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Circular economy and waste management in the textile manufacturing industry

Economía circular y gestión de residuos en la industria textil

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Abstract

The Circular Economy presents a new logic for producing and consuming through the optimization of resources, technological innovation and the development of new business models. It is a model to advance towards a productive transformation that invites industries, the public sector, academia and civil society to adopt different actions. Such as the case of the textile and clothing industry, in which every season change a large number of garments become waste without being used. A paradigm shift opposed to the linear economy is proposed, based on a circular economy in which important cultural changes could be reached in society and lead to zero waste, where everything we produce and consume can safely return to nature or society, for this purpose, an application model is proposed in the textile manufacturing industry, for the detection of counting, handling, reduction and disposal of waste.

Circular economy, Life Cycle Analysis (LCA), Waste, 9R

Resumen

La Economía Circular presenta una nueva lógica para producir y consumir a través de la optimización de los recursos, la innovación tecnológica y el desarrollo de nuevos modelos de negocios. Se trata de un modelo para avanzar hacia una transformación productiva que invita a las industrias, sector público, academia y la sociedad de civil a adoptar diferentes acciones. Tal es el caso de la industria textil y de la confección, en la que cada temporada se cambia una gran cantidad de prendas que se desperdician sin ser utilizadas. Se propone un cambio de paradigma opuesto a la economía lineal, basado en una economía circular en la que se puedan alcanzar importantes cambios culturales en la sociedad y desembocar en un residuo cero, donde todo lo que producimos y consumimos pueda volver de forma segura a la naturaleza o sociedad, para tal fin, Se propone un modelo de aplicación en la industria textil, para la detección de conteo, manejo, reducción y disposición de residuos.
Palabras clave

Economía circular, Análisis del ciclo de vida (ACV), Residuos, 9R

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Introduction

The linear economy has led to a rapid and global increase in resource extraction. Its basic logic is to extract primary natural resources, producing an ever-increasing quantity of products, generally designed not to last long, involving dubious environmental standards and toxic effects. The products are then transported around the world by means of intensive use of energy, ensuring their fast and compulsive consumption, where they are finally disposed of in landfills or incinerators. In this sense, the linear economy is not only driving excessive consumption and unsustainable exploitation of natural resources, but also contributes to increasing waste production, a problematic aspect in itself, (Fischedick, M., et al., 2014).

The IPCC already recognizes that programs that reduce, reuse, and recycle municipal waste are effective and high-impact means of reducing greenhouse gas emissions. In fact, a zero-waste circular economy goes beyond the 3 Rs model and proposes a much more comprehensive transformation of our production and consumption patterns to achieve high resource efficiency and thus move towards a zero-waste society and zero emissions (Waste hierarchy, 2013).

As opposed to the linear economy, the basis of a circular economy is a zero-waste society, where everything we produce and consume can safely return to nature or society.

The best waste is the one that is never produced. In fact, waste prevention and reduction is the preferred option in the waste hierarchy in terms of sustainability (Fig. 1).

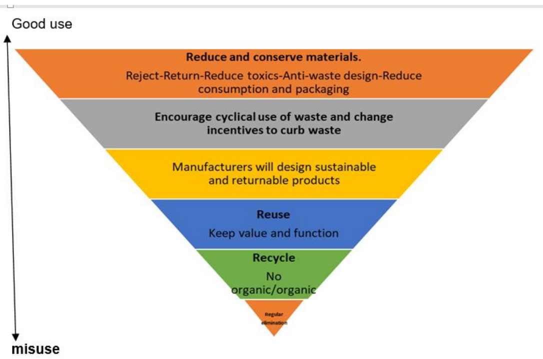

Figure 1 Waste hierarchy

Textiles, aluminum, food waste and plastic are among the main wastes that can be decisive for the mitigation of climate change, if they are reduced (Eunomia, 2015). In the production of textiles, for example, greenhouse gas emissions totaled 1,200 million tons of CO2 equivalent in 2015, more than the total generated by all international flights and maritime transport combined, mainly due to the "fast fashion or fast fashion" of the global rates of production and consumption of clothing products. If only the average number of times a garment is worn were doubled, GHG emissions would be 44% lower (Ellen MacArthur Foundation, 2017). A zero-waste circular economy for textiles, including high utilization rates for clothing, improved recycling, and reduced waste in production, would reduce negative impacts.

One of Mexico's great challenges is waste management since it produces more than 44 million tons per year and this number is estimated to reach 65 million by 2030. Today, approximately 90 percent of solid waste ends in outdoor dumps or landfills (Gutiérrez, 2006)).

