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# Use of solid urban waste at the Technological Institute of Toluca

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**Abstract.** Solid Urban Waste (SUW) and Special Handling (EHW) generated in the Institution are handled in 200-liter plastic containers with the appropriate identification according to the type of waste and the race, placed in the buildings of each of the races; the waste is separated by the students following the criterion of the 4 Rs (Reduce, reduce, reuse and recycle). Reusable waste is used for students to make different products in the reuse workshop of the Institutional Environmental Program (IEP) such as paper pads, acetate pencil holders, pens, paper holder and paper board, among others for use by the Institution's population. With the organic waste (OR) compost is prepared in the composting center, which is used to fertilize the green areas. The recyclable waste is sold obtaining an economic benefit that allows the operation of the activities carried out by the (IEP). The (EHW) are concentrated in the "green point" to be sent to the "recyclers". The alkaline batteries, the Institution collects them temporarily, giving the service to the population of the Toluca valley to be sent to confinement by the municipality of Toluca. The use of Solid Urban Waste allows to form a sustainable environmental culture in the population of the Institution, such as savings in the consumption of paper, financing in the operation of the (IEP) and supporting the economy of the students.

### **Keyword:**

Solid waste, paper, composting, reuse, recyclable

## 1. Introduction

The Technological Institute of Toluca is a public technological education institution, located in the municipality of Metepec, state of Mexico. Mexico. In 1975 he began with higher level studies; Currently the schooling is eight engineering careers: Industrial, Chemical, Electromechanical, Electronics, Mechatronics, Logistics, Computer Systems and Information and Communication. In postgraduate studies, the Institution offers a master's degree in

Engineering Sciences and a master's degree in Environmental Engineering, as well as a doctorate in Environmental Sciences [1]. The institution has a population of approximately 6000 people, including students, professors and administrators.

The Technological Institute of Toluca (ITT) has more than a decade of participating in the care of the environment, inside and outside the Institution and in formal environmental education. For which it created an Environmental Management System considering the topics of Rational and Efficient Use of Water, Rational and Efficient Use of Electric Power, Comprehensive Management of Hazardous Waste and Comprehensive Management of Solid Waste, figure 1 and an Institutional Environmental Program (PAI) [2, 3], figure 2. With the creation of the (PAI) it was intended to group formal and non-formal environmental education activities and establish links with society, to influence the solution of environmental problems in the Toluca valley.

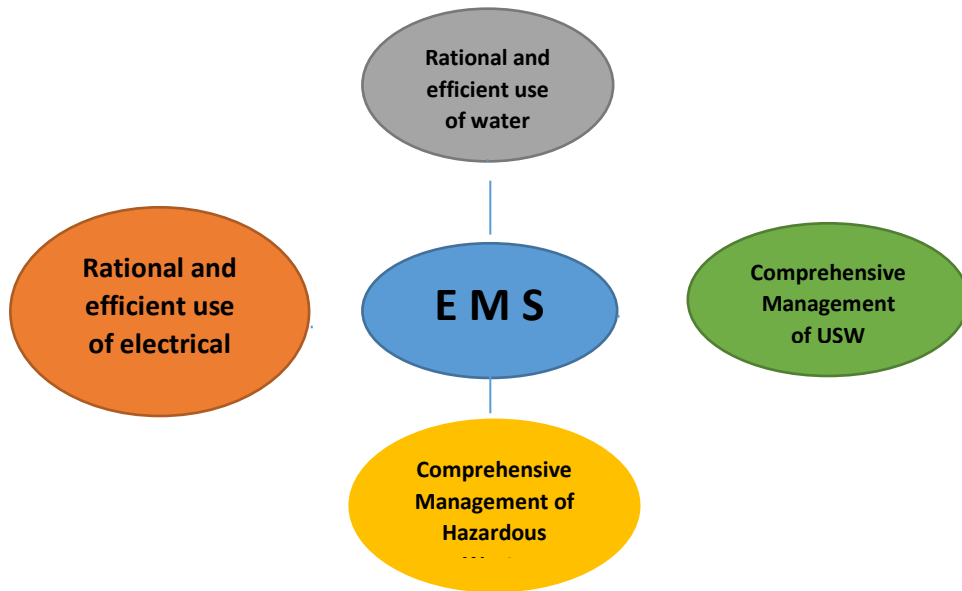
The objective set by the (PAI) is to manage, control, and dispose of the waste generated [4, 5]; promote the participation of the population in the solution of environmental problems inside and outside the Institution, link the different strata of society with knowledge and participation in the solution of environmental problems and make the (ITT) an environmentally and socially sustainable Institution responsible.

