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REDUCTION OF HAZARDOUS WASTE IN THE PAINTING PROCESS: CHALLENGES AND EFFECTIVE SOLUTIONS

REDUCING HAZARDOUS WASTE IN THE PAINTING PROCESS: CHALLENGES AND EFFECTIVE SOLUTIONS

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Abstract-- This paper presents the results of a strategic plan designed to incorporate effective solutions for reducing the generation of hazardous waste in the paint industry. This initiative arose in response to a clear problem faced by companies: the accumulation of this waste not only has a significant environmental impact but also poses a health risk to workers and can lead to legal and financial penalties for non-compliance with environmental regulations. Therefore, the urgent need to propose viable and, above all, sustainable solutions was identified. The research adopted a qualitative and descriptive methodological approach, as it sought to gain a comprehensive understanding of the painting process to analyze why and how this waste was being generated. Everything from daily operational practices to compliance with current regulations was evaluated, and strategies were developed for implementation by analyzing available resources and actual conditions within the plant. A continuous improvement approach was also adopted using the PDCA cycle (Plan, Do, Check, Act). This was complemented by key engineering tools to visualize critical waste generation points, which helped build a clear picture across different areas. A substantial reduction was achieved in the amount of waste generated and in the costs associated with its management. Likewise, a proactive organizational culture was adopted. The results are projected to be encouraging, both in environmental and operational terms. This research allowed not only for the analysis of a specific problem but also laid the groundwork for a profound change in the way work is conducted. It demonstrated that, with the right tools and a willingness to improve, it is possible to transform complex processes into practices that are more efficient, safer, and environmentally friendly.
Keywords-- Environmental impact, painting process, hazardous waste.

Abstract-- The results obtained from a strategic plan that incorporates effective solutions to reduce the generation of hazardous waste in the painting process are presented. This initiative arose in response to a clear problem faced by companies: the accumulation of this waste not only has a significant environmental impact but also poses a risk to workers' health and can lead to legal and financial penalties for non-compliance with environmental regulations. Therefore, there was an urgent need to

propose viable and, above all, sustainable solutions.

The research employed a qualitative and descriptive methodological approach, aiming to gain a comprehensive understanding of the painting process in order to analyze why and how this waste was being generated. Everything from daily operating practices to compliance with the current regulatory framework was evaluated, and strategies that could be implemented were outlined, taking into account available resources and actual conditions within the plant. A continuous improvement approach was also adopted using the PDCA (Plan, Do, Check, Act) cycle. This was complemented by key engineering tools to visualize critical waste generation points, which made it possible to build a clear picture across different areas. A substantial reduction in the amount of waste generated and in the costs associated with its management was achieved. Likewise, a proactive organizational culture was adopted. The results are projected to be encouraging, both in environmental and operational terms. This research allowed not only for the analysis of a specific problem but also laid the foundations for a profound change in the way of working. It demonstrated that, with the right tools and the will to improve, it is possible to transform complex processes into more efficient, safer, and environmentally friendly practices.

Keywords: Environmental impact, painting process, hazardous waste.

INTRODUCTION

The improper management of hazardous waste poses a significant risk to the environment and human health; therefore, this study focuses on a paint manufacturing company as an initiative to address this issue through the implementation of a strategic plan aimed at analyzing, identifying, and reducing the generation of hazardous waste. Through a preventive and continuous improvement approach, the goal is to optimize material handling practices by ensuring regulatory compliance, while simultaneously fostering a culture of environmental responsibility within the organization.

The proposal includes redesigning the preparation room to convert it into a technical area for mixing and dosing paints, thereby preventing excesses and reducing waste. Additionally, guidelines can be developed to modify the current procedure, ensuring quality and uniformity in the finishes.

The issues with the painting process are described in detail, highlighting that hazardous waste is generated in quantities requiring urgent intervention. The context, environmental implications, and associated risks are outlined, justifying the need to implement effective sustainable solutions that reduce environmental impact.

To support the proposal, key concepts related to hazardous waste, applicable regulations, and best practices for its management and reduction are addressed. Specific types of paint applicable to the process and their impact on waste reduction are also explored, providing a deeper understanding of the tools available to achieve the stated objectives.