The textile sector in Mexico consists of approximately 20,000 companies, of which 90% are small and medium-sized (SMEs), responsible for around one million direct and indirect jobs Information from the System of National Accounts of Mexico of the National Institute of Statistics, Geography and Information Technology (INEGI), indicates that from 2003 to 2017, the sector has remained relatively stable and has generated more than 120 million pesos annually with a slight upward trend since 2012 (INEGI, 2018).

This project arises from the need for the Textile Manufacturing company established in Hidalgo State, México, to carry out a diagnosis of the current situation of the generation of waste and create a history of its management, developing and implementing a program in the clothing and embroidery area based on existing Mexican regulations.

The project focused on the following points: identify, classify, quantify the waste from the manufacturing and embroidery process.

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The form of reduction from the source generation, economic, environmental valuation without forgetting the final disposal, through the participation of its personnel to create environmental awareness, through the reuse, recycling and reincorporation of some by-products to the process seeking to implement objectives of the circular economy.

Methodology to be developed

The focus of the study is quantitative descriptive experimental since it seeks to determine what waste is generated and in what quantity to make a management proposal that will be implemented and feedback will be given to the managers and personnel involved, with the consecutive training and to observe its effects on other variables.

Theoretical Methods

The methods used were those described in the Official Mexican Standards on waste: NOM-051-Semarnat, NOM-052-Semarnat-

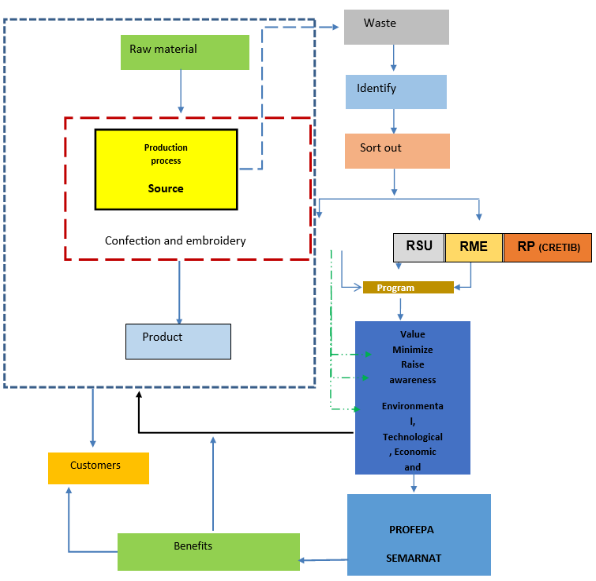

Figure 2 Methodology applied
Source: Own elaboration

Results

A daily count was made of each of the identified residues; Obtaining as a result that 73.68% of Solid Urban Waste and 13% of Hazardous Waste are generated and the same percentage of Special Handling Waste (Table 1). In each of the types of waste it is feasible: Avoid its generation, minimize it, reuse, recycle and, failing that, recycle.

Classification	Units	Percentage
Special Handling Waste	5	13.15%
Dangerous residues	5	13.15%
Municipal Solid Waste	28	73.68%
TOTAL	38	100.00%

Table 1 Results of the garment area waste classification
Source: Own elaboration

In figure 1 we can see that of the MSW the one that is generated in greater quantity is the fabric, followed by the paper and in third place of generation is the thread. All of them can be done through training and awareness of staff; eliminate or decrease its generation.

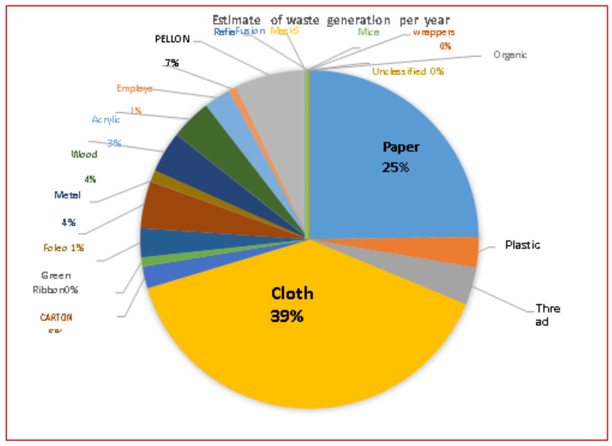

Figure 1 Estimation of MSW in one year
Source: Own elaboration

In table and figure 2 we can specifically review the hazardous wastes that were identified. These wastes were reviewed in their safety data sheets (SDS) and non-hazardous alternatives were identified to replace them.

