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Aspect And Impact Survey In Chemistry Laboratory

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Abstract:
Background: *The continuous search for improvements in processes has led several enterprises, whether in the public or private sector, to insert in their management procedures methodologies linked to Environmental Management, especially those accredited by ISO-14001 (SGA). IFAM is a public institution composed of a set of 17 campuses, operating in the area of technical and technological education, and needs to adopt a system or program along these lines. For this, it is necessary to conduct a diagnostic survey of its aspects and impacts, especially those linked to laboratories intended for scientific practices and experiments, including the Laboratory of Organic Chemistry of the Campus - CMC, the object of this research.*
Materials and Methods: *This study was divided into four stages: 1- definition of the study site; 2- survey of aspects and impacts (interaction matrix method); 3- treatment and examination of the collected data; and 4- analysis of failures using the FMEA process method. For the data examinations, the Environmental Risk Significance methodology was used, a kind of diagnosis of the impacts in which the data are arranged in cells of a matrix with rows and columns, and the memos are analyzed quantitatively and qualitatively.*
Results: *Of the five activities analyzed, 10 significant impacts were detected, with an importance of 5. Of these, 6 were considered high and 4 were moderate. Therefore, it can be seen that IFAM needs to improve its processes in this laboratory, since 90% of the impacts analyzed were classified as risky, involving the exhaust system and the lack of chemical waste management.*
Conclusion: *Given the above and the data collected, it is noted that, for the implementation of any management system, it is necessary to preliminarily implement a Waste Management Program (PGR), because in all the activities studied, this significant impact was found (class B waste).*
Keywords: *Diagnostics, Aspects, Impacts, Management, Organic Chemistry Laboratory.*

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I. Introduction

The Federal Institute of Sciences, Education, and Technology of Amazonas – IFAM, is an educational institution composed of a set of 17 campuses, including the Manaus Centro Campus - CMC. This campus includes several laboratories, one of which is the Organic Chemistry Laboratory. In this laboratory, it was possible to detect several failures in the process (practices and experiments), especially those related to the improper disposal of chemical waste[1]. Therefore, it needs a management program that allows, through continuous improvement, the improvement of its operations and management[2]. To this end, it was necessary to survey the causes and effects (diagnosis) of[3] the main activities developed in this environment, aiming at a possible implementation of an Environmental Management System (EMS)[4]. This system facilitates the identification of these environmental problems[5]. Therefore, the objective of this study was to identify these unintended consequences[6], using the interaction matrix tool and the FMEA process method, propose measures to mitigate them[7] and contribute to the implementation of a robust Environmental Management System (EMS) for this institution8.

II. Materials and Methods

The research was carried out at the Organic Chemistry Laboratory of the Department of Chemistry, Food, and Environment (DQA) of the Federal Institute of Sciences, Education, and Technology of Amazonas – IFAM/ Campus Manaus Centro-CMC, located at Av. Sete de Setembro, 1975 - Centro, Manaus - AM, 69020-120 (-3.133735, -60.012778).

To facilitate the study of this diagnostic survey, it was necessary to divide it into four stages: Collection of information on the main activities developed, application of the interaction matrix method (Leopold matrix)[9], examination of information, and analysis of failures (FMEA tool)[10]. For the examinations, the Environmental Risk Significance methodology was used, a method similar to interaction matrices, a kind of impact diagnosis in which

the data are arranged in cells of a matrix with rows and columns, and the data are analyzed quantitatively and qualitatively[11]Status: Situation (Normal, Abnormal, or Risk), Scope (Local, Regional, and Global), Incidence (Direct or Indirect), Class (Beneficial or Adverse), Time (Past, Current, or Future), Frequency, Probability, and the characteristics of the impacts found during the surveys, emphasizing their importance (IMP ≥ 5) and stakeholder (P.I.). In addition, to facilitate comprehension, the spreadsheet or matrix used in this study was adapted, inserting two columns in it, one for the photographic records and the other for the detailing of the aspects, as shown in Image 1.

Image 1 - Leopold's matrix spreadsheet model, adapted by the authors.

