic sector. The methodology initially consisted in the identification of the different operational areas and type of waste under the NTC GTC 24, in the second instance the solid waste classification was carried out taking into account the simple method of analysis of CEPIS and finally the quantification of The waste taking as a reference what Ruiz (2012)[1] did. It is evident that there is an increase (10.2%) in the generation of solid waste generated, from 545,750 kg in 2013 to 601,492 kg in 2014. The activities with the largest generation of solid waste (cardboard, plastic, wood) Are those of the reception and storage processes and the packaging process in each of the plants.**

Index Terms—**pollution, waste, environmental hydrocarbons.**

I. INTRODUCTION

Problems of waste disposal can be traced back to the time when humans began to congregate in tribes, villages and communities, accumulation of these is a consequence of life[2],[3],[4]The throwing of food and other solid materials into the medieval streets (the practice of throwing waste to unpaved streets, roads and empty lots) led to the breeding of rats, carrying the bubonic plague[5],[6]. The presence of lands that maintain their natural value and that are less affected by human activities leads to more sustainable environments with minimal waste generation. These types of land use (i.e. meadows and pastures) are usually related to more natural and sustainable uses involving protective values forbidding the existence of particular economic activities that could lead to increased production of waste.[7] It was not until the 19th century that public health control measures became a vital consideration for public officials, at occupational levels can be mentioned characterizations of analysed processes were obtained among the main risks the possible exposures of workers who subsequently presented breathing problems due to ammonia releases and high concentrations of chlorine and burns caused by this. The ones with the greatest impact are manifested as the contamination of groundwater, soil and atmosphere, these mainly due to the poor technical state of the liquid waste treatment system that deteriorates the ecosystem and the population in general[8].

At the entrepreneurial level, industrial activity in Colombia has undergone great growth in the last 50 years, which is reflected in an increase in personnel directly or indirectly linked in this productive sector[9]. Focusing on solid waste as a result of the population's population growth, it should be taken into account that the production of solid waste was not only due to industrial systems, but also if they are one of the largest producers of solid waste [10], [11]. All industries have had to focus their production systems in such a way as to reduce the use of raw materials and to solve the management and final disposal of the remains of their raw material [12].

The petrochemical industry comprises the production of compounds from basic raw materials derived from petroleum and natural gas. In the elaboration of a great part of the products we use processes of refining and separation, obtaining the raw materials of the petrochemical industry; Associated to these there is a generation of residues and the approach for its integral management [13], [14].

The objective of the present study was to carry out a diagnosis of the solid waste management in a company of the petrochemical-plastic sector, for which the solid waste generation points were identified; the residues were classified and finally quantified.

II. METHODS

The study was descriptive - prospective, carried out in a petrochemical-plastic company located in the district of Cartagena, industrial zone of Mamonal km 11, adjacent to the Zona Franca Industrial Park and Dexton SA, in the west with The route to Mamonal and the area of the pier of Yara and finally to the south it borders with the route that leads to the population of Port Badel. The company operates five manufacturing plants and one petrochemical plant, the operating processes are described in Table 1.

Table 1. Description of the processes

Plant	Type of process	Products
PVC film	Plastics manufacture PVC	films Extensible and heat shrinkable
Rotomoldeo	Plastics manufacture	Tanks and materiel
EPS Glassware	Plastic Manufacturing	EPS Disposable Cups and Polystyrene Caps
Plastics	Manufacturing Plastics	Sheets and profiles
Texas	Plastic Manufacturing	PVC Tiles
Polystyrene Petrochemical Crystal and high impact polystyrene	Petrochemical	Crystal and high impact polystyrene

Source: Author

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The diagnosis of solid waste management consisted of the following aspects:

1. Identification of the different operational areas and type of waste generated by each one, evaluating the current situation based on the Colombian Technical Standard GTC 24 "Rules for Classification and Handling of Waste in the industrial sector", using tables Described by Rodríguez[15] and Villarroel Cantillana[16]. The data was obtained through inspections applied at random, it was necessary to study the company's process map and to read in detail the step-by-step production processes that exist.

2. Classification of solid waste generated, was determining the type of waste generated by each of the areas. For this, it was very helpful to visit the waste transfer area, where all the waste arrives, the containers and bags were inspected. The so-called simple method for the analysis of solid wastes[17], which is recommended by the Pan American Center for Sanitary Engineering and Environmental Sciences CEPIS, states that for the determination of the composition of solid wastes The residues generated in the selected samples should be separated and classified according to the typical categories of residues that have been used for characterization studies, which can be observed in Table 2.