Commissions of students of social service or credits, collect the urban solid waste (MSW) generated by the population of the Institution; They are separated, weighed, recorded and delivered to the recyclable waste warehouse, the reuse workshop and the composting center for disposal. The recyclable waste goes to the collection center for sale; In the reuse workshop, the reusable waste is transformed by the students into more than ten products and the organic waste is processed to obtain compost. Special handling waste (RME), received from the Institution and the population of the Toluca valley, is mainly electronic waste, which is delivered to a company for its use. The alkaline batteries are received from the Institution and the population of the Toluca valley, to be sent to confinement by the municipality of Toluca. With the participation of society, government, academia and companies; The (PAI) coordinates an environmental program to conserve a volcano called Nevado de Toluca, carrying out remediation actions of eroded soils, elimination of (MSW) and control of eutrophication of two lakes, the Sun and the Moon located in the part alpina of the nevado de Toluca. Another program coordinated by the (PAI) is to mitigate the problem of global warming, carrying out activities to eliminate (MSW), capture rainwater and afforestation in a park of 1,255 hectares that is in the city of Toluca; with the average participation of 4,000 people per work cycle; carrying an approximate production of 240,000 timber trees.

## **2. Method**

### **2.1 Tools**

To participate in caring for the environment, the institution has an Environmental Management System that is presented in figure 1, which consists of four elements: Rational and efficient use of water. Comprehensive management of solid waste, comprehensive management of hazardous waste and rational use of electrical energy; of which the Institutional Environmental Program (PAI) supports the integral management of Urban Solid Waste.



## 2.2 The Institutional Environmental Program

It was created by the Institution to attend to the operational part and fulfill the objective of managing, controlling, and disposing of the waste generated by the Institution's population, the program has the organization that is presented in figure 2.