Spreadsheet for surveying aspects and impacts in the organic chemistry laboratory of the chemistry department -dqa- ifam campus manaus centro cmc																	
Sector area: chemistry department(dqa)_____sub-area___organic chemistry laboratory																	
Process/system: _experimental classes and academic research_.																	
ACTIVITY: Temporary storage of waste											**SECTOR: Organic Chemistry Laboratory**					**DATE: 17/03/2023**	
Identification:						**Test**								**Meaningfulness**			
Item	**Photographic records**	**Activity**	**Aspect**	**Aspects details**	**Impacts**	**SIT**	**AB**	**INC**	**Cl.**	**EPO**	**S/V A**	**F/P B**	**IMP A+B**	**LA W**	**P. I**	**I ≥ 5**	
Legend: sit= operational situation; AB: Opening; inc= incidence; cl= class; ep= season; s/v= severity; f/p= frequency probability; imp= importance; p. I= interested parties.																	

Source: Worksheet adapted from Leopold – Own authors, 2023.

For this study, the Failure Mode Analysis (FMEA) was also used, as it aimed to identify the potential failure modes during some processes in this laboratory, as well as the risks associated with them so that they are classified in terms of importance and then receive corrective actions to reduce the incidence of these failures.

The use of this tool was mainly based on the certainty of the best analysis of failures, as there is a natural tendency to minimize and eliminate potential failures in the processes after the application of this tool. Thus, the results can cover all areas, increasing the reliability of the analyses. In addition, for this survey, the FMEA method of processes was used, that is, only the processes were analyzed since it is a public educational institution; therefore, for the time being, the final product was not deepened, only the processes, aiming at improving them in the PDCA plan, do, check, and act mode.

For this analysis, a spreadsheet was used that lists the processes considered significant and duly surveyed during the application of the spreadsheet of environmental aspects and impacts[12], as shown in the spreadsheet in image 2.

To fill out this worksheet, about severity, occurrence index, detection of failures, and degree of detection, the methodology of Cruz 2012 was adapted[12].

Image 2 - FMEA worksheet: process analysis.

FAILURE ANALYSIS IN PROCESSES USING THE FMEA METHOD															
IDENTIFICATION													**FMEA PROCESSES**		
						indexes				**IMPROVEMENT ACTIONS**					
Process description	**Process Functions**	**Type of Potential Failure**	**Causes of failure**	**Effects of potential failure**	**Current control**	**S**	**OR**	**D**	**R**	**Rewarded actions**	**Responsible/ deadline**	**Improvements implemented**	**Current Indices**		
													S	**Or**	**D**	**R**

Source: Adapted from the spreadsheet by CRUZ, 2012.

III. Results and Discussions

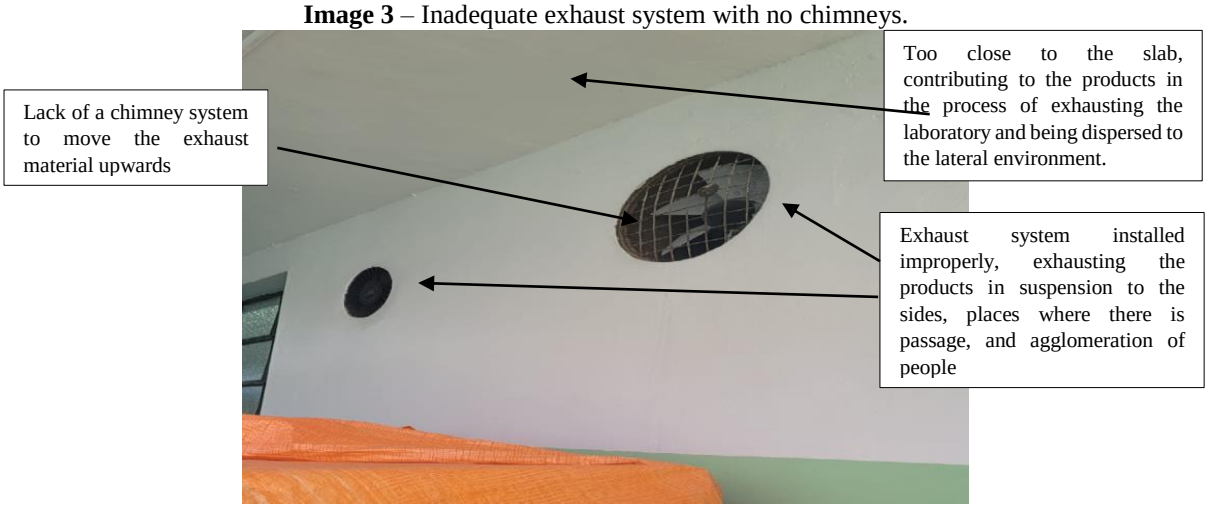
By analyzing the spreadsheets that were applied in the Organic Chemistry Laboratory linked to the Department of Chemistry of the Manaus Centro Campus (CQA/CMC/IFAM), based on five activities: temporary

