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Special Edition

Cleaner production applied at beauty salon: considerations and opportunities

Produção mais limpa aplicada em salão de beleza: considerações e oportunidades

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ABSTRACT

Beauty salons generate hazardous waste from their services, being characterized as a potentially polluting activity, in which this waste does not receive its deserved attention from the current environmental legislation. Cleaner Production (CP) stands out as an efficient program capable of acting in the prevention of pollution generated by processes, products, and/or services. In this context, this paper sought to analyze possible CP actions in a beauty salon located in the city of Osório, in the north coast of the state of Rio Grande do Sul, Brazil. Therefore, the methodology used for the development of this study was based in the material of the Centro Nacional de Tecnologias Limpas[1] (CNTL), which presents the main five steps for the implementation of a Cleaner Production Program. This work consisted of defining the main services offered in a beauty salon that are responsible for generating significant environmental impacts and in carrying out a qualitative-quantitative environmental evaluation of these services, in order to list possible improvements for the enterprise, aiming, as a priority, to reduce the waste of raw material, water, and energy, the emission of effluents with a high chemical load, and waste disposal. From the data collected, the CP program offered eight possibilities of improvement in the services provided, highlighting the replacement of a product with carcinogenic potential for another that offers a lower health risk, as well as a lower cost to the enterprise. Additionally, environmental indicators were developed to stimulate and visualize the reduction in water and electricity consumption and the generation of hazardous waste and effluent, with the goal of reducing 10% of these indicators when compared to the values generated before the implementation of the Program. Given the above, it is possible to assert that Cleaner Production was efficient in finding alternatives that seek to avoid the generation of potentially polluting waste and effluent in the beauty salon.

[1] In free translation: Brazilian National Center for Clean Technologies.

Keywords: Cleaner production; Beauty salon; Waste

RESUMO

Os salões de beleza geram resíduos perigosos provenientes dos seus serviços, caracterizando-se como uma atividade potencialmente poluidora, em que tais resíduos não afetam a atenção por parte da legislação ambiental vigente. A Produção Mais Limpa (P + L) destaca-se como um programa eficiente capaz de atuar na prevenção da gerada por processos, produtos e / ou serviços. Neste contexto, este artigo buscou analisar as possíveis ações de P + L em um salão de beleza localizado no município de Osório, litoral norte do estado do Rio Grande do Sul. Para tanto, a utilização utilizada para o desenvolvimento deste estudo baseou-se em nenhum material do Centro Nacional de Tecnologias Limpas (CNTL), que apresenta cinco passos principais para a implementação de um Programa de Produção Mais Limpa. Este trabalho consiste em definir os principais serviços ofertados no salão de beleza responsáveis por gerar impactos em realizar e em realizar uma avaliação ambiental quali-quantitativa destes mesmos serviços, um fim de elencar possíveis melhorias para o empreendimento, treinamento de forma prioritária a diminuição do desperdício de matéria-prima, água e energia; a diminuição da emissão de efluentes com alta carga química e a diminuição de descarte de resíduos. A partir dos dados coletados, o programa de P + L ofereceu possibilidades de melhoria nos serviços prestados, tendo como destaque a substituição de um produto com potencial cancerígeno por outro de menor risco à saúde e, ainda, de menor custo ao empreendimento. Adicionalmente, indicadores ambientais foram desenvolvidos para estimular e visualizar a redução no consumo de água e energia elétrica e a geração de resíduo e efluente perigoso, tendo como meta a redução de 10% destes indicadores quando comparados aos valores gerados antes da implementação do Programa. Diante do exposto, é possível afirmar que a Produção Mais Limpa se fez eficiente em encontrar alternativas que buscam evitar a geração de resíduos e efluentes potencialmente poluidores gerados no salão de beleza.

Palavras-chave: Produção mais limpa; Salão de beleza; Resíduo

1 INTRODUCTION

The first recorded beauty salon was *Le Sieur 6*, opened in 1635, in Paris. In Egypt, at about 5000 BC, hair care was already considered very prestigious by the Pharaohs (FREITAS, 2014). The record of aesthetic care in ancient times corroborates the current popularity of beauty salons. Even in an economic crisis scenario, according to IBGE[2] (2018), Brazilians spend more on beauty than on food, seeking products and services that raise their self-esteem and well-being, and that meet their personal hygiene needs. In 2016, according to SEBRAE[3], around 7 thousand beauty salons were opened per month throughout the country.

[2] Brazilian Institute of Geography and Statistics

[3] Initials for “Serviço Brasileiro de Apoio às Micro e Pequenas Empresas”. In English, it stands for the Brazilian Micro and Small Enterprises' Support Service.

Like any other activity, the services provided in a beauty salon generate waste and must be analyzed for their composition, so that they can be handled and disposed of correctly, without causing harm to human and environmental health. Unfortunately, this does not occur in beauty salons in Brazil. There are two possible causes for the environmental neglect in these establishments: the large number of salons in an informal situation and the exemption from the obligation of environmental licensing of this activity.