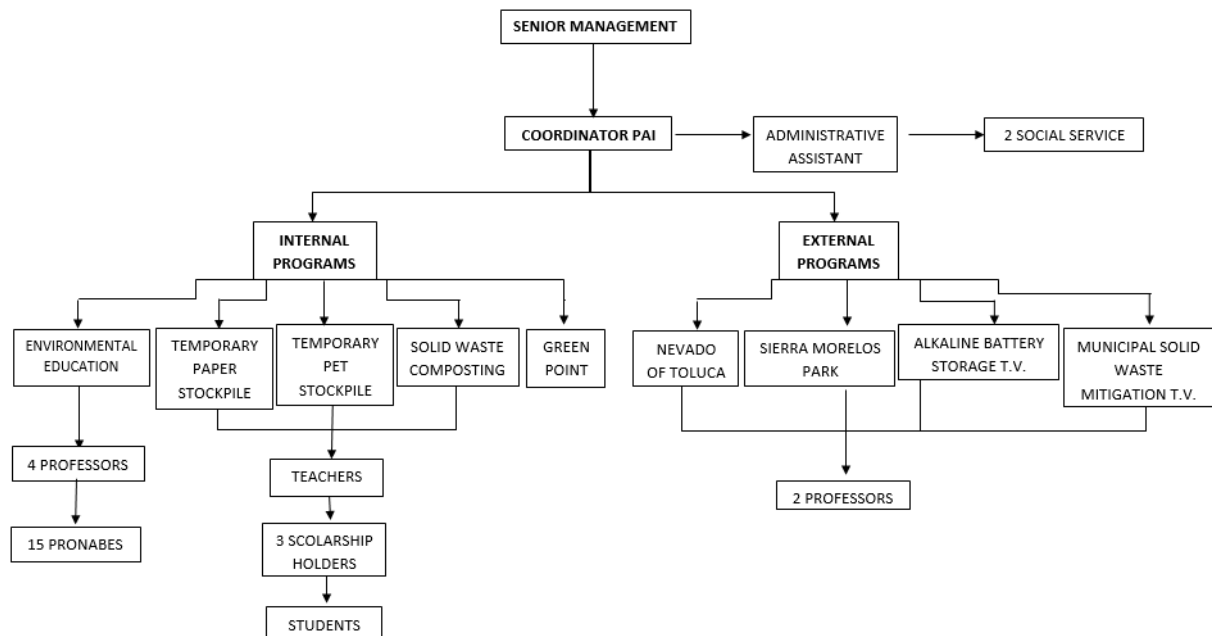


Figure 2. Organization chart of the Institutional Environmental Program

## 2.3 Coordination

The Institutional Environmental program depends directly on the operational part of the General Directorate of the Technological Institute of Toluca and administratively on the Division of Postgraduate Studies and Research

Before describing solid waste management, a consideration is made about its financing. The coordination signs agreements with companies that collect waste, for the collection of recyclable waste (paper, cardboard, pet, iron, aluminum, glass, high-density plastic, tetrapak, among others) obtaining a score that is exchanged for items in kind and / or cash; This makes the internal programs coordinated by the (PAI) self-financing.

The coordination for the control of the RSU, consists of two programs.

### 2.3.1. Internal programs

#### 2.3.1.1. Environmental Education Commission

Formed by a group of social service students, who are trained each semester in the environmental problems of the Institution and the planet, so that they can carry out talks and workshops to people inside and outside the Institution.

#### 2.3.1.2. Temporary Paper Stock Commission

It collects the solid waste that they control in high-density plastic containers of 200 liters capacity, placing five containers at the entrance of each building, they are labeled with the name of the race, with the type of waste that must be deposited and with a strip corresponding to the official color of the waste, figure 3. Students, teachers and support staff deposit their waste in the indicated containers, which are located in the materials reuse workshop, figure 4 a, or in the recyclable waste warehouse, figure 4 b.

There are Institutions that donate paper for reuse to the Technological Institute of Toluca who rewards them with products made with their waste, especially compost bags and paper pads of different sizes and types.



Figure 3. Containers to deposit the MSW. Left, Systems Engineering, right Logistics Engineering.

#### 2.3.1.3. PET temporary collection

Polyethylene terephthalate (PET) is the main waste that is generated in the Institution's dining room, also obtaining glass and tetrapak, which are collected in the temporary waste warehouse figure 4 b.



#### 2.3.1.4. Composting RSO

The Organic Solid Waste generated mainly in the Institution's dining room is composted in the composting center by students of social service and loans. Researchers compost organic solid waste in bioremediation projects with biosolids, to improve quality and speed. The product is used as fertilizer in the green areas of the Institution; it is also donated to staff at events inside and outside the Institution, figure 5.



#### 2.3.1.5. Green Point

An adapted place with containers for the collection of special handling waste (RME), accepting only electronic waste and computers generated in the Institution, extending the service to the society of the Toluca valley, to be delivered to the contracted company or to the “recyclatrones” for their use. The waste is registered and the personnel who deliver it are given compost bags, paper pads or some other incentive.

#### 2.3.2. External programs

External programs are linked to the federal, state and municipal government, academia, private initiative and society. The objective is to solve or mitigate the environmental problem. Currently, work is being done on the conservation of the Nevado de Toluca, an alpine zone; conservation of the Sierra Morelos Park in the city of Toluca; storage of alkaline battery and mitigation of urban solid waste in the Toluca valley.

### 3. Results

#### 3.1. Environmental education

Environmental Education is considered by the (PAI) as a way of changing students, directing them towards awareness and culturalization, thinking and acting, in the face of the environmental problems that most ecosystems on the planet travel through. Each semester the commission gives talks on Environmental Education emphasizing the dynamics of solid waste management and control to students of all careers. Talks and workshops on

Environmental Education issues are also given to companies, schools and institutions located in the city of Toluca and in the Toluca valley that request this support. A group of ten service students is trained at the beginning of each semester on management, control, and disposal of (MSW), (RME) and (RSO) [6], including information on benefits and damages that these wastes cause to the environment. At the beginning of each semester, these students officially give an Environmental Education talk to all the Institution's students, lasting five minutes; the teacher of each group signs the control, endorsing the activity.