storage of waste, experiments and practical classes; experiments for fixed oil extraction with the use of SEBELIN battery equipment; use of the exhaust system and extraction of essential oil; maceration of samples; It was preliminary found that no Waste Management Plan or Program (PGR) (storage, collection, transportation, treatment, and final disposal) was found, as well as any document that proves the integration of this Institution into the collection and management system of this type of waste with the collection system of the municipal government (Manaus City Hall), according to guiding standards.

Although there is an environment for the temporary storage of inputs and materials (a warehouse), it was found that this physical space is insufficient (small), leading to a limitation on the acquisition of these materials given the demands of the laboratory and, consequently, the exposure of possible damages. In this context, the lack of a procedure (plan or program) for inventory control can lead to a shortage of these inputs or materials to be used during practical classes, as there is a deficiency in their movement, which can be improved with adequate storage and sufficient physical spaces and, therefore, an improvement in the flow of service. During the use process[15]. It was also found that, due to the lack of a Waste Management Plan or Program (RMP), the visitors of this laboratory store their chemical residues (remains of reagents) in glass vials in the laboratory itself.

In the activity of using the exhaust system, it was found that the exhaust fans were installed very close to the slab of the building (image 3), contributing to the exhaled materials being dispersed in an environment of coexistence and passages of people (students, servers and outsourced workers), located on the side of the laboratory.

Image 3 – Inadequate exhaust system with no chimneys.



Source: External photo of the laboratory – own authors, 2023.

In the activity of essential oil extraction, maceration of samples, and other analyses, it was found once again, that residues were stored inappropriately, arranged or stacked in cabinets in the laboratory itself, without the minimum storage conditions and contrary to the guidelines and procedures, as shown in image 4. In this context, we were informed that the Institution entered into a contract for the collection of chemical waste with a specialized company, however, there was no renewal of this contract.

After surveying the main activities developed in this research environment, it was possible to list the environmental aspects and impacts related to these activities, as shown in Table – 1. It is reiterated that the method of interaction matrices was used, specifically the model adopted by Leopold, which consists of relating the "x" axis (horizontal), which is defined by anthropic actions, potentially causing environmental impacts, with the "y" axis (vertical) which is defined by environmental factors (from social to natural), adding "x.y" possible combinations, together with the association of magnitude values. importance and nature (beneficial or adverse). It is ratified that, as mentioned in the methodology, there were changes in Leopold's spreadsheet, with insertions of new information that aimed at a better interpretation of the aspects through their detailing, because it is believed that with this procedure it ispossible to have a more detailed association of its possible impacts and, therefore, the possibility of better negotiationswhen proposing necessary mitigating measures. Therefore, this entire procedure was necessary to anticipate the risks and possible environmental impacts to be prevented, corrected, mitigated, and/or compensated, according to the spreadsheet model filled out and represented in image 4.

Image 4 – Completed spreadsheet template: Temporary waste storage activity.