When acting in informality, the enterprise is not subjected to the inspections and legal requirements from the licensing bodies. The lack of environmental requirements also happens due to the fact that beauty salons are exempt from environmental licensing, according to the CONAM[4] Resolution 237/97. Considering this exemption, it is possible to assume that the environmental legislation does not consider beauty salons a venture that offers environmental risk or damage, which is not confirmed in practice. The high degree of informality and the absence and ignorance of technical, sanitary, and environmental standards of operation are considered a structural lack of beauty enterprises by SEBRAE (2016).

The negative environmental impacts generated by beauty salons are related to the composition of the products used and the waste generated. Manicure/pedicure process and hair smoothing can be considered the most impactful activities of a beauty salon.

In the manicure/pedicure service, the use of acetone to remove nail polish, as well as the nail polish itself, emits volatile compounds dangerous to the health of those who are in contact with the substances (GAUDÊNCIO *et al*., 2012). Dibutyl phthalate, formaldehyde (formalin), toluene, and triphenyl phosphate are some of the components of nail polish with carcinogenic potential, in addition to being related to respiratory problems and hormonal dysfunctions. Acetone and nail polish are present in the waste generated by this activity as well. Cotton containing

[4] Initials for “Conselho Nacional do Meio Ambiente”. In English, it stands for the Brazilian National Council of the Environment.

acetone and nail polish is classified by ABNT [5] NBR 10004:2004 as Class I – hazardous. This classification demands the appropriate final destination so that there is no contamination of soil and water resources that may come in contact with this waste. Currently, in most beauty salons, the cotton with acetone and nail polish is discarded in the common trash, which sets a risk to the place that will receive it.

Apart from the process of manicure and pedicure, hair smoothing using products containing formalin in their composition offers risks similar to those of exposure to acetone and nail polish. However, in the smoothing process, formalin is present in greater quantity, and, according to the INCA, it can cause irritation in the eyes, nose, mucous membranes, and upper respiratory tract, both in who applies the product, as well as who is subjected to the process. In addition to risks to human health, formalin also offers risks to the environment when discarded incorrectly. When washing the hair containing the smoothing product, formalin becomes part of the effluent generated in the enterprise. According to Nkansah *et al*. (2016), beauty salon effluent can significantly influence the physicochemical characteristics of the recipient body, due to the uncontrollable nature of some contaminants when disposed of in the natural environment. According to Silva and Lopes (2016), formalin in a natural environment is characterized as a persistent organic pollutant, that is, of difficult chemical and biological degradation.

From what was exhibited above, it is possible to state that the current standards of services provided in beauty salons are mostly environmentally unsustainable. However, these enterprises have increasingly sought to achieve and demonstrate a positive socio-environmental performance. While customers and consumers become aware of the risks and environmental impacts that human activities generate, companies and institutions see the need to demonstrate this kind of awareness to attract/retain their clients, because they understand that, in

[5] Initials for “Associação Brasileira de Normas Técnicas”. In English, it stands for Brazilian National Standards Organization.

order to keep acting competitively in the market, they will have to increasingly integrate environmental components to their productive processes, commercial strategies and long-term planning (CNTL, 2002).

Among the various tools that seek to minimize the environmental impacts of a productive process, Cleaner Production (CP) stands out as an "efficient and effective tool to meet the environmental needs of sustainable development" (CNTL SENAI-RS, 2003, p.119).

Cleaner Production is a tool that differs from end-of-pipe technologies, which focus only on the destination or treatment of waste. CP consists of a program that aims to increase the efficiency of the productive processes through the non-generation, minimization, or recycling of waste. This, through the optimization of the resources used, such as raw materials, water, and energy, as well as the replacement of the raw materials and inputs considered harmful to health in general, also brings economic and occupational health benefits, apart from the environmental ones (CNTL, 2003). Among the existing methodologies for the implementation of CP, Cruz *et al.* (2020) highlight the model proposed by the National Center for Clean Technologies (CNTL), published in 2003 by SENAI-RS[6] in partnership with UNIDO and INEP (CNTL, 2003). The model proposes five main steps, which must be preceded by a visitation *in loco* to the establishment in which the CP program is to be implemented. In a brief way, Cruz *et al.* (2020) indicate that Step 1 involves the sensitization of senior management and the formation of an ecoteam, aiming to obtain the commitment of the company, in addition to the identification of barriers. Next, Step 2 comprises the execution of a process diagnosis, contemplating material and energy balances to identify inputs and outputs (raw materials, water, energy, waste). From the diagnosis, in Step 3 the CP opportunities are identified, with actions at 3 levels, namely: Level 1 – Reduction at Source, Level 2 – Internal Recycling, and Level 3 – External Recycling. Subsequently,

[6] Initials for Serviço Nacional de Aprendizagem Industrial - Rio Grande do Sul. In English, it stands for the Brazilian National Service of Industrial Learning - Rio Grande do Sul branch.

in Step 4, the identified actions are evaluated for their technical, economic, and environmental feasibility, in order to decide which actions will be implemented in the next step – Step 5. In this last step, the implementation, monitoring, and continuity plan is outlined.

According to Cruz *et al.* (2020), the model is applicable in industries, as well as in commercial and service establishments in general. Considering that beauty salons can have significant environmental impacts to the environment and the effectiveness of the CP methodology in terms of minimizing such impacts, this study sought to apply such methodology in the Bless Unisex Beauty Salon, located in the city of Osório-RS. The objective of this work is to propose alternatives to reduce the consumption of inputs and raw materials, minimize the generation of process waste, and replace hazardous products with others with less impact.