### 3.2. Temporary paper collection

Waste management is done according to a semester program, where social service students, from Monday to Friday, collect the containers to separate recyclable and reusable waste according to the 4 Rs criteria (Reeducation, Reduce, Reuse and Recycle) [7, 6]: the recyclables warehouse and reuse workshop are weighed, registered and distributed, as the case may be: pet cardboard, HDPE, Fe, Al and letter size paper, staples, magazines, cardboard (folders), acetate sheets, CDs, floppy disks, polyethylene and some (PET). Students make some crafts following procedures established in the Workshop, such as blocks of different media and types, acetate pen holders, paper sheets, separators, pen floppy discs and polymer casting paper holders with staples, among others, which are used by the administrative staff and students of the Institution or sold in external events.

### 3.3. Temporary pet storage

Pet is hardly biodegradable waste, so it must be used as a recyclable material, or else stop using it. Institutions such as the Toluca Technological Institute are carrying out a program of "100% free of single-use plastic" through environmentally friendly actions, ceasing to use this type of plastics as a gesture of conscience and values.

The recyclable solid urban waste generated by the Institution's population during one year (2018), are presented in table 1.

Table 1. Solid urban waste generated in the Technological Institute of Toluca for a year.

CONCEPT	UNIT	QUANTITY
<b>Recyclable and Reusable waste</b>		
White paper	Kg	5,100
Newspaper and magazines	Kg	1,200
Paperboard	Kg	613
PET	Kg	750
HDPE	Kg	224
Iron	Kg	85
Aluminum	Kg	54
Electronic waste (EMR)	Kg	140,000 aprox.

Approximately 2,100 Kg per day of Urban Solid Waste (MSW) are generated in the Institution, of these, the most abundant waste is Inorganic Waste with 52% and Organic Waste 48%; adjusting the total (MSW) by its percentage, on working days (5 days per week), there is a generation of 1,070 Kg / day of inorganic solid waste. 390,608.4 Kg / year and 1,085

Kg / day; within inorganic waste, white paper was generated at 1.30%, followed by newspaper with 0.31% and PET with 0.19%.

From the waste generated, 100% of the white paper for reuse and recycling is used (newspaper, magazines, cardboard, pet, HDPE, iron and Aluminum) [8, 9, 10].

In table 2. Some products made with the residues reported in table 1 and general information are presented.

Table 2. Products made with residues that are reported in table 1.

Letter size white paper	Blocks	1,971
Small white paper, 1/4 letter	Blocks	513
Pens, pencil holders with floppy disks, picture holders, sheet separators, collage type notebooks, piza and paper holders with polymer casting and staples, among others, were elaborated.		
Social Service Release	Students	18
Release of fulfilled credits	Students	248
Release for administrative offenses	Students	22
Environmental Education talks	Students	1,120
Part of the RSO generated in the dining room is used in composting research projects		

Table 2. Shows the actors, their release after completing 480 hours of social service and the students who only take some credits in the MYP activities

### 3.4. Composting of organic waste

The function of this commission is to carry out the composting process of organic solid waste, under aerobic conditions, to use it as organic fertilizer [11] and to support the activities of researchers in bioremediation processes of biosolids and organic solid waste.

4.

### 3.5. Green Point

Special handling wastes (RME) and electronics that are controlled in the green point, are the ones with the highest generation after the (RSO), approximately 140,000 Kg / year were received.

The electronic waste that is generated in the Institution and externally as special handling waste.

### The external programs commission

In this commission, social service students attached to the Institutional Environmental Program, permanently provide support to external programs in the solution and / or mitigation of problems such as Urban Solid Waste, afforestation and reforestation, cubing of cisterns, gullies and ravines.

## 5. Conclusions

Despite the environmental problems that continue to affect the functioning of most



ecosystems, we continue to pollute the environment, which denotes a lack of Environmental Education, therefore awareness and culture; This can be seen in the generation of waste and the lack of its use. At the Institution, approximately 140 tons of electronic waste are being received per year and all of it is being used through recycling companies. Reusable waste such as paper, cardboard, acetates, staples among others; they are used one hundred percent, just like recyclable waste. RSOs are composted and used as organic compost.

The Institution is managing to change the mentality and attitude of students and people in society, making them participate in environmental programs, with the vision of solving and / or mitigating some problems that affect the environment and therefore organisms.

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