	Worksheet for the identification of aspects and impacts in the Organic Chemistry Laboratory of the Department of Chemistry -DQA- IFAM Campus Manaus Centro CMC.																
	Sector: department of chemistry____(dqa)_____sub-àrea____laboratório of orgânica__chemistry.																
	Process/system: _experimental classes and research acadêmicas_.																
ACTIVITY: Temporary storage of waste from ESSENTIAL OIL EXTRACTION, MACERATION OF SAMPLES											**SECTOR: Organic Chemistry Laboratory**			**Date**	**17/03/2023**		
IDENTIFICATION					**EXAMINATION**									**SIGNIFICANCE**			
Photographic Records	**Activity**	**Aspects**	**Details of Aspects**	**Impact**	**SIT**	**ABR**	**INC**	**CL**	**EPO**	**S/V The**	**F/P B**	**IMP A+B**	**LAW**	**P.I**	**I ≥5**	**MITIGATING MEASURES**	
 	Storage of residues from chemical products used in the activities of ESSENTIAL OIL EXTRACTION, SAMPLE MACERATION and other analyses.	1- Improperly stored waste; 2- Lack of a waste management plan; 3- Non-systematized procedures; 4- Discontinuity in the collection process by specialized companies; 5- Dispose of improperly;	1- Waste stored in an improvised way in sink cabinets (poorly ventilated environment); 2- The institution does not have a waste management plan (RMP), with information ontemporary storage, collection, anddisposal; 3- Waste discardedin the sink, however, there is no control if all responsible persons (researchers) perform these procedures;	1- Contamination of Professors andstudents who usethe Organic Chemistry laboratory; 2- Administrative interventions ofon-site inspection bodies (SEMMAS, IPAAM, MPF, ANVISA andCLASS COUNCILS) administrative actions – notifications andfines; 3- Contamination of the environment outside the laboratory	**A/A**	**L**	**I**	**A**	**F**	**3**	**2**	**5**	* Law No. 4457 of 04/12/2017; * Decree No. 41,863/20 - Provides for the execution of the State Solid Waste Policy and Law 4,457/17; * ENVIRONMENTAL CODE MANAUS2021; * LAW NO. 12,305 OF AUGUST 2, 2010; * ABNT NBR 10.004/2004;	**X**	**X**	1- Immediate removal of wastefrom this site ethrough contracting (bidding) of specialized companies; 2- Develop a Waste Management Plan(RMP) that manages all waste generated in the laboratories of this Institution; 3- Enhance the training and sensitization oftechnicians and usersof this environment on the proper disposal of class Bwaste.
					A	**L/R**	**D/I**	**A**	**A**	**2**	**2**	**4**					
					R	**R**	**D/I**	**A**	**A**	**4**	**3**	**7**		**X**	**X**		
Legend: SIT= Operational Status; INC= Incidence; CL= Class; PE= Epoch; S/V = Severity; F/P= Frequency Probability; IMP= Importance; P.I= Stakeholders.																	

Source: Adapted from Leopold's Matrix, own authors, 2023.

For this first analysis of the Leopold matrix, adapted by the authors of this study, five (5) main activities wereobserved in this laboratory, duly represented in Table 1, which shows the aspects and impacts found during the application of the spreadsheet (import. 5) ≥.

Table Nº1 Main impacts (import. 5) associated with the five activities analyzed. ≥

ITEM	ACTIVITY	ENVIRONMENTAL ASPECT	IMPACT	IMP	PROPOSED MITIGATION ACTIONS
1	Temporary storage of waste in the Organic Chemistry	1- Lack of a suitable place to store this waste;	Contamination of visitors to this environment;		Hiring a company specialized in waste management (SHORT to MEDIUM TERM); Preparation of a Waste Management Plan (RMP) (SHORT to MEDIUM TERM);