2 MATERIAL AND METHODS

The model that served as a basis for the implementation of the Cleaner Production Program in the Bless Unissex beauty salon was the model created by the National Center for Clean Technologies. This work contemplates the first four steps of the Program, leaving it up to the company to decide if it will continue the Program.

The program was structured from the flowchart of processes, a survey of inputs and outputs, and through the definition of the steps of greatest environmental impact, which had priority regarding mitigation.

The method begins with a technical visit, through which a pre-sensitization of the target audience (top management of the company) was carried out, highlighting successful cases and the economic and environmental benefits that CP offers the company.

After the first visit, the step 1 consisted of obtaining a commitment from management, which is of the utmost importance for the program to reach

consistent results; identifying barriers to implementation, and finding solutions in order to predict and to solve possible problems in the next steps; establishing the breadth of the program, and determining its scope inside the company, for example, if the program is going to include the entire company or just one sector, from which sector it will start, if there is one sector that is critical, among other things that must be considered; and establishing the ecoteam, a team formed by the researchers and collaborators of the company, with the aim of coordinating, conducting, and continuing the program.

Step 2 of the program contemplated the study of the flowchart of the production process, which, through a detailed analysis, allows the definition of the flow of raw material, water, and energy, in addition to the clear visualization of the generation of waste in the process. Thus, in possession of the flowchart, the ecoteam can perform the environmental and process diagnosis, which consisted of the quantification of production data, such as inputs (raw material, water, energy, and other inputs), outputs (waste, effluents, by-products, and products) and data of the environmental situation of the company.

In order to obtain the quantitative data necessary to carry out the steps of the CP program, the inputs and solid waste were estimated using a common digital scale. With regard to effluents, the flow rate of the sink was estimated and multiplied by the average time of water use for each capillary process, obtaining the average flow rate of effluent generated in each process. The other liquids used as process inputs were estimated using containers of known volume. In the case of electricity, to estimate the average consumption for each activity, the power of the equipment was multiplied by the average time of use specific to each activity. The noise emission was obtained using the *software* Decibel Meter Pro. Dust emission was not quantified due to the lack of specific technical equipment for this purpose. For purposes of comparisons after the implementation of the program, the average monthly consumption of water and electricity and their respective cost for the

company were also calculated, using the monthly invoices of the last six months of operation of the beauty salon.

Later, from such quantitative data and the environmental diagnosis, a spreadsheet was developed contemplating the environmental aspects and impacts, aiming to highlight the activities and operations of the company that require greater attention, thus allowing to select the focus of evaluation in the establishment.

The process of characterization of the aspects and their respective environmental impacts was carried out based on the UNISINOS EMS (Environmental Management System), according to the guidelines of NBR ISO 14001, which proposes as evaluation criteria: the scope (spatial coverage of the impact), severity (severity of the change caused by the impact and the capability of reversibility), and frequency (periodicity of occurrence in a normal situation). These criteria offer a score of 1 to 4 for each, which, added together, result in the rating of the aspect/impact that varies between negligible (score up to 3), moderate (from 4 to 6), and critical (7 to 12). This classification also determines the priority of work. The critical impact will have priority 1. The one which is classified as moderate will have priority 2 and can be treated in the background by the team.

In Step 3, the quantitative analysis of the inputs and outputs of the aspects that received priority at the time of selection of the focus of evaluation was performed. Additionally, the indicators that are essential to evaluate the efficiency of the program and the development of the proposed CP actions were also defined. After the causes of waste generation were identified, and respecting the level of performance of the program, the possible actions of cleaner production to be taken were identified.

Finally, Step 4 consisted in evaluating technically, economically, and environmentally the opportunities established in the previous step and defining which were the viable opportunities. Lastly, the CNTL implementation model proposes a fifth step, in which the program is finalized by defining the

implementation and monitoring plan (outlines strategies for the implementation of the actions), and the continuity plan, which aims to ensure that the program has continuity. It is worth mentioning that the last step present in the model was not contemplated in this work, since it was intended to analyze, in a preliminary way, the potential of implementation of CP in the beauty salon being studied.

3 RESULTS AND DISCUSSION

Next, the results related to the development of steps 1 to 4 of The Cleaner Production Program will be presented and analyzed.

3.1 Step 1

The first contact with the company took place on September 04, 2020, being present the owner of the beauty salon and one of the researchers of the project. At this time, the entrepreneur was asked what aspects she would like to develop or improve in the procedures of her establishment. The answer was direct: the owner aims to reduce costs with water and energy consumption.

When asked about a probable adequacy in the generation and disposal of waste in the beauty salon, the person in charge said that she already separated them correctly. However, when analyzing the garbage cans of the space, the opposite was found. The waste was not separated, nor were the trashcans identified so that customers/visitors to the salon knew about the separation. Thus, it was possible to observe a certain reluctance of the owner to adapt the management of her establishment's waste. Even knowing the likely resistance regarding this matter, the need to properly separate these materials is indisputable, since many of them are even classified as hazardous waste.