The actions implemented to reduce hazardous waste are detailed, including the evaluation of current processes, the selection of materials, and training for the personnel involved. Improvements in the operational and administrative controls applied to the management of materials and waste are described, ensuring that the measures adopted are sustainable over time.

Finally, the results obtained show a reduction in the generation of hazardous waste and improved compliance with current environmental regulations. In addition, the economic and social benefits achieved by the company are analyzed, demonstrating that environmental responsibility also generates competitive advantages and contributes to strengthening corporate reputation. As González Morales (2022) notes, the joint implementation of regulatory and normative frameworks contributes significantly to the reduction of environmental and health risks, as well as to the improvement of operational efficiency in industries that generate hazardous waste.

OBJECTIVES

General

- To develop a strategic plan for the reduction of hazardous waste, ensuring compliance with environmental regulations and protecting workers' health.

Specific

- Identify the operational factors that contribute to the generation of hazardous waste during the production process.

- Ensure compliance with the applicable legal framework regarding environmental matters and hazardous waste management.
- Promote environmental awareness and responsible resource management.
- Establish procedures to ensure proper management of the painting process and its waste.
- Implement a monitoring and recording system to assess the impact of the strategies implemented on the reduction of hazardous waste.

JUSTIFICATION

The need for this research arises from the negative impact of the hazardous waste generated during the company's painting process. Currently, the accumulation of this waste not only poses a significant environmental risk but also exposes the company to regulatory penalties (both financial and administrative). Furthermore, continuing these practices jeopardizes the organization's sustainability and limits its chances of obtaining environmental certifications. This research project aims to establish an efficient and safe strategic plan to reduce hazardous waste. Through this initiative, we seek to promote environmental awareness and responsible resource management, as well as establish guidelines and procedures for resource optimization that contribute to a safer work environment for employees and a better brand perception among customers and authorities.

METHODOLOGY

The company has a total of 121 employees working at the plant, covering the areas of sales, engineering, administration and finance, production, quality control, safety, health, and the environment, human resources, and maintenance.

To address the problem of excessive hazardous waste generation in the painting process, a continuous improvement methodology based on the PDCA cycle (Plan, Do, Check, Act) was applied, supplemented by root cause analysis tools, direct observation of processes, and structured interviews with operational staff. This methodology enabled the systematic identification, analysis, and correction of detected deficiencies through various engineering tools, such as process analysis, the application of environmental engineering principles for the identification

and minimization of waste, as well as the implementation of continuous improvement methodologies. These tools will enable mapping of the current process, identification of critical points, and the proposal of viable technical solutions that ensure the project's long-term sustainability.

Instrument

To collect quantitative data, an interview instrument was used for the management and reduction of hazardous waste in the painting process, based on studies by Ciro Martínez Oropeza and Lázaro V. Cremades (2012).

Procedure

For this study, interviews were conducted with company employees to identify hazards in key work activities and assess their risk levels based on probability, severity, and exposure.

RESULTS

The achievements resulting from the implemented strategy were the establishment of and participation in two complementary fronts: operational and administrative. In the operational segment, we had the voluntary collaboration of the painting staff, who contributed their direct experience to identify opportunities for improvement in the paint mixing process. This involvement allowed us to optimize the segregation of hazardous waste generated during operations and laid the groundwork for better dosing in paint preparation, which will contribute to a gradual reduction in the generation of excess materials.

Meanwhile, in the administrative segment, actions were taken to formalize and systematize the process. Through continuous improvement sessions modeled after quality circles—without a rigid methodology but with a participatory approach—a documented set of instructions was developed to standardize the stages of paint calculation and use.

This enabled clearer and more consistent management of the process, facilitating compliance with current environmental regulations and promoting a more efficient use of resources. Both approaches, implemented in parallel, led to measurable reductions in hazardous waste, strengthening both regulatory compliance and the internal culture of continuous improvement.