	Laboratory				Monitoring, through action plans;
		2- Improvisation of sharps storage waste;	Personal accidents.		Training and sensitization of the visitors of this environment on the proper disposal of waste (SHORT TO MEDIUM TERM); Preparation of a Waste Management Plan (PGR) (short to medium term) and monitoring,
2	Experiments in practical classes (teaching, research, and extension) with the use of inputs and materials.	1- Inadequate place for temporary storage of inputs to be used in practical classes;	Contamination of the attendees (technicians, professors, and students) of the Organic Chemistry laboratory; Breakdowns and losses of inputs to be used during practical activities in this laboratory.		Increase the capacity of physical space in the warehouse (MEDIUM TO LONG TERM); Systematize the monitoring of input and output of inputs and materials, Managed, through an action plan.
		2- Lack of systematization for the control of waste from these inputs;			Contracting (bidding) of specialized chemical waste companies (SHORT TO MEDIUM TERM); Preparation of a PGR Waste Management Plan (short term); Monitoring through an action plan.
3	Fixedoil extraction with the use of the SEBELIN Battery equipment.	1- Waste is stored in an improvised way or discarded in the sink.	Contamination of areas outside the laboratory, (contamination of soil and streams)		Immediate removal of waste from this site and contracting (bidding) of specialized companies (SHORT TO MEDIUM TERM); Preparation of a Waste Management Plan (PGR) (SHORT TERM); (SHORT-TERM); Monitoring through an action plan.
		2- Waste stored and mixed inside glass jars	Contamination of the environment.		
4	Use of fume hood equipment and exhaust system in experiments in this laboratory.	1- Toxic gases and vapors exhaled in environments close to the laboratory, including living environments for students, employees, and contractors;	Inhalation of suspended chemicals dispersed by the inappropriate exhaust system; (air contamination and ersonal accidents)		Periodic maintenance of this equipment, according to standard (SHORT to MEDIUM TERM); Elaboration of a safety manual for IFAM laboratories (SHORT TERM); Installation of chimneys according to standards (MEDIUM TO LONG TERM); sensitization (SHORT TERM). Monitoring Action Plan.
		2- Lack of chimneys for adequate exhaust of gases, vapors, and aerodispersoids.	Airway contamination (Air contamination and personal accidents);		Installation of chimneys at the ends of the exhaust fans, (MEDIUM to LONG TERM); a form of monitoring: Action plan and checklist.
5	Residues from the activities of EXTRACTION OF ESSENTIAL OIL, MACERATION OF SAMPLES.	1- Improvised waste storage (sink cabinets) and poorly ventilated environment;	Contamination of those who frequent these environments;(air contamination)		Immediate removal of waste and contracting (bidding) of specialized companies (SHORT to MEDIUM TERM); Preparation of a Waste Management Plan (PGR) (SHORT TERM); form of monitoring: Action plan and checklist; Enhance the training and sensitization of technicians and users of this environment. Form of monitoring Action plan and checklist
		2- Dilution of some chemicals (residues) to be later discarded in the sink (improvisation) and lack of control in this procedure;	Contamination of the work environment with possible leakage of these products. (Pollution of soil and streams in external laboratory environments)		

Source: own authors of the research, 2023

In this survey, it was possible to account for 17 (seventeen) impacts, of which 10 (ten) were considered significant (Table 2). In addition, for each activity surveyed, the impacts were considered to be 5, on a scale of 1 to 7of importance, according to the methodology. Therefore, these impacts were classified by the significance table, as consequences that required interventions through mitigating measures, in addition to the elaboration of monitoring projects, either through action plans or ≥ checklists. It is also possible to observe that most of the classifications referred to waste from the activities developed in this laboratory, especially when aspects related to inadequate storageand improvised disposal were analyzed. In this context, the suspended hazardous materials (aerodispersoids) that aredissipated in this environment by an inadequate exhaust system stand out, which can

cause environmental damage and personal accidents by inhalation.

Table No. 2 – Main impacts (import. 5) associated with the five activities analyzed ≥.

