

# Sustainability in motion at UAO: integrated waste management

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**Abstract.** The Universidad Autónoma de Occidente (UAO), located in Cali (Colombia), launched the Sustainable Campus Program in 2015, in order to implement sustainability actions and strategies within the University campus with the purpose of contributing both to a better environmental performance of the campus operations and to generate knowledge and experience than can be used in the context of cities and regions in their search for reaching sustainable conditions. Integrated waste management is one of the components of the UAO Sustainable Campus Program. Based on the categories and indicators presented in the GreenMetric 2017, the integrated waste management includes the program to reduce the use of paper and plastic in campus, recycling program for university waste, toxic waste handled, organic waste treatment and inorganic waste treatment. **Keywords:** Integrated waste management, sustainable campus.

## 1 Introduction

The Sustainable Campus Program of the Universidad Autónoma de Occidente –UAO– (Cali, Colombia) was launched in 2015. Being a sustainable campus requires performing and promoting local, regional, national and global actions and activities to minimize negative impacts on the environment, economy, society and health, resulting from its teaching, research and projection functions Social. In addition, a sustainable campus considers and promotes environmental, social and health practices and considerations in these three activities and at all levels.

In this order of ideas, a sustainable campus is an environmentally healthy space, which promotes the efficient use of natural resources, the reduction of waste generated in its processes, the recovery of local fauna and flora, animal protection, minimization of the use and disposal of hazardous materials and waste, sustainable and collaborative consumption practices, both in their community and in their local and regional environment. The University actively promotes this type of action in its community and its social and economic environment. The institution actively involves its knowledge, experience and human resources to address and provide solutions to the environmental and social challenges facing current and future society, with a view to establishing a balance between the needs of human beings and those of other beings with which we share the planet, to guarantee its process of evolution and integration in the web of life. For these reasons, it is proposed that the Sustainable Campus project be transformed into a strategic program of the University, taking into account the quantity and complexity of the factors with which it has been decided to work. Although the University has good results in the environmental

management of the campus, there is still much to be done in the aspects of each of the aforementioned components. Being coherent and building sustainability at home, require addressing multiple aspects, which merit being taken, each, as projects of a program that must be developed and consolidated in the medium and long term. The Program takes into account both campus operation aspects, such as integrated energy management, integrated water management, air quality and climate change, and integrated waste management. The latter is discussed in this work. Based on the categories and indicators presented in the GreenMetric 2017, the integrated waste management includes the program to reduce the use of paper and plastic in campus, recycling program for university waste, toxic waste handled and organic waste treatment.

## 2 Integrated waste management at UAO

### 2.1 Recycling program for university waste

Currently the University has a policy to reduce the use of pads and plastics on the campus, which includes training and awareness programs to make use of printing exclusively when necessary, as well as encouraging double-sided printing, the use of reusable bags and the use of reusable cups. The recycling program at the University is carried out by the separation at the source approach. All reusable materials are then stored and the deliver to private actor for material recovery.

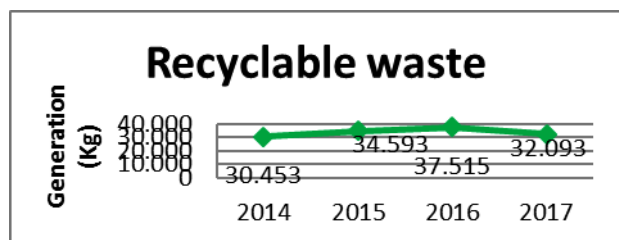
The University implemented the Integrated Solid Waste Management Plan in 2014, giving continuity to a waste management program established in 2005, with

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the objective of making an adequate disposal of solid waste, managing alternatives for collection, handling, treatment, material recovery and final disposal [1]. To carry out this initiative, the University has arranged various collection points within the university campus, allowing the academic community to separate the different waste fractions at the source. In addition, educational campaigns are carried out every six months to raise awareness among students, teachers and collaborators of the adequate disposal of waste in the bins, identifying them by color:

- Green: not recyclable (dirty napkins, food packaging and sweeping).
- Gray: recyclable (paper, cardboard, kraft, folding, glasses and cardboard plates).
- Blue: recyclable (plastic jars, pet, metal, polypropylene, video and tin).
- Brown: biodegradable waste (food waste of fruits and vegetables, stems and leaves of trees and pruning and gardens).
- Red - dangerous (luminaires, electronic waste, markers, fluorescent tubes, light bulbs, paint jars, oils, chemical residues).

The recyclable waste is stored and classified depending on the type of material, in the warehouse of the Technical Storage Unit to be delivered every 15 days to the company PROGECOL S.A.S, which is responsible for the recovery of recyclable materials in addition to the certification of the proper final disposal of the different material when they are not recovered. Figure 1 shows the generation of recyclable waste during the last 4 years, in which the year 2014 presented the lowest generation with 30,453 kg / year and the year 2016 presented the highest with 37,515 kg / year. The decrease for the year 2017 can be associated with the implemented policy to reduce the use of pads and plastics on the campus, which includes training and awareness programs to make use of printing exclusively when necessary, as well as encouraging double-sided printing, the use of reusable bags and the use of reusable cups [1].



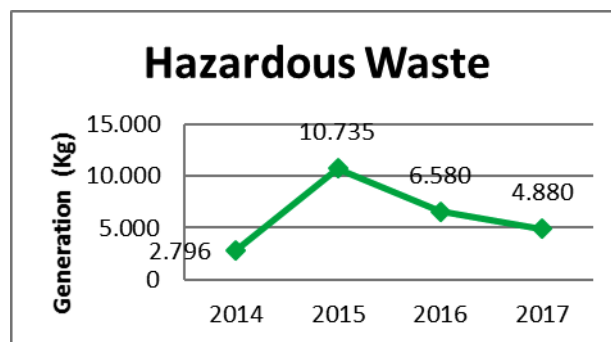
**Fig. 1.** Generation of recyclable waste during the last four years

## 2.2 Toxic waste handled

Toxic waste management is undertaken through high efficiency deactivation treatment for biosanitarios and sharps, incineration for toner cartridge waste - lubricants - markers, chemicals, maintenance and grease trap. Other treatment are employed for luminaires, electronic waste, batteries, vegetable oil from coffee shops and used

industrial oil from chillers and the emergency energy plant.

Weekly collection of hazardous waste generated in laboratories, nursing and collection points of the university [2]. In the case of laboratories and nursing, the personnel in charge must label the bags mentioning the elements that it contains and, in this way, prevent and inform the operator that performs the collection. The company that performs the external collection of hazardous waste from the university is RH S.A.S. This company is responsible for collecting them monthly, in addition it gives the university a certificate of final disposal. On average 550 kg / month of hazardous waste and 6,600 kg / year are generated. The second graph shows the generation of hazardous waste during the last 4 years [2]. The high generation of hazardous waste in 2015 is mainly due to Waste Electrical and Electronic Equipment (RAEEs), considering that in June the modernization of the computer equipment located in the study rooms was carried out with a generation of 4,372 kg / month.



**Fig. 2.** Generation of hazardous waste during the last four years

## 2.3 Organic waste treatment

According to the campus waste composition, organic waste has three significant components: food waste, garden waste and sludge from the wastewater treatment plant. For each of them, a monthly, annual and an average production report is presented. The total organic waste produced by the campus is treated through vermicomposting. It should be noted that the gardens of the University Campus are fed with the compost obtained by this process [3].

The University is currently carrying out two processes for the production of compost. The first is made with plant residues resulting from the pruning of trees, palms and cutting of the meadow. These wastes have an approximate utilization of 90%, considering that the remaining 10% are large residues that cannot be processed by the available chipper, therefore they are delivered to the company PROMOAMBIENTAL, who collects them between two and three times per month, depending on the amount of waste stored. Like the company RH S.A.S, PROMOAMBIENTAL delivers a certificate of final disposition to the University.