Procedures performed frequently at the Bless Unisex salon are: manicure/pedicure service; hair cutting, moisturizing, coloring, and Brazilian Blowout services; and eyebrow design service/threading (with line). Other services,

such as waxing and massage, are offered only on demand. Therefore, these were not included in this article because they are difficult to analyze due to the limitation in their occurrence.

At this first moment, the Program's ecoteam was also defined. Due to the fact that the beauty salon has few collaborators, the owner decided to be solely responsible for the project, along with the research team.

Regarding the barriers to the implementation of the Program, two possible barriers were identified in the enterprise: resistance to change in the separation of waste and resistance to invest in the actions proposed by the program.

In general, the meeting could be considered fruitful, because, despite the impasse regarding the management of the waste produced, the owner was excited about the possibility of reducing the costs of her business.

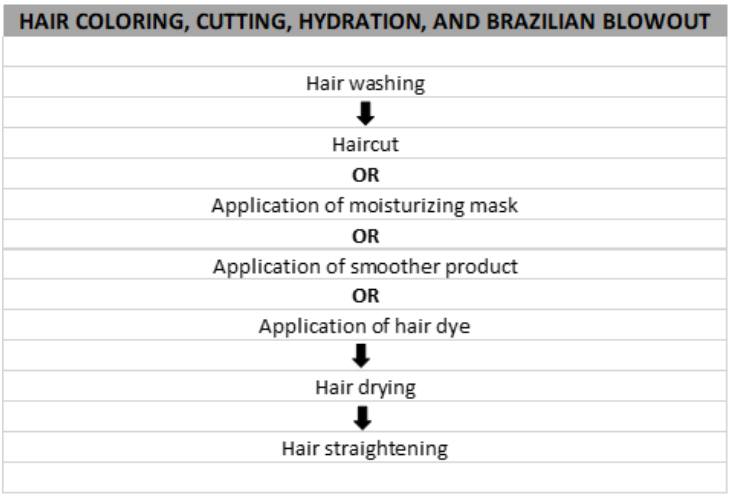
3.2 Step 2

As stated earlier, the services most often provided in the beauty salon being studied here are: hair services, manicure/pedicure, and eyebrow design/threading. After an analysis of these services, the process flowcharts were structured, which allowed to identify the steps that generate waste and efluente.

As shown in Figure 1, in the hair processes, it is possible to observe that the only change between coloring, hydration, and the Brazilian blowout is the product used. The beginning and end of the processes are the same and consist of washing, eventual cutting, drying, and ironing of the hair.

Figure 2 shows the step-by-step of the manicure/pedicure process. It is important to note that in this flow chart are the steps of nail polishing and removal of nail polish with acetone, which are one of the impactful aspects that will be treated with priority in the Program.

Figure 1 – Flow chart of hair processes



Source: Authors, 2021

Figure 2 – Flow chart of manicure/pedicure service

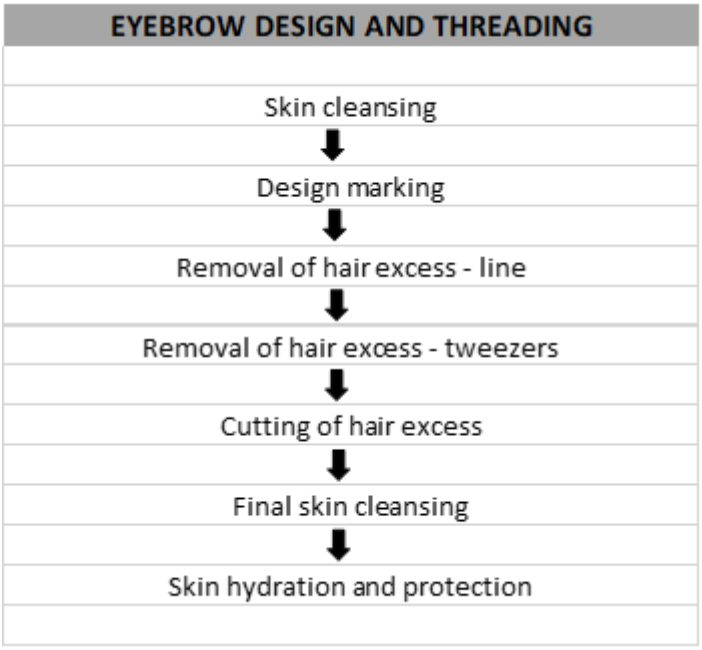
Source: Authors, 2021

In Figure 3, on the other hand, the detailed process of the eyebrow service/threading is shown, which, among the services analyzed, are the only ones that do not use hazardous substances. However, the waste commonly generated in these processes does not allow recycling, which makes them moderately

impactful (as will be seen below). If bleeding occurs during the performance of any of these services, the blood-contaminated cotton becomes hazardous waste and requires the correct separation and consequent destination.

From the process flowcharts, the quantitative block diagrams of the services being studied were elaborated, presented in the following figures.

Figure 3 – Flow chart of eyebrow design and threading services



Source: Authors, 2021

In Figure 4, it is possible to observe the emission of approximately 1 liter/month of liquid effluent from hair processes. As mentioned earlier, this effluent has a high chemical load due to the composition of the products used, which requires proper treatment so as not to contaminate the receiving body.