Analysis and Diagnosis of the Problem

As part of the situational diagnosis, a representative weighing of the materials was carried out, with the aim of establishing the relationship between weight and volume generated. Based on this information, an analysis was conducted for the periods 2023 and 2024, considering the average weight relative to the volume generated. The results are presented in Table 2.1: Hazardous Waste Generation in kg (2023–2024).

Table 1. *Hazardous waste generation in kg (2023 vs. 2024)*

Tipo de residuos peligrosos	Cantidad de generación anual 2023 (kg)	Cantidad de generación anual 2024 (kg)
Sólidos impregnados	928.20	924.30
Recipientes vacíos (latas)	414.00	621.00
Aceite hidráulico	1,005.48	1,427.08
Arena contaminada	563.49	433.93
Agua contaminada de ácido	626.91	572.99
Natas de pintura	9,752.53	6,335.72
Fibra de vidrio	160.30	595.4
Bidones vacíos	62.60	28.00
Cubetas vacías	794.67	558.80
Total	**14,308.21**	**11,497.22**

Source: Author's *own calculations* (2025).

It is important to note that the data presented reflects the amount of hazardous waste in kilograms; however, some of this waste is generated and managed in volumetric units. Waste is expressed in units of weight, as this is the criterion used by the authorized supplier for its acquisition.

In addition, an average density value was used to minimize potential errors and ensure a more representative assessment in the analysis of hazardous waste generation, management, and classification.

The following findings emerge from the above:

The facility was classified as a small generator of hazardous waste (from 400 kg/year to 10 tons/year). According to the analysis, it has been determined that current waste generation exceeds this threshold, which implies a change in classification to a large generator of hazardous waste.

Figure 1. *Pie chart showing hazardous waste generation in 2023 vs. 2024*

Source: Author's *own work* (2025).

68% of the hazardous waste generated consists of paint residues (paint residues and cleaning process byproducts that are no longer usable). It is clear that hazardous waste management in the painting process is a complex challenge, but with the right information and the implementation of well-founded strategies, significant progress can be made; thus, this marks the beginning of a new challenge for the field.

Root Cause Analysis and Diagnosis

Reaffirming the above, we are now in a position to provide solutions that contribute to developing the strategic plan for reducing hazardous waste (paint sludge), ensuring compliance with environmental regulations, protecting worker health, and lowering production costs. To support this, the Ishikawa diagram "Generation of Paint Sludge" was created.

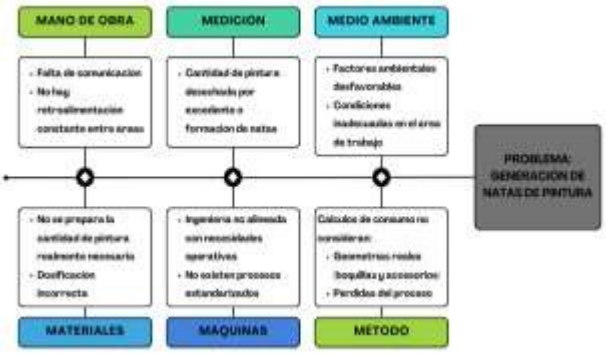


Figure 2. *Ishikawa diagram*

Source: Author's *own work* (2025).

This analytical tool made it possible to categorize and organize potential causes into six key factors associated with the company's operating environment:

Workforce: It was found that some staff members have communication gaps, as well as a lack of feedback between departments.

Measurement: The company lacks effective systems for monitoring and tracking waste, which leads to a significant amount of paint waste due to the formation of scum.

Materials: It was found that the actual amount of paint needed is not prepared because there is no control over dosages.

Machinery: Recurring technical failures occur due to the lack of standardized processes.