Table 2. Sources of Solid Wastes in a Community

Source	Typical facilities, activities, or locations where wastes are generated	Types of solid wastes
Residential	Single-family and multifamily dwellings; low-, medium-, and high-density apartments; etc.	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum, other metal, ashes, street leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), and household hazardous wastes
Commercial	Stores, restaurants, markets, office buildings, hotels, motels, print shops, service stations, auto repair shops, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes (see preceding), hazardous wastes, etc.
Institutional	Schools, hospitals, prisons, governmental centers, etc.	Same as for commercial
Industrial (nonprocess wastes)	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes (see preceding), hazardous wastes, etc.
Municipal solid waste*	All of the preceding	All of the preceding
Construction and demolition	New construction sites, road repair, renovation sites, razing of buildings, broken pavement, etc.	Wood, steel, concrete, dirt, etc.
Municipal services (excluding treatment facilities)	Street cleaning, landscaping, catch-basin cleaning, parks and beaches, other recreational areas, etc.	Special wastes, rubbish, street sweepings, landscape and tree trimmings, catch-basin debris; general wastes from parks, beaches, and recreational areas
Treatment facilities	Water, wastewater, industrial treatment processes, etc.	Treatment plant wastes, principally composed of residual sludges and other residual materials
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.	Industrial process wastes, scrap materials, etc.; nonindustrial waste including food wastes, rubbish, ashes, demolition and construction wastes, special wastes, and hazardous waste
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, and hazardous wastes

Source: (Tchobanoglous & Kreith, 2002, 1.3 Introduction)

3. Quantification of Solid Waste was based on the weighing tickets of the scale that the company has, which are generated whenever a vehicle collects recyclable materials leaves the facility. The weighing of the total of the waste generated was carried out using an industrial mechanical scale with a capacity of 500 kg for the case of mixed waste bags and an electronic scale with a capacity of 50 kg for separate waste. Due to climatic factors, physical characteristics of bags and waste and human errors, the accuracy of this study is estimated at +/- 10%[18]. In all cases the total weighing of the generated organic and inorganic residue was carried out.

III. RESULTS

In general, the processes of transformation of plastics generate solid waste (scrap) that can be reprocessable and not reprocessable. The reprocessable scrap is separated into the source, stored in containers or closed containers to prevent contamination, are ground and then fed back into the initial stages of the production process. The non-reprocessable materials are stored in plastic bags inside mugs and taken to the material transfer area, for later collection and final disposal by the cleaning company.

Most of the recyclable and non-recyclable waste generated basically comes from the packaging material of raw materials, bags, film, cardboard, paper clips and wood. Table 3 shows the management of solid waste in the petrochemical-plastic company. Today, we work with a recycling corporation that is in charge of collecting waste paperboard, wood and plastic that are generated inside the company's facilities, for later use.

According to Montoya & Martinez[19], the inadequate management of solid waste is a latent situation in the world; In Colombia, the daily accumulation of tons of residues in Sanitary Landfills, a product of the production and consumption habits of humans in industry, the home, and institutions, shows this problem. Table 3 shows that there is an increase (10.2%) in the generation of solid waste generated, from 545,750 kg in 2013 to 601,492 kg in 2014. In 2014, 240,230 kg of timber in bad condition) corresponding to 40% of the total, followed by 193,071 kg of Carton (boxes and packaging material) with 32% and finally 168,191 kg Plastic (bags, straps, packaging films) with 28%. Most carton, wood and plastic are generated from the storage and receiving process, and from the packaging.

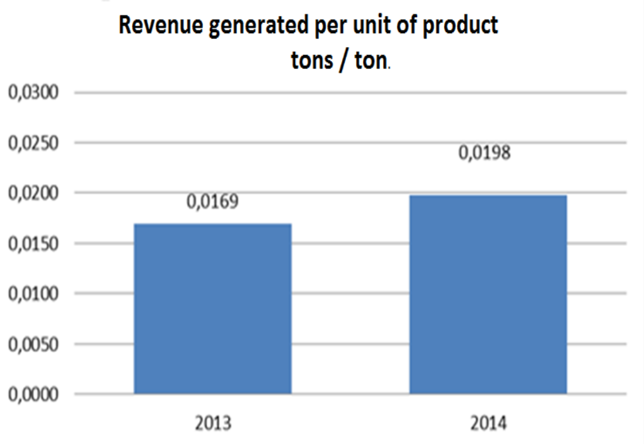
Table 3. Quantities of waste generated in 2013 Vs. 2014 Ordinary Waste Kilograms generated in 2013

Ordinary	**Waste Kilograms generated in 2013**	**Kilograms generated in 2014**
Carton	173.349	193.071
Wood	225.050	240.230
Plastic	147.351	168.191
TOTAL	**545.750**	**601.492**

Source: Author

Some studies state that recycling is an effective way to manage plastic waste and receives considerable attention. Since plastic blends are difficult to recycle because of their intrinsic characteristics, the separation of mixed plastics is the key problem for recycling. Separation of polyethylene terephthalate (PET) from municipal waste plastics (MWP) by foam flotation combined with alkaline pretreatment was investigated for recycling industry (Wang et al., 2015). The ratio of waste generated per unit of product in the years 2013 and 2014 went from 0.0169 to 0.0198, which means there was a 14% increase in the amount of solid waste generated per unit of product manufactured as illustrated in Figure 2, this increase is basically due to the fact that in 2014 there was a greater amount of waste sent to the material collection center due to the bad separation that prevents them being reincorporated to the process and to technical failures that presented machines due to failures in the plan Maintenance of equipment, which resulted in a decrease in production.

Figure1. Waste generated per unit of product



Source: Author

IV. CONCLUSIONS

From the results shown the following main conclusions can be obtained: (i) Lack of training to operators in waste management; (Ii) Lack of tools that allow adequate separation at source, (iii) Lack of policies in the company that promote environmental education in the area, (iv) Activities with the highest generation of solid waste (cardboard, plastic, Wood) are those of the reception and storage processes and the packaging process in each of the plants.

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