Among the products used (shampoo, conditioner, dye/toner, moisturizing mask, and straightener), the one that requires the most attention is the one responsible for hair smoothing, due to the fact that it contains formaldehyde in its composition. The impact of using this product will be mitigated by replacing it with one that does not contain formalin in its composition.

Figure 4 – Quantitative block diagram and form of measurement of hair processes

HAIR COLORING, CUTTING, HYDRATION, AND BRAZILIAN BLOWOUT		
INPUTS	**PROCESS**	**OUTPUTS**
		SOLID WASTE
		Hair remnants - 50g
Water - 1.015L		Product packaging - 63g
Hydrogen peroxide - 0.27L		Disposable glove/mask - 107.83g
Conditioner - 289.4g		**LIQUID EFFLUENT**
Electricity (hair straightener) - 0.09kWh		Water + conditioner - 0.371L
Electricity (hair dryer) - 1.05kWh	Smoothing	Water + moisturizing mask - 0.036L
Disposable glove - 92g	Coloring	Water + smoother product - 0.075L
Disposable mask - 15.83g	Hair cutting	Water + shampoo - 0.371L
Moisturizing mask - 10g	Hydration	Water + hair dye - 0.162L
Smoother product - 0.11L		**EMISSIONS**
Shampoo - 0.178L		Hair dryer noise - 77dB to 87dB*
Hair dye/toner - 240g		Steam from hair straightener - N/D
		Steam from hair dryer - N/D
		PRODUCT
		Colored, cut, hydrated, and smoothed hair
FORMS OF MEASUREMENT		
INPUTS		
Water: wash basin flow x average washing/rinsing time		
Hydrogen peroxide: see packaging		
Conditioner: see packaging		
Electricity: device power x average time of use		
Disposable glove: weighed in scale		
Disposable mask: weighed in scale		
Moisturizing mask: see packaging		
Smoother product: see packaging		
Shampoo: see packaging		
Hair dye/toner: see packaging		
OUTPUTS		
Hair remnants: average of 3 cuts - weighed in scale		
Product packaging: weighed in scale		
Disposable glove/mask: weighed in scale		
Water + conditioner: wash basin flow x average rinsing time		
Water + moisturizing mask: wash basin flow x average rinsing time		
Water + smoother product: wash basin flow x average rinsing time		
Water + shampoo: wash basin flow x average rinsing time		
Water + hair dye: wash basin flow x average rinsing time		
Hair dryer noise: measured by *software*		

Source: Authors, 2021

Figure 5 – Quantitative block diagram and form of measurement of manicure/pedicure service

MANICURE AND PEDICURE		
INPUTS	PROCESS	OUTPUTS
Water - 18.33L	Manicure and pedicure	SOLID WASTE
Cotton - 393g		Cotton + nail polish - 393.3g
Pliers - 48g		Autoclave packaging - 275g
Cuticle softener - 0.196L		Dead skins - N/D
Foot wash basin - 191g		Bags - 962g
Base for nail polish - 0.098L		Cut nails - N/D
Nail clipper - 20g		LIQUID EFFLUENT
Autoclave packaging - 275g		Nails soaking water - 18.33L
Nail polish - 0.196L		
Cuticle pusher - 17g		EMISSIONS
Nail file - 98.32g		Nail dust - N/D
Drying oil - 0.098		PRODUCT
Nail polish remover - 0.05L		Filed, cuticled, and polished nail
Plastic bag for wash basin/hands - 962g		
FORMS OF MEASUREMENT		
INPUTS		
Water: measuring cup dispenser (known volume)		
Cotton: weighed in scale		
Pliers: weighed in scale		
Cuticle softener: measuring cup dispenser		
Foot wash basin: weighed in scale		
Base for nail polish: measuring cup dispenser		
Nail clipper: weighed in scale		
Autoclave packaging: weighed in scale		
Nail polish: measuring cup dispenser		
Cuticle pusher: weighed in scale		
Nail file: weighed in scale		
Drying oil: measuring cup dispenser		
Nail polish remover: measuring cup dispenser		
Plastic bag for basin/hands: weighed in scale		
OUTPUTS		
Cotton + nail polish: weighed in scale		
Autoclave packaging: weighed in scale		
Bags: weighed in scale		
Soaking water: measuring cup dispenser		

Source: Authors, 2021

As shown in Figure 5, about 400g/month of the cotton + nail polish waste is generated in the manicure/pedicure service. However small the generation may

seem, this is a class I waste – hazardous (ABNT, 2004), and must be disposed of appropriately so that it does not contaminate soil and other materials with recycling potential.

Another aspect that requires attention is the monthly generation of 18L of effluent consisting of the water in which the nails are soaked in. Compared to the use of water in hair processes, the manicure/pedicure service uses a lesser quantity, however, it is a service performed more often than hair services, which justifies the difference in effluent generation.

