Article **Journal-General Economics**
December 2021, Vol.5 No.9 1-8

Diagnosis of cleaner production in automotive mechanical workshops in Ciudad Valles, S. L. P.

Diagnóstico de producción más limpia en talleres mecánicos automotrices en Ciudad Valles, S. L. P.

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DOI: 10.35429/JGE.2021.9.5.1.8 Received July 10, 2021; Accepted December 30, 2021

Abstract

The objective of this study was to prepare a diagnosis of cleaner production in the automotive repair shops of three companies in Ciudad Valles, S.L.P., to determine the input and output materials of their processes, legal compliance in terms of hazardous and solid urban waste, and to propose recommendations. An exploratory research was carried out to determine the problem. To do so, information provided by SEMARNAT and the Municipal Ecology Office was used as a starting point to determine the number of mechanic workshops registered in the locality, and pre-diagnosis visits were made to these workshops. Descriptive research was used to collect data, through techniques such as interviews and observation, to prepare flow diagrams of the processes carried out in the workshops. The data from the diagrams were used to identify the materials used and the waste generated in the processes. The applicable regulations were reviewed and compliance with them was evaluated. Personnel were involved to learn about the legal requirements regarding waste, as well as to consider the need to comply with them as a priority.

Cleaner production, Hazardous waste, Municipal solid waste, Environmental regulations, Management plan

Resumen

En el presente trabajo se planteó como objetivo, elaborar un diagnóstico de producción más limpia en los talleres mecánicos automotrices de tres empresas de Ciudad Valles, S.L.P., que permitiera conocer los materiales de entrada y salida de sus procesos, el cumplimiento legal en materia de residuos peligrosos y sólidos urbanos y proponer recomendaciones. Se realizó una investigación exploratoria para determinar la problemática. Para ello, se partió de la información proporcionada por la SEMARNAT y Dirección de Ecología del Municipio respecto a los talleres mecánicos registrados en la localidad, se realizaron visitas de prediagnóstico a los mismos y posteriormente se seleccionaron a los participantes. Se hizo uso de la investigación descriptiva, al recolectar datos, mediante técnicas como la entrevista y la observación, para elaborar los diagramas de flujo de los procesos que se llevan a cabo en los talleres. Con los datos de los diagramas se identificaron los materiales usados y los residuos generados en los procesos. Se hizo una revisión de la normatividad aplicable y se evaluó su cumplimiento. Se propició el involucramiento del personal para conocer los requisitos legales en materia de residuos, así como para considerar prioritaria la necesidad de dar cumplimiento a los mismos.

Producción más limpia, Residuo peligroso, Residuos sólidos urbanos, Normatividad ambiental, Plan de manejo

Citation: RUEDA, Belzabet, VIDAL, Eleazar, ACOSTA, Dulce and HUERTA, Rosalba. Diagnosis of cleaner production in automotive mechanical workshops in Ciudad Valles, S. L. P. Journal-General Economics. 2021. 5-9:1-8.

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Introduction

In the history of humanity, domestic and economic activities have been developed for which renewable and non-renewable natural resources are used. From these activities, waste is generated that, according to Mexican environmental legislation, in terms of waste, can be urban solid, dangerous and special handling.

The irrational use of natural resources and the generation of waste have an environmental impact on the soil, water and atmosphere, a situation that has contributed to climate change.

Due to the above, the United Nations (UN) and the governments of these nations have made efforts to address this problem. In 1989, the concept of Cleaner Production was born in the United Nations Environment Program (UNEP). In 1992, the Earth Summit was held in Rio de Janeiro, in which the Agenda 21 World Plan emerged, which contains the guidelines aimed at adopting a development approach that would protect the environment while ensuring economic development. And social. In response to the above, the United Nations Organization for Industrial Development (UNIDO) establishes the need to create National Centers for Cleaner Production. As part of this world project, it was born at the national level, in December 1995,

The objective of the CMP+L is to promote the transfer of technical information, experience and cleaner technologies from developed and developing countries, to industrial organizations and government institutions in Mexico through the incorporation of the concept of Cleaner Production (P+L) to its Environmental Management programs.

LP+L arises from process engineering as a result of their continuous improvement. In addition, it channels its efforts through the efficient use of resources, reducing the generation of by-products from industrial activities and services. It contemplates from simple changes in the operational procedures of easy and immediate execution, to major changes, which imply the substitution of raw materials, supplies, more efficient production equipment, among others.

In terms of processes, cleaner production includes the conservation of raw materials, water and energy, the reduction of toxic raw materials (toxicity and quantity), emissions and waste, which go into the water, into the atmosphere and to the ground. Regarding products, the strategy aims to reduce all impacts during the product life cycle from the extraction of raw materials to the final waste; promoting friendly designs according to the needs of future markets.