Product	quantity	weight (Kg)	
		Weight per unit	Total
loose everything	12 piezas	0.121 Kg	1.452 Kg
Adhesive 62O	72 piezas	0.121 Kg	8.712 Kg
silicone248	12 piezas	0.121 Kg	1.452 Kg
Oil	24.22 L *	0.90 Factor	21.798 Kg
Silicone 223	12 piezas	0.121 Kg	1.452 Kg
Plastic cleaner	6 piezas	0.121 Kg	0.726 Kg
Contaminated rags	2 bolsas		2.369 Kg
TOTAL			**37.961 kilograms**

Note: The conversion of the liters of oil generated to kilograms was carried out through the density of the lubricating oil, which is 900 kg / m3, so that 1 liter of oil weighs 0.900 kilograms, information taken from (LIQ-ES. A de CV (nd). safety data sheet soluble oil product 1: 20 and 1: 30)

Table 2 Kilograms of RP generated in one year (estimate)
Source: Own elaboration

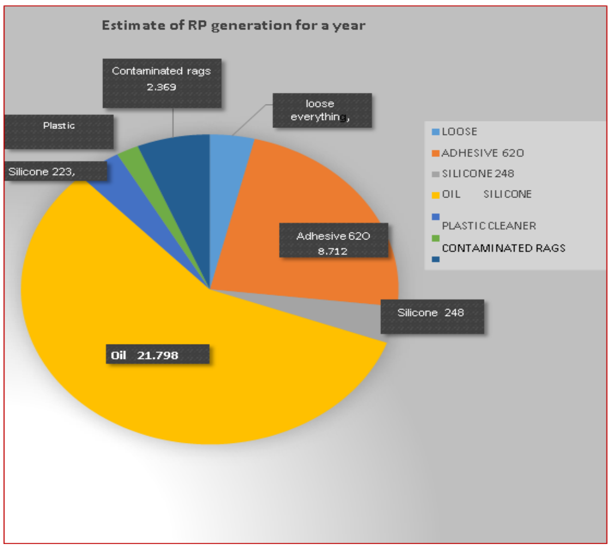

Figure 2 We can see that the RP that is most generated is Oil, followed by Adhesive and in third place, contaminated rags

The estimation of the RME generated in a year is made and the following graph is obtained, see (figure 3). Which shows the kilograms of each waste and the percentages they represent annually.

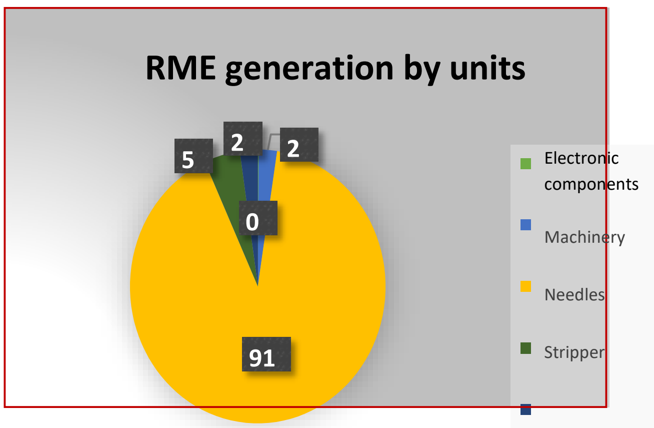

Figure 3 Results expressed in kilograms of SMR and their respective percentage

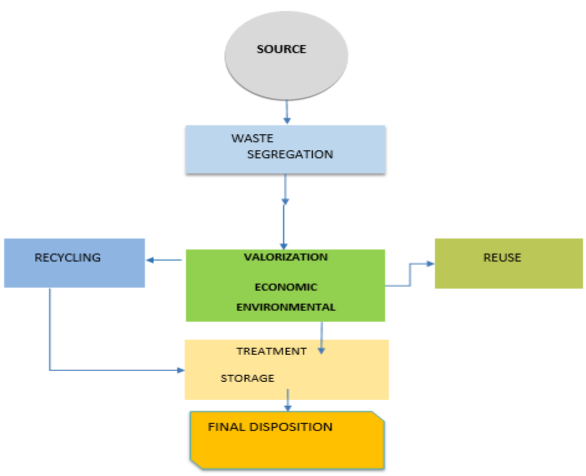

Figure 4 Process for waste reduction
Source: Own elaboration

Figures 4 and 5 represent the waste management procedure: MSW and RME; They will be economically valued once classified and separated and will be channeled for Recycling, Reuse and treatment. It is proposed to reduce the generation of those destined for Final Disposal.