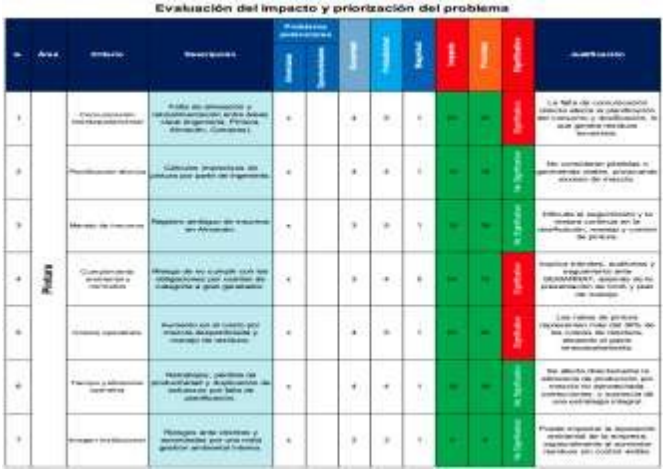
Methods: Work procedures are inadequate, which leads to losses in the process. **Environment**: Regarding the physical environment, environmental factors are unfavorable, and conditions are inadequate for the type of work being performed.

Operational risk assessment.

From an operational standpoint, the presence of foam indicates inefficiencies in the paint mixing and application process, which can lead to rework, material waste, and reduced productivity. The impact is also reflected in the company's corporate image, as improper waste management can result in legal penalties or negative perceptions among customers and authorities.

Table 2. *Impact assessment and prioritization of the problem.*

Evaluación del impacto y priorización del problema



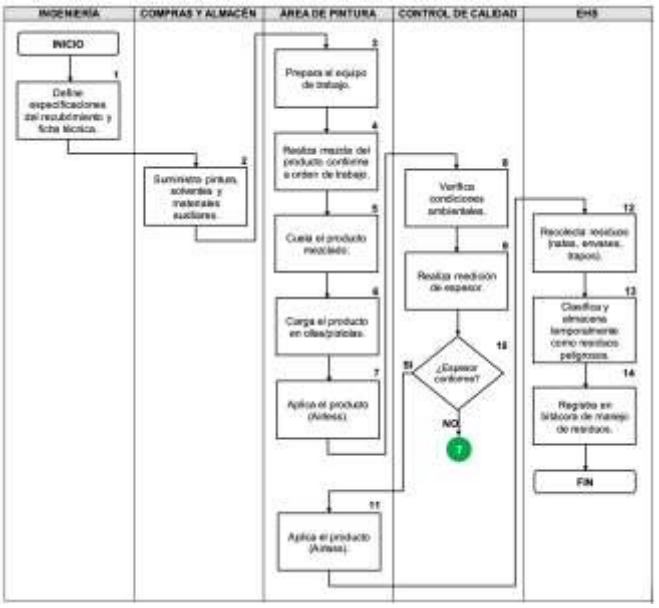
Source: Author's *own work* (2025).

Through this analysis, we can gain a clear understanding of the key findings to prioritize in order to achieve the objective of this research, while also providing a realistic roadmap for implementing improvements using engineering tools to ultimately reach the goal.

Classification and evaluation by area

The paint application process at the company has several operational flaws that significantly contribute to the excessive generation of hazardous waste. To clearly illustrate the current sequence of the process, Figure 3 presents a flowchart representing each of the stages involved, from the preparation of the work equipment to the final cleaning activities of the equipment used. This graphical representation facilitates the identification of critical points where material losses and waste generation risks are concentrated, and serves as a basis for designing improvement proposals.

Figure 3. *"Painting process" flowchart*



Source: *Prepared by the author* (2025).

Based on this prioritization, three fundamental criteria stand out that were developed in greater depth, each of which carries weight in the overall analysis. The identification and quantification of these factors not only allows us to understand the origin of the waste generated but also to more precisely guide the design of corrective strategies that promote more efficient environmental performance in compliance with applicable regulations.

Table 3. *Criterion 1.*

№	Área	Criterio	Descripción	Problema potenciales		Severidad	Probabilidad	Magnitud	Impacto	Prioridad	Significativo	Justificación
				Amenazas	Oportunidades							
1	Pintura	Comunicación interdepartamental	Falta de alineación y retroalimentación entre áreas clave (Ingeniería, Pintura, Almacén, Compras).	x		4	5	1	20	20	Significativo	La falta de comunicación directa afecta la planificación del consumo y dosificación, lo que genera residuos excesivos.

Source: *Prepared by the author* (2025).

The first criterion is classified as significant because the lack of communication between departments is inefficient; as a result, products are dosed incorrectly, inevitably leading to excesses that go directly to waste, which gives rise to the following risk. The strategy to be implemented is to establish collaboration circles (quality) among the departments involved.