The generation of compost from vegetable waste is done in a nursery garden through a composting process.

This process consists of 4 phases: in the first phase a stacking of the vegetable waste is carried out and its size is reduced to facilitate the process, in the second phase the freshly cut material is placed and a natural decomposition process is carried out that lasts approximately 15 days. In the third phase the residue of phase 2 is combined with the one currently in this phase, in addition to adding purge honey and wheat bran to increase the reproduction of enzymes that allows the rapid decomposition of the plant material. In the fourth phase, the process of humus generation ends naturally. This product is strained and mixed with rice husk to be applied directly in the gardens of the university campus and the coarse material is reintegrated into the process. The compost generation inside the university lasts approximately 6 months and generates around 6 and 9 tons per year [4].

The second process to generate organic fertilizer is done through the vermicompost. For the generation of this product it is necessary to collect organic waste from the cafeterias that generate an average of 1,500 kg per month, of which approximately 90% is recollected and treated. The remaining 10% corresponds to material that cannot be treated in this process such as the shell of lemons and oranges.

Initially the cafeterias carry out the separation at the source of the usable organic waste, later they are transported to the nursery garden and deposited in some containers, which allow a natural decomposition to be carried out and then its size is reduced to facilitate the process. The leachate generated in this first phase is applied to the beds of the vermicomposting or in the second phase of composting from vegetable waste. At the moment the University has 14 beds of vermicomposting of which 10 are in operation, and these are fed between one and two times per week.

The method used for the generation of vermicompost is initially composed of a layer of compost generated from phase 3 of plant waste, a California worm base, again a layer of compost and a layer of organic waste that is fed around once or twice a week. The process lasts on average between 6 and 8 months and approximately 800 to 900 kg per bed are generated. The leachates generated in the beds are collected in individual chambers connected to the main collector, which are finally reincorporated in the second phase of the composting process carried out with plant residues.

Additionally, there is a bed specifically to work with sludge from the WWTP. This process starts with 90 kg of sludge, but as the sludge production is variable in quantity and quality, this bed must be fed with organic

waste, so the process is continued working under the same conditions as vermicomposting. This bed is fed on average once a week and the process last approximately eight to nine months generating about 500 kg [4].

### 3 Concluding remarks

In 2017 there was a decrease in the generation of recyclable waste, associating with the implementation of waste policy to reuse, recycle and reduce, in addition to the training and awareness programs implemented by the University for the whole community. In this way, it is essential to continue strengthening the policy and the programs implemented to continue reducing this type of waste significantly.

Based on last year's composting production, it is necessary to analyse in detail the delay presented during the process, considering that the generation of 2017 was less than 20% of the historical average.

The production of sludge generated in the WWTP is currently being included in one of the composting lines, however these sludges must be examined to improve their quality and quantity, considering that one of the objectives is the use and generation of organic fertilizer. In the current year a research project dealing with an assessment and optimization of the composting plant has been launched, as well as, a program to reduce the production of food waste in the campus.

### References

1. Universidad Autónoma de Occidente, *Informe general de residuos reciclables durante los últimos 4 años en la Universidad Autónoma de Occidente* (2017)
2. Universidad Autónoma de Occidente, *Políticas para el adecuado manejo y disposición final de los residuos peligrosos, además de la generación durante los últimos 4 años en la Universidad Autónoma de Occidente* (2017)
3. Universidad Autónoma de Occidente, *Manual para la generación de compost en el Campus y cifras históricas (2014 – 2017)* (2017)
4. Universidad Autónoma de Occidente, *Políticas para el adecuado manejo de los residuos ordinarios en la Universidad Autónoma de Occidente y entrega a la empresa prestadora del servicio de recolección* (2017)