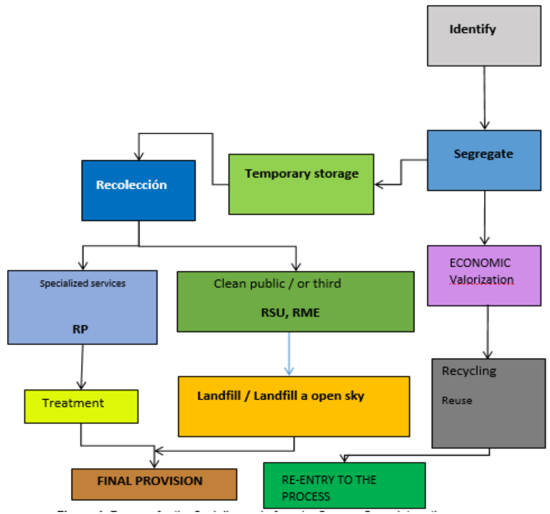

Figure 5 Process for the final disposal of waste
Source: Own elaboration

It is proposed to adopt the classification of waste by colors in accordance with the Design Guide for the Graphic Identification of the Integral Management of Urban Solid Waste of the (SEMARNAT, 2018).

For the identification and segregation of the waste generated in the clothing and embroidery area, separation by colors was proposed, in order to obtain a visual aid, and accelerate the learning process, reducing time for the staff.

In Hidalgo, state there is no a NOM that specifies the correct separation of waste by colors, for this reason the federal *Design Guide for the Graphic Identification of the Integral Management of Solid Urban Waste 2015* and the environmental standard were used for the federal district NADF-024-AMBT-2013, which establishes the criteria and technical specifications under which the separation, classification, selective collection and storage of waste from the federal district must be carried out. Following, the correct iconography is presented to classify the waste generated in the clothing and embroidery area, it is of vital importance that all the members of the departments know it. It is recommended to implement strategies to disseminate such information (figure 6**).**

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Figure 6 Proposed iconography for the primary and secondary classification of urban solid waste
Source: (SEMARNAT, 2018)

Subsequent, the location within the area of preparation and embroidery of the containers for the collection and classification of waste is proposed.

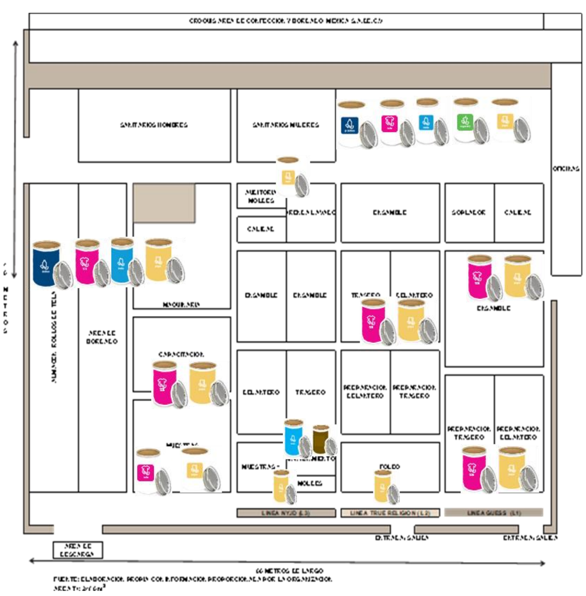

Figura 7 Container location in process area
Source: Own elaboration

Conclusion

The Textile Manufacturing sector produces, to a greater extent (73%) Urban Solid Waste, which is viable for reuse, recycling and, above all, its reduction. It is important to note that the amounts were estimated without prior awareness and training. It is expected that after these events the generation of the different types of waste decreased. It is feasible in this sector to carry out the zero-waste policy.

A zero-waste circular economy needs the help of policies that make the sale of services in lieu of goods legally and economically viable, that goods are durable and repairable, reusable and upgradeable, that promote shared or leased ownership, and support programs. deposit and return.

In short, the consumption of resources should be discouraged and services around products, such as their maintenance and repair, should be encouraged, where in turn they should be more economical.

Also increase taxes on the use of virgin natural resources; This will help decrease the use of resources while encouraging companies to adopt circular patterns of production and consumption.

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