Table 4. *Criterion 2.*

№	Área	Criterio	Descripción	Problema potenciales		Severidad	Probabilidad	Magnitud	Impacto	Prioridad	Significativo	Justificación
				Amenazas	Oportunidades							
4	Pintura	Cumplimiento ambiental y normativo	Riesgo de no cumplir con las obligaciones por cambio de categoría a gran generador.	x		3	4	2	24	12	Significativo	Implica trámites, auditorías y seguimiento ante SEMARNAT, además de la presentación de COA y plan de manejo.

Source: Author's *own work* (2025).

Regarding Criterion 2, the risk is classified as significant because the increase in the amount of hazardous waste generated changes the company's category from "small generator" to "large generator." This change entails new, stricter legal obligations under the General Law for the Prevention and Comprehensive Management of Waste (LGPGIR) and its regulations.

Table 5. *Criterion 3.*

Source: *Prepared by the author* (2025).

Criterion 3 is considered significant due to poor communication and the increase in hazardous waste generation, which directly results in higher operating costs. The operational risk analysis of the painting process identified key deficiencies related to interdepartmental communication, improper material dosing, and hazardous waste management. These factors not only increase the volume of waste generated but also raise operating costs and the risk of regulatory non-compliance.

Strategic Plan

To address the problem of excessive hazardous waste generation in the painting process, a continuous improvement approach based on the PDCA cycle (Plan, Do, Check, Act) was implemented, supplemented by root cause analysis tools, direct observation of processes, and structured interviews with operational staff. This methodology made it possible to systematically identify, analyze, and correct the deficiencies detected.

Figure 4. *PDCA Cycle*

Source: Author's *own work* (2025).

The tool applied was adapted to specific needs and also helped strengthen the proposed strategies for reducing hazardous waste in the painting area, optimizing both the effectiveness and efficiency of the process.

In addition, open-ended interviews were conducted, which provided key information on paint preparation. These findings were reinforced through direct observation, allowing for the visual and systematic documentation of procedures. These methodologies provided a deeper understanding of the process and supported the improvement proposals.

Table 6. *Tactical strategies.*

Estrategia	Actividad	Descripción
Operativa	Capacitación continua y cultura ambiental	• Charlas de buenas prácticas de manejo de pintura. • Difusión de la importancia de la correcta segregación de los residuos peligrosos. • Apoyos visuales en el área de trabajo.
Administrativa	Propuesta de mejora estructural	• Rediseño del cuarto de preparación, implementación de un "área técnica de mezcla y dosificación de pinturas". • Implementación de las cabinas de pintura como estrategia a largo plazo • Instalación de contenedores para segregación y reducción de residuos.
Administrativa	Documentación	• Instructivo para la modificación del procedimiento actual • Fichas técnicas y Hojas de Seguridad por tipo de pintura en un lugar adecuado para su visualización.
Operativa	Círculos de calidad	Implementar cada 15 días reuniones de retroalimentación entre áreas involucradas (las áreas involucradas deberán dar puntos de vista de acuerdo con las demás estrategias).

Source: Author's *own work* (2025).

This approach aims to optimize the use and handling of paint supplies, ensure the proper segregation of hazardous waste, minimize environmental impacts, and ensure regulatory compliance. Additionally, the goal is to strengthen interdepartmental communication, improve safety and order in the work area, and promote shared responsibility among engineering, purchasing, warehousing, painting, and occupational safety and health. Together, these actions will contribute to a more efficient, safe, and sustainable operation, aligned with organizational objectives.

Proposal for Structural Improvements

A key component of the plan involved improvements to the infrastructure used in the painting process. These improvements aim to optimize material usage, ensure safety and environmental control, and minimize waste generation from the preparation stage through to the application of coatings. The preparation room was redesigned, transforming it into a "technical area for paint mixing and dosing" to ensure controlled, safe, and orderly mixing.