SIGNIFICANCE TESTS									
ACTIVITY	**IMPACTS (consequences)**	**SIT**	**APR**	**INC**	**CLA**	**EPO**	**S/V**	**F/P**	**IMP**
Temporary storage of waste in the Organic Chemistry Laboratory	1- Contamination of the attendees (technicians, professors and students) in the Organic Chemistry laboratory; Personal accidents; 2- Administrative interventions by on-site inspection agencies (SEMMAS, IPAAM, MPF, ANVISA and CLASS COUNCILS) administrative actions – notifications and fines; 3- Personal accidents.	**R**	**L**	**D**	**A**	**A**	**4**	**2**	**6**
		R	**L**	**D**	**A**	**A/F**	**3**	**2**	**5**
Experiments in practical classes (teaching, research, and extension) with the use of inputs and materials.	1- Administrative interventions of on-site inspection bodies (SEMMAS, IPAAM, MPF, ANVISA and CLASS COUNCILS) administrative actions – notifications and fines; 2- Personal accidents due to limited spaces (storage); 3- Breakdowns and consequently, losses of the inputs to be used during the practical activities in this laboratory.	**R**	**L**	**D**	**A**	**F**	**4**	**2**	**6**
		R	**L**	**D**	**A**	**A/F**	**3**	**2**	**5**
Fixed oil extraction with the use of the SEBELIN Battery equipment.	1- Influence of external factors on the sample, when improvising equipment; 2- Administrative interventions of on-site inspection bodies (SEMMAS, IPAAM, MPF, ANVISA, and CLASS COUNCILS) administrative actions – notifications and fines; 3- Contamination of areas outside the laboratory; 4- Contamination of the environment, due to the improvisation of storage of this waste.	**A**	**L**	**I**	**A**	**A**	**3**	**2**	**5**
		R	**L/R**	**D/I**	**A**	**A/F**	**3**	**3**	**6**
Use of fume hood equipment and exhaust system in experiments in this laboratory.	1- Administrative interventions of on-site inspection bodies (SEMMAS, IPAAM, MPF, ANVISA and CLASS COUNCILS) administrative actions – notifications and fines; 2- Contamination of areas outside the laboratory; 3- Inhalation of suspended chemicals dispersed by the inappropriate exhaust system; 4- Contamination of the airways of people (students, employees, outsourced workers, and visitors) who travel near this environment (external area of the laboratory).	**R**	**L/R**	**D/I**	**A**	**F**	**4**	**2**	**6**
		R	**L/R**	**D/I**	**A**	**F**	**4**	**3**	**7**
Residues from the activities of EXTRACTION OF ESSENTIAL OIL, MACERATION OF SAMPLES.	1- Contamination of Professors and students who use the Organic Chemistry laboratory; 2- Administrative interventions of on-site inspection bodies (SEMMAS, IPAAM, MPF, ANVISA and CLASS COUNCILS) administrative actions –	**A**	**L**	**I**	**A**	**F**	**3**	**2**	**5**
		R	**L**	**D/I**	**A**	**A**	**4**	**3**	**7**

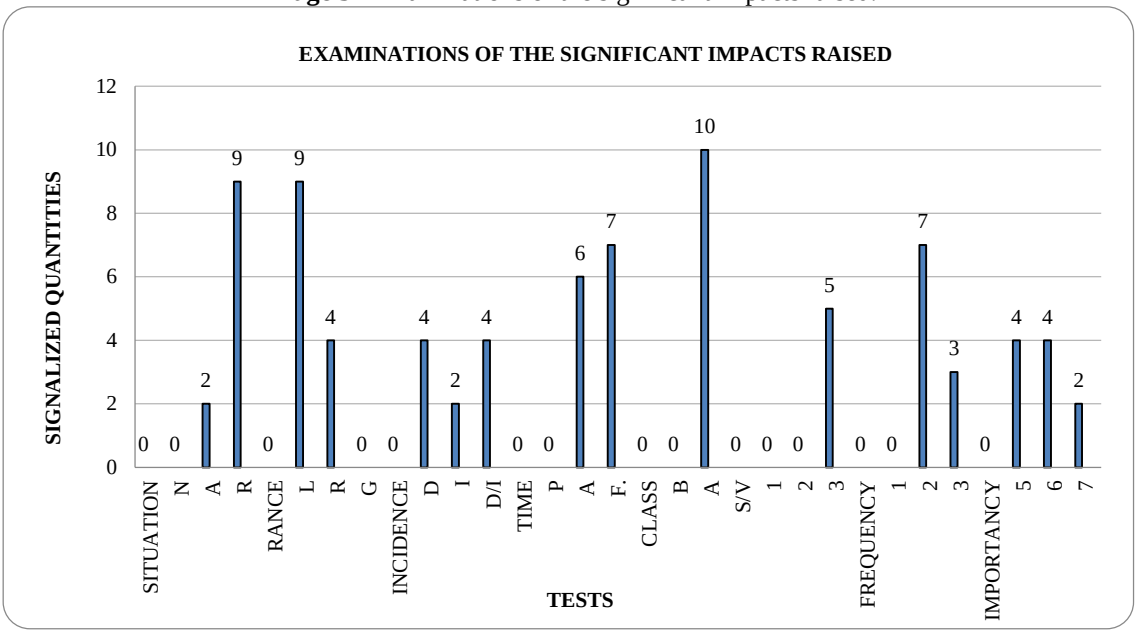
	notifications and fines; 3- Air contamination with possible leakage of these products in the laboratory environment.								