Cleaner production allows for greater environmental and economic benefits, since it focuses on reducing the generation of waste at its source, minimizing its quantity and increasing efficiency in resource management. Otherwise, the management of waste at the end of the process, although it reduces or minimizes the environmental impact, generates less economic benefits for the company. See figure 1.

Figure 1 Pyramid approach to waste management, from the Cleaner Production approach

As far as its application is concerned, one of the sectors that could benefit is that of automotive repair and maintenance services.

According to the National Institute of Statistics and Geography, there are 185,720 establishments in the country dedicated to automotive mechanics, repair, maintenance and electrical service, which generate around 500,000 jobs and more than 90% are micro-enterprises.

The automotive workshop sector in Mexico is classified into three sub-branches: mechanical and electrical repair, bodywork, upholstery and other bodywork repairs, and other repair and maintenance services.

Of the activities carried out in this sector, each year more than 325 million liters of used oils are generated in Mexico, and other waste such as used fats, antifreeze, solvents, brake fluids, oil filters, paints, batteries, containers and tires (see figure 2).

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Therefore, giving proper management to said waste is one of the main problems to be solved by the three levels of government, the productive sector and educational institutions.

Figure 2 Hazardous waste generated in automotive repair shops

This project was developed in the automotive mechanical workshops of three companies, through the following phases: identification and analysis of input and output materials of the processes; identification and quantification of hazardous and solid urban waste; analysis of the management and disposal of hazardous and solid urban waste, as well as an evaluation of compliance with applicable environmental regulations.

Methodology to develop

The Head of the Regional Coordination Unit of the Huasteca Zone of the Ministry of the Environment and Natural Resources, in Ciudad Valles, was contacted to learn about the priority aspects of attention in environmental matters; being one of these, the hazardous waste generated in the mechanical workshops of the locality.

It is based on the following premise: the waste generated in mechanical workshops is not handled properly.

To study this problem, the mechanical workshops of three companies were chosen based on their size (medium and large) and their availability to participate in the study.

The large company "A", dedicated to the passenger transport service, has a fleet of 359 units. Medium-sized company "B", dedicated to industrial assembly services, has 24 automotive units. Medium-sized company "C" offers cargo transportation services and has a fleet of 30 trailers.

The objective of this work was to develop a diagnosis of Cleaner Production in three automotive mechanical workshops of companies in Ciudad Valles, San Luis Potosí, which would allow the identification of hazardous waste and urban solids that are generated, quantities and their management.

An exploratory investigation was carried out to determine the problem. To do this, we started from the information provided by the Regional Coordination Unit of the Huasteca Zone of SEMARNAT and by the Ecology Directorate of the Municipality, regarding the priority aspects of attention in environmental matters and the mechanical workshops registered in the locality, respectively. Prediagnostic visits were made to them and subsequently the participants were selected.

Descriptive research was used, by collecting the data of the problem, through techniques such as interview and observation, to prepare the flow charts of the processes that are carried out in the workshops. With the data from the diagrams, the materials used and the waste generated in the processes were identified.

Once the waste was identified through process diagrams, it was classified into urban, hazardous and special handling solids, according to the General Law for the Prevention and Integral Management of Waste, 2008. Subsequently, the formats for the registration of waste were designed. hazardous and urban solids. For this, concepts of area, generating activity, type of waste, quantity generated, waste management and final disposal were used. In addition, the format was promoted with the mechanics for daily use.

We reviewed current environmental regulations and identified those applicable to hazardous waste and urban solid waste in order to evaluate compliance with them.

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Training was provided to the workers of the automotive repair shops on cleaner production practices and the benefits of their implementation, in addition to making clear what waste is, its classification, the main wastes identified in the company during its processes, the impact caused to the environment and human health, as well as the proper management of these wastes.

Finally, the data obtained were described, analyzed and interpreted.

Results

Identification and analysis of input and output materials of the processes

In the development of the diagnosis, the maintenance and repair processes for units were identified and analyzed, these being: general greasing, motor service, electrical system service, transmission and clutch service, hydraulic system service, differential service (inter and motor), fuel services, air and brake system service, intake system service, wheel system service, rims and tires. For each process, the inputs and outputs of materials were identified, as shown in the example of Figure 3.