Figure 6 – Quantitative block diagram and form of measurement of the eyebrow design/threading service

EYEBROW DESIGN AND THREADING		
INPUTS	**PROCESS**	**OUTPUTS**
Alcohol in gel - 0.083L		**SOLID WASTE**
Cotton - 40g		Cotton + cleaning solution + pencil - 48.84g
Moisturizer - 0.055L		Line + dermatographic pencil - 0.314g
Dermatographic pencil - N/D	Eyebrow design	Line - 0.627g
Line - 0.627g	Threading	**EMISSIONS**
Tweezers - 7g		Dust (hair) - N/D
Brush - 6g		**PRODUCT**
Cleaning solution - 0.011L		Eyebrow and threading
Scissors - 27g		
FORMS OF MEASUREMENT		
INPUTS		
Alcohol in gel: measuring cup dispenser		
Cotton: weighed in scale		
Moisturizer: measuring cup dispenser		
Line: weighed in scale		
Tweezers: weighed in scale		
Brush: weighed in scale		
Cleaning solution: measuring cup dispenser		
Scissors: weighed in scale		
OUTPUTS		
Cotton + solution + pencil: weighed in scale		
Line + dermatographic pencil: weighed in scale		
Line: weighed in scale		

Source: Authors, 2021

Of the services studied in this work, the eyebrow design/threading is the one that least negatively impacts the medium. As shown in Figure 6, approximately 50g/month of solid waste is generated. This is not an alarming quantity, however, the waste generated is not amenable to recycling, being characterized as residue. Given this, it is a residue that must be sent to the landfill, without the possibility of reuse or recycling.

The values of inputs and outputs contained in the diagrams (Figures 4, 5 and 6) represent the average of generation and consumption in the period of one month of operation of the salon, and allow to highlight the most generated waste, enabling a comparison after the implementation of the program.

In order to find the focus of the evaluation of the program, a spreadsheet of environmental aspects and impacts of the services provided by the salon was prepared, as shown in the following figures.

Figure 7 – Spreadsheet of environmental aspects and impacts of hair services

ITEM	PROCESS	ACTIVITY	ASPECT	IMPACT	EVALUATION CRITERIA			
					SCOPE	SEVERITY	PROBABILITY	CLASS
1	Smoothing	Hair washing	Energy consumption	Resource depletion	1	2	3	6
2	Smoothing	Hair washing	Water consumption	Decrease in the availability of natural resources	1	2	3	6
3	Smoothing	Hair washing (shampoo + conditioner)	Hydric effluent generation	Change in water and soil quality	1	2	3	6
4	Smoothing	Use of chemical product (smoother)	Consumption of mineral resources	Change in water, air, and soil quality	1	3	3	7
5	Smoothing	Steam of the smoothing process	Emission of gases/vapors	Change in air quality	1	2	3	6
6	Smoothing	Steam from hair straightener	Emission of gases/vapors	Change in air quality	1	2	3	6
7	Smoothing	Noise	Noise emission	Disturbance of the comfort of the community	1	1	3	5
8	Hydration	Hair washing	Hydric effluent generation	Change in water and soil quality	1	2	3	6
9	Hydration	Use of chemical product (moisturizer)	Consumption of mineral resources	Change in water, air, and soil quality	1	2	3	6
10	Hydration	Hair washing	Water consumption	Decrease in the availability of natural resources	1	2	3	6
11	Hydration	Hair washing	Energy consumption	Resource depletion	1	2	3	6
12	Haircut	Hair remnants	Solid waste generation	Change in water and soil quality	1	2	3	6
13	Haircut	Hair washing	Energy consumption	Resource depletion	1	2	3	6
14	Haircut	Hair washing	Water consumption	Decrease in the availability of natural resources	1	2	3	6
15	Haircut	Hair washing (shampoo + conditioner)	Hydric effluent generation	Change in water and soil quality	1	2	3	6
16	Haircut	Use of chemical product (shampoo + conditioner)	Consumption of mineral resources	Change in water, air, and soil quality	1	2	3	6
17	Haircut	Hair drying	Energy consumption	Resource depletion	1	2	3	6
18	Haircut	Hair drying (noise)	Noise emission	Disturbance of the comfort of the community	1	1	3	5

Source: Authors, 2021

The smoothing process, presented in Figure 7, obtained classification 7 due to the use of a product with an aggressive chemical (formalin). According to the classification, this is a critical significant aspect, and should be treated with priority in the Cleaner Production program.

Figure 8 – Spreadsheet of environmental aspects and impacts of the manicure/pedicure service

ITEM	PROCESS	ACTIVITY	ASPECT	IMPACT	EVALUATION CRITERIA			
					SCOPE	SEVERITY	PROBABILITY	CLASS
19	Manicure/pedicure	Nail polish removal	Use of cotton with acetone	Decrease in the availability of natural resources	1	2	3	6
20	Manicure/pedicure	Nail polish removal	Chemical waste generation (cotton + nail polish)	Change in water and soil quality	1	3	3	7
21	Manicure/pedicure	Nail polish removal	Generation of atmospheric emissions (by volatile compounds present in acetone and nail polish)	Change in air quality	1	2	3	6
22	Manicure/pedicure	Nail cutting	Biological waste generation	Change in water and soil quality	1	1	3	3
23	Manicure/pedicure	Nail filing	Use of inputs	Decrease in the availability of natural resources	1	1	3	3
24	Manicure/pedicure	Removing piercing-cutting tools from the package	Solid waste generation	Change in water and soil quality	1	2	3	6
25	Manicure/pedicure	Cuticle removal	Use of cuticle softener	Decrease in the availability of natural resources	1	2	3	6
26	Manicure/pedicure	Cuticle removal	Use of piercing-cutting materials (metal)	Decrease in the availability of natural resources	1	2	3	6
27	Manicure/pedicure	Cuticle removal	Effluent generation (water + cuticle softener)	Change in water and soil quality	1	1	3	5
28	Manicure/pedicure	Dead skin removal	Use of piercing-cutting materials	Decrease in the availability of natural resources	1	2	3	6
29	Manicure/pedicure	Dead skin removal	Biological waste generation	Change in water and soil quality	1	2	3	6
30	Manicure/pedicure	Nail polishing (base and color)	Generation of atmospheric emissions (by volatile compounds present in nail polish)	Change in air quality	1	2	3	6
31	Manicure/pedicure	Cleaning of excess nail polish	Chemical waste generation (cotton + acetone)	Change in water and soil quality	1	3	3	7
32	Manicure/pedicure	Cleaning of excess nail polish	Generation of atmospheric emissions (by volatile compounds present in acetone)	Change in air quality	1	2	3	6
33	Manicure/pedicure	Nail polishing (drying oil)	Generation of atmospheric emissions (by volatile compounds present in nail polish)	Change in air quality	1	2	3	6