Source: own authors of the research, 2023.

In the survey, using Interaction Matrices (Leopold matrices), proposed for this study, the impacts that received specifications 6 and 7 presented a high potential for risks to the environment, with the possibility of contamination of the environment and personal damage. Regarding the environment, the chemicals that are improperlypoured into sinks in that laboratory can come into contact with nature causing unwanted consequences, as many of these substances (chemical waste) can affect ecosystems and life forms in a very aggressive way, causing various losses and pollution. On the other hand, those related to personal injuries can affect the health of people who travel near this environment, due to the inhalation of possible suspended chemicals that are dispersed by the improperly installed exhaust system.

When analyzing the examinations of significant environmental impacts, with importance ≥ 5, depicted in image – 5, the following considerations are made:

Image 5 – Examinations of the significant impacts raised.



Situation		Opening		Incidence		Time		Class		S/V		Frequency		Importance	
Normal	0	Local	9	Direct	4	Past	0	Beneficent	0	Minimum (1)	0	Little Thing (1)	0	Moderate Risk (5)	4
Abnormal	2	Regional	4	Indirect	2	Actual	6	Adverse	10	Low (2)	0	Frequent (2)	7	High Risk (6)	4
Risk	9	Global	0	D/I	4	Future	7			Moderate (3)	5	Very common (3)	3	High Risk (7)	2
										High (4)	5				

Source: own authors of the research, 2023.

Situation: Regarding the significant aspects and impacts (Imp to 5) with adverse class, it was found that 90%of the impacts analyzed were classified as risk, including irregularly stored chemical waste, as well as the disposal ofchemical waste directly in the sinks of this Laboratory. ≥

Scope: Most of the impacts analyzed in this survey were classified as local or regional, however, some wereconsidered to be of great proportion, when compared to their severity.

Incidence: Regarding the INCIDENCE factor of the significant impacts analyzed in this study, it was foundthat 40% had a direct and indirect impact at the same time, 20% directly and 40% indirectly.

Time: Regarding the TIME factor, which portrays the time in which the impact occurs, it was found that, of the impacts qualified in this study, 58% of these will have their consequences in the future and 42% in the current moment;

Class: when we analyze the adverse or beneficial CLASS, it is found that 100% of the significant impacts

that have been raised are classified as negative. Therefore, all are considered to be adverse.

Severity: Regarding the severity of the impact analyzed, it was found that 50% are indicator 3, i.e., medianimpact (MODERATE). Therefore, inconsiderable reversible pacts beyond the area of influence (R) with medium-termmitigating actions. The other 50% of the significant impacts were classified as 4 (HIGH), which express a large magnitude or extent with irreversible consequences (G), even with mitigating actions in the long term.

Frequency: By analyzing the number of times that these impacts can be repeated, it is possible to verify that70% of the analyzed impacts happen frequently, that is, they can occur a few times or with the possibility of occurring,while 30% can occur several times or with certainty that they will occur.

Importance: Of the impacts analyzed in this study, by the method of survey of the interaction matrix, about IMPORTANCE, we found that 60% of the significant impacts raised in this study were classified as high risk and 40% considered moderate. In this context, we emphasize that only impacts with importance 5 were considered, according to the methodology. ≥

By checking all five spreadsheets that were worked for the five activities surveyed, it was detected that mostof the failures in the processes are associated with an inappropriate exhaust system and the lack of a PGR Waste Management Plan or Program.

IV. Discussions

From the data presented in this research, it can be seen that IFAM needs to improve its processes, specificallyin the Organic Chemistry Laboratory, since 90% of the impacts analyzed were classified as risk[11]**.** This improvementinvolves the reduction, elimination, and compensation of the damage caused by its actions [2, 16,] as well as the incorporation and monitoring of its indicators, inspecting and complying with proposed actions, and disseminating information by strategic sectors.[9] This Institution needs to include in its management processes, management programs[2] that improve its aspects and consequently its impacts, especially those related to the management of chemical waste[1,]all of this aiming at the possibility of implementing an Environmental Management System – EMS[4, 8].