Features of the new space:

- Ventilation and forced exhaust system for safe VOC management.
- Automated control of humidity and ambient temperature.
- Categorized shelving for proper storage of resins, solvents, and pigments.
- Complete equipment: precision scales, measuring containers, and mixers.
- Clear safety signage and clearly marked evacuation routes.
- Optional: Sink and emergency eyewash station.

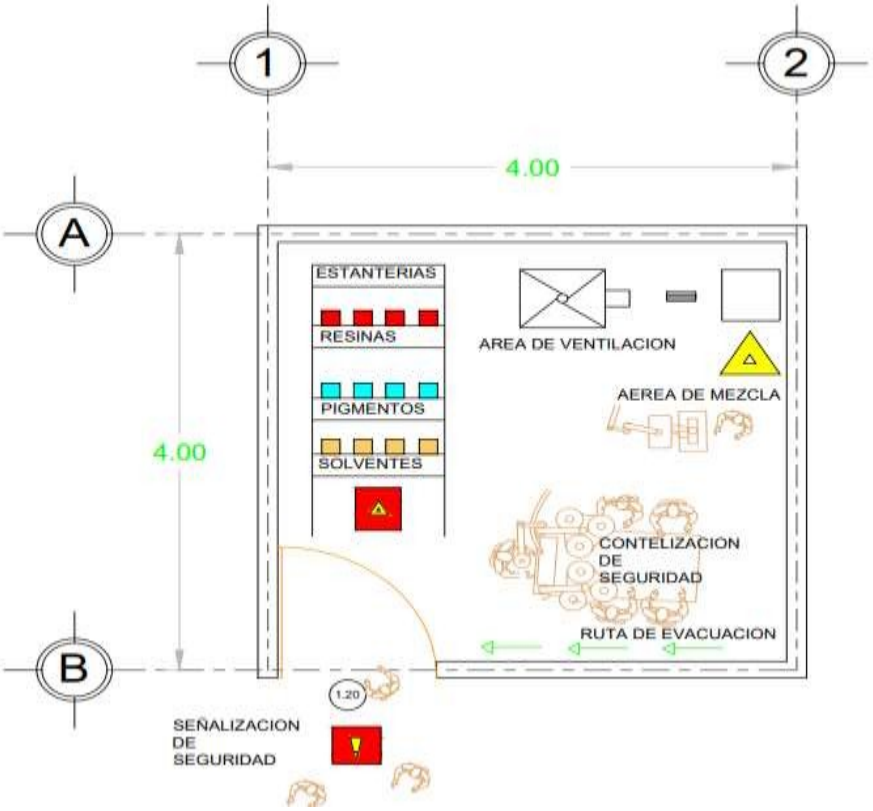


Figure 5. *Room redesign.*

Source: Author's *own work* (2025).

Quality circles

To ensure the sustainability of the implemented actions, a continuous feedback system was established through the creation of quality circles. These periodic meetings allow for the analysis of key performance indicators (KPIs) and the proposal of adjustments to the applied strategies.

The data in Table 7 not only confirm the effectiveness of the strategies implemented but also serve as an essential tool for future decision-making and the continuity of the continuous improvement system implemented in the painting area.

Table 7. *KPIs*

Indicador	Antes de la propuesta	Después de la propuesta
Generación de natas	6,335.72 kg (2024)	Reducción de un 30% (4,435.025 kg anuales)
Costo anual por manejo de natas	$13,861.80 (2024)	Reducción estimada de un 15%
Segregación correcta de residuos	Inexistente	Segregación correcta en un 80%

Source: *Prepared by the author* (2025).

CONCLUSIONS

This research demonstrated that it is possible to implement significant improvements in the painting process as long as engineering tools are applied strategically. Thanks to these actions, a clear change in staff practices was achieved. The proper segregation of hazardous waste went from being practically nonexistent to being applied in 80% of cases, supported by the new labeled containers and an understanding of the environmental purpose behind each action. Likewise, a 13.5% reduction in the generation of hazardous waste was achieved, particularly in paint sludge, representing a substantial decrease.