Source: Authors, 2021

The manicure/pedicure service also obtained critical significant aspects in the activities involving disposal of cotton + acetone waste. These activities will have an emphasis on mitigation also due to the dangerousness of the waste, classified by ABNT NBR 10004:2004 as class I – hazardous.

The aspects and impacts of the eyebrow design/threading service, according to Figure 9, present only moderate impacts, which does not characterize urgency in mitigation through the Program, but requires alternatives that seek to reduce this significance.

Figure 9 – Spreadsheet of environmental aspects and impacts of the eyebrow design/threading service

ITEM	PROCESS	ACTIVITY	ASPECT	IMPACT	EVALUATION CRITERIA			
					SCOPE	SEVERITY	PROBABILITY	CLASS
34	Eyebrow design threading	Skin cleansing (cleaning solution + cotton)	Solid waste generation	Change in water and soil quality	1	2	3	6
35	Eyebrow design threading	Threading (line)	Solid waste generation	Change in water and soil quality	1	2	3	6
36	Eyebrow design threading	Design (dermatographic pencil)	Solid waste generation	Change in water and soil quality	1	1	2	2

Source: Authors, 2021

3.3 Steps 3 and 4

Considering the cause of the generation of the waste presented in the block diagrams, it is possible to carry out modifications in several levels of action proposed by the CNTL. The program to be implemented will work at level 1. According to this level, the proposed actions are based on modification of the products and processes through good practices and replacement of raw materials. To define whether an action is feasible or not of being implemented, considering economic and environmental aspects, a critical evaluation of the pros and cons of each action is necessary. Below are the proposed actions and their analysis.

1. Standardization of the amount of product used in hair: considering that there is no initiative of this standardization by the manufacturers and that the products are very concentrated, generating a great waste, standardizing a sufficient amount of use of the products for each length of hair is a way to avoid excessive consumption of this raw material, and the generation of effluents with a high chemical load. For this, a test of usage can be carried out, with dosers/measuring spoons and, at the end of the test, a standardization for each type of shampoo, conditioner, moisturizing mask, smoothing product, and hair length can be established. It is also possible, with information of the length and volume of the hair, to find the exact amount of products for each client through

specialized websites, such as hairsize.com.br. In addition to avoiding the excessive use of chemicals and the generation of effluents, this standardization also generates an economic gain, because it reduces the waste of the product, allowing for more washes/hydrations/smoothings with the same amount that was used before the standardization process.

2. Installation of flow reducers and aerators: with this action it is possible to reduce the waste of potable water used in wash basins and faucets in general. At first, this requires a certain cost of implementation, but, in the long term, it will generate financial gain by reducing water consumption. The use of aerators is most suitable, since it does not require major changes in the systems, as they must be installed directly in the nozzle of the faucets, with the function of retaining water and mixing air in the jet, reducing the flow without losing the "comfort".

3. Reuse of water from the wash basin to clean the salon: usually two to three hair washes are performed for each procedure. The water used for rinsing can later be used as cleaning water for the salon, increasing the service life of the resource and, consequently, ceasing to consume more resource for an activity that does not require water potability (cleaning activity). For this, the first rinse water from the hair should be discarded, while the second and third can be stored (for a short time) and used on the outside of the salon.

4. Change in the process of soaking the feet: for the purpose of softening cuticles and skins of the feet for subsequent removal, the salon currently uses a basin with water to soak the feet in. However, cream, cotton wool, and a spray jet of water are used for the softening of the hands. The suggestion is to use this technique also when soaking the feet, making the use of water decrease and, consequently, the generation of effluent as well.

5. Replacement of aggressive chemicals with natural products: in many processes of the beauty salon, specifically in the hair area, chemicals with components that are harmful to the medium, and, above all, to human health, are used. Replacing these products with others that contain natural ingredients in their

composition will lead to a decrease of the chemical load of the effluent generated, allowing the conventional treatment to contemplate all contaminants present in the effluent, avoiding chemical contamination of the receiving body. The Life Cycle Assessment (LCA) tool can prove the environmental and health benefits that come from the replacement of highly hazardous products, such as formalin, used in hair processes.