The generation of chemical waste from laboratories places Higher Education and Technological Institutionsas one of the main responsible for the generation of a wide variety of these wastes resulting from teaching and research activities[17]. As an example, some experimental disciplines dispose of their waste inappropriately in sinks, for liquid waste, and directly in common waste, when it comes to solid [waste,18] a fact also observed, during the surveys, for liquidwaste in the Organic Chemistry Laboratory of IFAM Campus CMC, despite the information that these residues are neutralized or diluted, before they were discarded, however, no control was presented. Thus, these actions provide impacts due to the insertion of these products within an ecosystem, because, when disposed of incorrectly, they can potentially contaminate water, sediments, soil, air, and even human beings. In this scenario, there is an imperative need to develop several diagnostic studies, monitoring, and remediation of contaminated environments[19]. Therefore, and given all these aspects, there is a demand for procedures and systematizations that enable better management of this waste, whether at the beginning, with the entry of inputs and materials, in temporary storage, or final disposal. It is noteworthy that we did not find any program or plan for this type of management in this institution. In this context, the responsibility attributed to Educational Institutions is observed, because fundamentally it is in these teaching andresearch centers that professionals with the necessary skills to solve various problems are trained, including those related to environmental issues, where Engineers and technicians with competence to work in the labor market are trained.

Finally, it is notorious that the responsibility, from a legal point of view, for the management of the waste generated lies with its generator. They are responsible for the control and disposal of the waste generated. Thus, the commitment of these institutions is essential to implement and maintain a Waste Management Plan or Program (PGR)that encompasses chemical waste, in addition to the collaboration of all professionals involved, who in many cases need to be re-educated for the possible changes needed[20]. It should be added that the PGR is perfectly inserted in a macro management system, such as the Environmental Management System - EMS, standardized by ISO 14001.

V. Conclusion

At the end of the research, and based on the information collected in this study, especially for the surveys ofaspects and impacts, using Leopold's method of interaction matrices, through spreadsheets of Assessment, Aspect andEnvironmental Impacts (LAAIA), duly adapted by the authors of this research, it was found that:

The Organic Chemistry Laboratory, despite having its physical structure well-dimensioned, presents some flaws in the installation of safety equipment, especially in the exhaust system of gases from the experimental activities carried out in the chapels, as it was found that this equipment disperses the gases in suspension (aerodispersoids) irregularly. This finding was possible when the exhaust system was activated, where these gases are dispersed to a lateral environment, frequented daily by students, servers, and outsourced workers who transit in

this environment.It is noteworthy that the gases or mixtures that are dispersed by these systems can be inhaled, bringing several consequences to the health of these people, however, a survey or investigation of possible contamination of these people was not carried out and there was no data available to affirm this hypothesis, because this research focused only on the surveys of aspects and impacts associated with the activities of this laboratory.

The other point to consider is the absence of a Waste Management Plan or Program (PGR), as it was found that the waste from these activities is stored inappropriately in glass bottles that are arranged in the cabinet in the laboratory itself. This aspect is aggravated by the fact that some chemical products (waste), after their dilution or neutralization, are disposed of in the sink itself, since this unit does not have a collection contract with a specialized company for these types of waste.

Of all the five activities analyzed in this survey, the presence of a significant impact was found - packaging and final disposal of class B waste inappropriately, as well as inputs and materials stored incorrectly, stacked on top of each other, causing possible losses due to breakdowns and consequently the lack of these in practical classes.

Given the above, and the data collected, it is noted that, for the implementation of any management system, it is necessary to implement a Waste Management Program (RMP), because, in all the activities studied, the significant impact of the inadequate disposal of hazardous waste (class B waste) was verified.

In this survey it was possible to detect 10 impacts, with 5 importance, of these, 6 were considered significant,therefore requiring the implementation of ≥ environmental control and monitoring projects, and 4 were considered moderate, therefore requiring only the implementation of mitigating and monitoring measures.

When we applied the failure collection method called PROCESS FMEA, two important failures were found,the first related to the exhaust system and the second related to the lack of a Waste Management Plan - PGR.

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