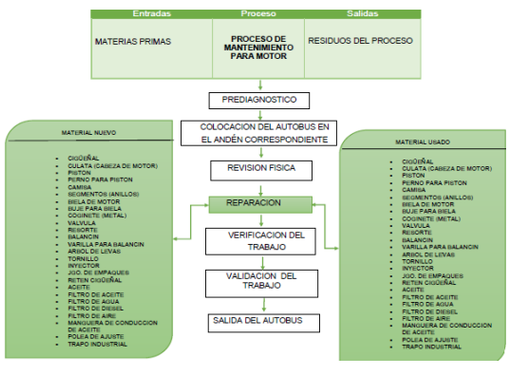

Figure 3 Flowchart for the identification of inputs and outputs of materials in the maintenance process for the engine

The analysis of the processes, shown in the previous figure, allowed to identify the materials used and the waste generated, such as: used oils, impregnated tow, filters, oil conduction hoses, used spare parts, tires, batteries, among others.

Identification and quantification of hazardous and solid urban waste

Hazardous waste and urban solid waste were identified and quantified, and generation per year was estimated. The results of these activities are shown in the following two tables:

Residuos Peligrosos/año	**Empresa A**	**Empresa B**	**Empresa C**
Aceite usado (l.)	27000	2600	3297
Filtros usados de aceite (ton.)	1.74	0.13	0.50
Filtros usados de diésel (ton.)	2.16	0.08	0.28
Trapos o estopas impregnadas (ton.)	0.24	0.08	0.01
Recipientes vacíos de: anticongelantes, líquidos de frenos, aerosoles. (ton.)	0.08	0.24	0.20
Anticongelantes y líquidos de frenos (l.)	2160	567	735
Desengrasante contaminado usado para el lavado de piezas (l.)	ND	189	144
Baterías usadas (ton.)	20.1	0.408	ND
Lámparas fluorescentes (pzas.)	50	25	12
Lodos contaminados (ton.)	18	ND	ND
Tierra contaminada con aceite (ton.)	ND	ND	ND

Table 1 Identification and quantification of hazardous waste

It is observed that the activities carried out in automotive repair shops generate a variety of hazardous waste, with used oils being the most important due to the amount generated and their toxicity and flammability characteristics.

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Residuos no peligrosos generados por año	Cantidades y Manejo de RSU				
	Empresa A		Empresa B		Empresa C
	Cantidad (ton./año)	Disposición	Cantidad (ton./año)	Disposición	Cantidad (ton./año)
Latas de aluminio	1.37	*Ejido San Felipe	ND	ND	ND
Botellas de Pet	8.06	*Ejido San Felipe	0.32	Vertedero mpal.	ND
Botellas de vidrio	4.2	*Ejido San Felipe	ND	ND	ND
Envolturas de plástico	2.3	*Ejido San Felipe	0.65	Vertedero mpal.	ND

Table 2 Identification, quantification and management of urban solid waste

Regarding urban solid waste, it was found that in company A, dedicated to the passenger transport service, a considerable amount is generated, which does not have a revaluation (See Annex No. 1), for which a management plan is required. comprehensive management for them.

Analysis of the management and disposal of hazardous waste

Likewise, the CRETIB hazard characteristic was identified for each hazardous waste, with the support of NOM-052-SEMARNAT-2005 and the classification in storage (See Annex No. 2). The management given to its hazardous waste was also identified. The results are shown in the following table:

Tipo de residuo peligroso	Manejo		
	Empresa A	Empresa B	Empresa C
Aceite usado (l.)	Entrega a empresa autorizada	Almacén temporal, disposición final a empresa autorizada	Entrega a empresa autorizada
Filtros usados de aceite (ton.)	Entrega a empresa autorizada	Vertedero municipal	Entrega a empresa autorizada y vertedero mpal.
Filtros usados de diésel (ton.)	Entrega a empresa autorizada	Vertedero municipal	Entrega a empresa autorizada y vertedero mpal.
Trapos o estopas impregnadas (kg.)	Vertedero municipal	Vertedero municipal	Entrega a empresa autorizada y vertedero mpal.
Recipientes vacíos de: anticongelantes, líquidos de frenos, y aerosoles (ton.)	Vertedero municipal (líquidos de frenos, y aerosoles)	Vertedero municipal	Vertedero municipal
Anticongelantes y líquidos de frenos (l.)	Se junta con el aceite	Vertedero municipal	Entrega a empresa autorizada
Desengrasante contaminado usado para el lavado de piezas (l.)	Vertedero sin control	Vertedero sin control	Entrega a empresa autorizada
Baterías usadas (ton.)	Proveedor	Proveedor	Entrega a proveedor
Lámparas fluorescentes (pzas.)	Vertedero municipal	Vertedero municipal	Vertedero municipal
Lodos contaminados (ton.)	Ejido San Felipe	Vertedero municipal	ND

Table 3 Hazardous waste management in the companies studied

It was found that used oils are the only hazardous waste delivered to companies authorized by SEMARNAT. Used batteries are delivered to the supplier and other hazardous waste is not handled in accordance with applicable environmental regulations.