Regarding the replacement of chemicals with natural products, the economic feasibility can also be evaluated based on the monthly costs with products for smoothing and the costs with the implementation of a new product without formalin. The Bless Unissex beauty salon uses a smoothing product within ANVISA standards, with a monthly cost of R$237.50 per kit. On the other hand, formaldehyde-free products cost, on average, R$224.30 per kit, according to research carried out on beauty sites. With this, it can be evidenced that the implementation of a new formaldehyde-free product reduces the cost for the salon by 5.5%. Therefore, such an exchange is considered economically feasible, although it is necessary to assess the durability of the smoothing treatment and customer satisfaction with the new product, despite the fact that the two types of product have an average durability of three to four months, according to manufacturer.

Regarding the environmental feasibility, evaluated based on the environmental impact of the smoother product with formalin and the product without formalin, the product with formalin obtained class 9 of environmental impact, considered as significant in this study. The smoothing product without formalin, on the other hand, was classified as 4, considered not significant. This result was due to the reduction in the degree of severity and probability of occurrence, since there are no hazardous chemicals in the composition of these products indicated to replace the kit currently used in the salon. Therefore, it was shown that the change of the smoother kit is considered environmentally feasible as well.

6. Adoption of individual kits for each customer: several materials used in the services provided are disposable or require post-use sterilization. Aiming to reduce the generation of disposable waste (nail file, tweezers, eyebrow brush, among others) and increase the time interval between autoclavings (reducing the cost spent on electricity), adoption of individual kits for customers is suggested. Each client will receive their own kit that will stay in the beauty salon, where the necessary sterilization will be done, although less frequently than it would be done if all clients used the same materials. The customer who adopts this individual kit will receive a financial discount on the procedures, which will encourage the customer while avoiding costs due to the less frequent need for sterilization of the materials.

7. Adoption of non-disposable materials by collaborators: such as the materials used in the procedures, some objects used by collaborators can also be replaced by non-disposable ones. It is the case of replacing disposable masks with fabric or plastic masks, as well as replacing disposable hair caps with fabric caps. This suggestion constitutes a small change that may prevent the generation of single-use waste.

8. Partnership with local waste pickers: many of the waste generated in the beauty salon is plastic and paper packaging. These materials allow for recycling, but, currently, are being sent to landfill. The proposal of the partnership with local waste pickers and/or recycling cooperatives aims to give a better destination to these materials, avoiding the occupation of landfills by materials with recycling potential. This action can also be defined as an industrial symbiosis, since the company can benefit from an environmental marketing and the recyclers will receive a segregated and quality material for later commercialization. Thus, the salon would segregate the waste directly at the source, store it in a suitable place and, by prior agreement, the recycler and/or cooperative would come to collect the materials.

Environmental indicators were used to evaluate the evolution of environmental aspects and impacts related to the services provided at the salon. These indicators were responsible for measuring what was requested by the owner of the establishment (reduction of water and electricity expenses) and to evaluate the aspects that received a significant degree of risk in the assessment of environmental aspect and impact (generation of waste and effluents with hazardous characteristics from the process of hair smoothing and nail polish removal). Figure 10 shows the aspects and their environmental indicators, an estimate of values based on the block diagrams and the water and electricity bills provided by the owner, and, finally, a goal to be achieved by the salon. This goal seeks a 10% decrease in the aspects covered by the indicators. The evaluation of the compliance to these indicators should be carried out monthly, and the enterprise must reach numbers below the estimate so that the indicator can be considered as fulfilled.

Figure 10 – Environmental indicators

ASPECT	INDICATOR	ESTIMATE	GOAL
Water consumption	Volume of water consumed	1500 liters/month	1350 liters/month
Electricity consumption	Amount of energy used	1.14 kWh/month	1.03 kWh/month
Hazardous waste generation	Amount of waste generated	500 g/month	450 g/month
Chemical effluent generation	Amount of effluent emitted	75 liters/month	67.5 liters/month

Source: Authors, 2021

4 CONCLUSIONS

From the analysis of inputs and outputs of the processes in question, it was possible to raise 8 actions to mitigate negative environmental impacts; these actions generate gains in the three pillars of sustainability: environmental, social, and economic. The most significant impact found was the use of the smoothing

product with formalin in its formulation, so, for its mitigation, it was proposed to replace it with a product with a lower environmental impact. Its environmental and economic feasibility was proven, with a 5.5% reduction in the monthly cost of this product and a reduction in the significance of class 9 to 4 in the environmental impact assessment. The company has been gradually implementing some of the suggested actions, such as the adoption of individual kits for each client and the replacement of disposable materials used by collaborators with materials for continuous use. In addition to corrective actions, environmental indicators were proposed to monitor the effectiveness of these, being: water consumption, energy consumption, generation of chemical effluent (with smoothing product), and generation of hazardous waste (with acetone).

Given the above, it is possible to prove the effectiveness of the Cleaner Production Program in the CNTL model, since it enabled a qualitative and quantitative analysis of all the processes of the Bless Unisex beauty salon, allowing for the proposition of more sustainable actions and practices for this type of enterprise. In addition to that, it was verified that the lack of specific legislation for beauty salons hinders the implementation of environmental actions and programs, evidencing the urgency of rethinking the environmental legislation of this branch of activities.

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