The overall objective was successfully achieved through the implementation of practical measures that led to a measurable reduction in such waste, as well as enhanced legal compliance and operational improvements in the painting process. As for the specific objectives, the operational factors generating waste were precisely identified, notably over-dosing and miscommunication between departments; operational efficiency and safety conditions were strengthened by redesigning the preparation room; regulatory compliance was reinforced in accordance with the LGPGIR and NOM-052-SEMARNAT-2005; environmental awareness was promoted through training and visual aids, improving waste segregation; the instructions for modifying the current procedure were documented to ensure uniformity in mixing, application, and cleaning; the conditions of the painting area were evaluated, and a structural transformation was proposed; an effective reduction in environmental impact was achieved by reducing waste; and finally,

The company implemented a monitoring system based on key performance indicators (KPIs), which will enable continuous assessment of progress and support future decision-making.

The objectives set were met by generating measurable and sustainable impacts, and the necessary conditions were established for an organizational culture focused on environmental responsibility and continuous improvement.

FUTURE WORK

We plan to conduct a research and monitoring project within the company regarding its legal status with SEMARNAT, since, having exceeded 10 tons of hazardous waste per year, it must update its registration as a major generator and have a duly authorized Management Plan.

REFERENCES

Albright, C. S., Wayne, W. L., & Christopher, Z. L. (2001). *Data analysis and decision*. Duxbury Press.

Anafapyt. (2023). *Statistics for the sector paint paint and coatings in Mexico*. https://www.anafapyt.org.mx/

Mexican Association of Automotive Distributors (AMDA). (2025). *Quick Guide to Hazardous Waste*. e3 Environmental Consulting.

ASTM International. (2011). *ASTM D16-11: Terminology for paint, related coatings, materials, and applications*.

BSL Marketing. (2025, April 14). IndustrialTypes: Types andcharacteristics. *FM SPRAY*. https://productosfm.com/pintura-industrial-tipos-y-caracteristicas/

Cym Materiales S.A. (2015). *Surface preparation*.

Dunn-Edwards Corporation. (n.d.). *Paint Skimming*. Dunn-Edwards®. Giraldo, J., &

Gómez, L. (2018). *Environmental Management and Waste*. Ecoe Ediciones.

González, R., & Hernández, L. (2020). *Industrial coatings and corrosion*. Trillas.

González-Morales, A., & Ramírez-Fuentes, H. (2022). Evaluation of the efficiency of hazardous waste management in the manufacturing industry. *Mexican Journal of Environmental Sciences*, 45–60.

Hillary, R. (2017). *ISO 14001: Case Studies and Practical Experiences*. Routledge.

Hillier, F. S., & Lieberman, G. J. (2007). *Operations Research* (7th ed.). McGraw-Hill.

International Organization for Standardization. (March 12, 2015). *ISO 14001:2015. Environmental management systems — Requirements with guidance for use*. https://www.iso.org/es/norma/14001

Ituarte, J. R. (2005). *NOM-052-SEMARNAT-2005*. Official Gazette of the Federation.

León, E. Z. (2019). *Regulations on Environmental Impact Assessment*. Official Gazette of the Federation.

López, J. (2019). *Paint and Coating Technology*. Alfaomega.

López-López, J. M. (2021). *Regulatory Compliance and Social Perceptions of Hazardous Waste in the Mexican Mining Sector* (Master's thesis, National Autonomous University of Mexico).

Madrid, M. D. (2023). *General Law on Ecological Balance and Environmental Protection (LGEEPA)*. Official Gazette of the Federation.

Marroquín, J. M. (2018). *Design of a waste management system for the straightening and painting process to reduce the environmental impact in Guatemala City* (Bachelor's thesis, University of San Carlos de Guatemala).

OECD. (2015). *Analysis of Environmental Outcomes*.

Quesada, V. F. (2014). *Regulations of the General Law on the Prevention and Comprehensive Management of Waste (LGPGIR)*. Official Gazette of the Federation.

Quesada, V. F. (2023). *General Law on Waste Prevention and Comprehensive Management*. Official Gazette of the Federation.

National National of La Plata. (n. f.). *Application of paint*. https://host170.sedici.unlp.edu.ar/server/api/core/bitstreams/4b5552a8-80da-45d3-84b1-961493c4fa3e/content

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