Evaluation and analysis of compliance with applicable environmental regulations

In Mexico, there are different laws, regulations and standards in environmental matters; For this reason, the analysis of the environmental regulations applicable to the generation of hazardous waste was carried out, to determine the current compliance of the companies. The results are presented in the following table:

Requisito Legal	**Cumplimiento**		
	Empresa A	Empresa B	Empresa C
Registro como generador de Residuos Peligrosos	Sí	Sí	Sí
Plan de manejo	No	No	No
Bitácoras	No	No	No

Table 4 Identification of the requirements of the regulation of the general law for the prevention and integral management of waste

Annexes

Figure 4 Rsolid urban waste generated in company A

Tipo de residuo peligroso	**Clasificación CRETIB**	**Clasificación en Almacén**
Aceite usado (l.)	Tóxico-Inflamable	Aceites
Filtros usados de aceite (ton.)	Tóxico - Inflamable	Inflamables
Filtros usados de diésel (ton.)	Tóxicos	Tóxicos
Trapos o estopas impregnadas (kg.)	Tóxico-Inflamable	Inflamables
Recipientes vacíos de: anticongelantes, líquidos de frenos, y aerosoles (ton.)	Tóxicos	Tóxicos
Anticongelantes y líquidos de frenos (l.)	Tóxico-Inflamable	Inflamables
Desengrasante contaminado usado para el lavado de piezas (l.)	Tóxico-Inflamable	Inflamables
Baterías usadas (ton.)	Corrosivo-Tóxico	Metales pesados
Lámparas fluorescentes (pzas.)	Tóxicos	Tóxicos
Lodos contaminados (ton.)	Tóxicos	Tóxicos

Table 5 CRETIB and Temporary Warehouse Classification for hazardous waste

It is also worth mentioning that company A, which is a large generator, does not carry out the Annual Operation Certificate, nor does it have environmental insurance.

Gratitude

The participation of the companies and the support received from the Huasteca Zone Regional Unit Coordination of SEMARNAT is appreciated. Likewise, the participation of the students of the Technological Institute of Ciudad Valles and of the participating companies is recognized.

ISSN-On line: 2524-2008

Conclusions

In the diagnosis carried out, poor operating practices were observed, such as spills of oil, antifreeze, grease, disposal of hazardous waste in the municipal landfill, lack of recovery of urban solid waste, excessive consumption of materials caused by the lack of established procedures and operational controls.

Once the hazardous waste was quantified and in accordance with the Regulations of the General Law for the Prevention and Integral Management of Waste, it was determined that company A is classified as a large generator and companies B and C as small generators.

Company A found considerable amounts of urban solid waste that could generate significant economic income for the company when sold (aluminum, pet and glass).

The identification of the applicable regulations supports the control of environmental aspects, serving as a reference for the implementation of preventive and corrective measures.

It is recommended that the three companies design and implement an integrated management plan for their hazardous waste and urban solid waste, since they are only registered with SEMARNAT as waste generators, but do not comply with the other requirements of environmental regulations. The waste management plan should focus on waste reduction at the source, reuse and recycling, co-processing, and, as a last resort, landfill.

It would be important for the companies under study to consider the use of synthetic oil (high performance) as a measure to reduce consumption and, as a result, reduce the generation of used oil. Regarding oil management, it is important to store used oil in spill-proof containers and to separate it correctly.

A co-processing scheme can also be agreed upon to reuse the used oil generated in the automotive repair shops for the cement industry in the region, which can be used in the clinkerization process as an alternative fuel, generating environmental and economic benefits for both companies.

The automotive repair shops of companies A and B generate urban solid waste from the daily operation of their processes, which can be separated for sale and recycling. In the case of company A, the economic benefit from the sale of aluminum cans, glass, pet bottles, and wrappers can amount to $44,060 per year, which can increase if waste such as paper, cardboard, tires, and scrap metal are included. In the case of company B, the annual economic benefit from the sale of pet and plastic wrappers can be projected at $2,197.00 per year, an amount that should increase if the sale of paper, cardboard and scrap metal is considered. With respect to company C, although the data were not available, it is important to mention that it would apply in the same way to consider the sale of urban solid waste.

Finally, each of the unit maintenance and repair processes will be analyzed to detect the most significant environmental aspects and thus determine improvements in order to reduce the use of inputs and promote good operating practices.

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