Automobile repair shops have a negative impact on the environment

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ABSTRACT

Vehicle repair shops carry out various types of activities related to the repair and maintenance of automotive vehicles, such as mechanics, electronics, painting, lights, or oil changes. These activities generate solid wastes, effluents and air pollutants. When improperly managed, such waste material can have a negative effect on the environment and pose health risks. In addition to governmental licensing, these establishments must follow normative guidelines for the control and prevention of possible environmental impacts. However, many business owners do not understand their obligations in relation to environmental legislation or licensing. Therefore, this work aimed to identify problems in car repair shops in relation to current environmental regulations to provide compliance guidelines. To accomplish this, we carried out a data survey in vehicle repair shop for small vehicles with low polluting potential in the City of Rio de Janeiro – RJ (Brazil). By evaluating physical facilities, environmental control mechanisms and environmental management of waste, or the lack thereof, our results shed light on the key sources of pollution created by these establishments and how such pollution can be controlled by compliance with legislation applicable to this sector.

Keywords: air pollution, environmental contaminant, vehicle service and repairs, passenger cars

RESUMO

As oficinas de automóveis realizam diversos tipos de atividades relacionadas à reparação e manutenção de veículos automotores, como mecânica, eletrônica, pintura, iluminação e troca de óleo. Essas atividades geram resíduos sólidos, efluentes e poluentes atmosféricos. Quando gerenciados incorretamente, esses resíduos podem ter um efeito negativo no meio ambiente e representar riscos à saúde. Além do licenciamento governamental, esses estabelecimentos devem seguir diretrizes normativas para o controle e prevenção de possíveis impactos ambientais. No entanto, muitos proprietários de oficinas não entendem suas obrigações em relação à legislação ambiental ou licenciamento. Portanto, este trabalho teve como objetivo identificar problemas em oficinas de automóveis em

relação às normas ambientais vigentes. Para tanto, foi realizado um levantamento de dados em oficinas de veículos de pequeno porte com baixo potencial poluidor na cidade do Rio de Janeiro - RJ (Brasil). Ao avaliar as instalações físicas, os mecanismos de controle ambiental e a gestão ambiental de resíduos, ou a falta deles, nossos resultados evidenciam as principais fontes de poluição geradas por esses estabelecimentos e como essa poluição pode ser controlada pelo cumprimento da legislação aplicável ao setor.

Palavras-chave: poluição do ar, contaminante ambiental, oficina de serviço e reparação automotiva, carro de passageiros

Introduction

Recent decades have seen improved socioeconomic development, more consumerism and increased travel. According to the National Association of Motor Vehicle Manufacturers - *Associação Nacional dos Fabricantes de Veículos Automotores* (ANFAVEA, 2016), 2,156,356 vehicles were produced in Brazil in 2016, of which 1,778,464 were passenger cars (light-duty vehicles) (ANFAVEA, 2016). In 2019, passenger car production in Brazil was 37,720,122 (ANFAVEA, 2020). Rio de Janeiro is the second largest metropolitan area in Brazil and the main economic, cultural, and financial center in the country. In 2015, Rio de Janeiro had a fleet of 1,943,456 vehicles (IBGE, 2015). Then in 2018, this same fleet increased to 2,035,943 (approximately 4.76%) (IBGE, 2018), generating a concomitant increase in various types of pollution. Vehicle emissions and fuel combustion have a relatively high contribution to urban pollution in Brazilianbig cities and around the world (Miranda et al., 2011). Recently, we have seen a movement to mitigate the use of environmental resources, proposing the use of alternative cars based on renewable energy, such as hybrid electric vehicle (HEV) and electric vehicle (EV) Technologies (Kumar and Alok, 2020). Nonetheless, the demand for car repair shops has remained steady or even increased. The addition of circulating motor vehicles generates a demand for specialized maintenance services.

Consequently, apart from environmental pollution by using cars, the services offered by repair shops, in turn, only increase the pollution. These shops are classified as economic activities included in the service tertiary sector, and the specific activities are standardized in the so-called National Classification of Economic Activities (*Classificação Nacional das Atividades Econômicas* CNAE). Here, we show activities related to the operation of vehicle repair shops, according to data provided by *Sistema Municipal de Informações Urbanas (SIURB*) and permits issued by the City of Rio de Janeiro, Brazil. From February 1, 2016 to January 9, 2017, the following classes of licenses were issued to auto shops in Rio de Janeiro: 219 for accessory installation, maintenance and repair services; 218 for maintenance and mechanical repair; 160 for washing, lubrication and polishing services; 157 for body shop services, including painting; 153 for maintenance and electrical repair; 96 for alignment and balancing services; 34 for maintenance and repair of motorcycles and scooters; 34 for tire repair; and 14 for upholstery repairs.

When improperly managed, the activities carried out in vehicle repair shops are sources of negative environmental impacts that can result in pollution, compromising the quality of life of the community and the environment.

In the water

Effluents are generated from lubrication, oil change, and car washing. These effluents can contain oily residues, sedimentable solids and detergents (INEA, 2014).

In the atmosphere

The main gaseous emissions are volatile organic compounds (VOCs) and nanoparticles emitted during body shop and painting processes (INEA, 2014). Pollutants, such as VOCs, can accumulate outdoors and in confined spaces, having a negative impact on air quality (Lv et al., 2020). Air pollution can also be caused by physical factors, such as heat and sound, the latter also being classified as noise pollution when the noise exceeds the decibels allowed outside the limits of the establishment. Noise sources are emitted by the body shop, as well as by equipment used in the services performed, such as compressors and exhaust systems (INEA, 2014).

In the soil

All services performed can generate solid waste, such as used tires and batteries, scrap, oil filters, contaminated grease rags, cans of paint and solvents, and used packaging. This calls for adequate waste management in order to avoid unlawful disposal.

Table 1 summarizes the main waste generated, according to the activities performed, correlated to the negative environmental impact and possible environmental pollution generated.

Table 1. Summary of possible negative impacts on the environment generated by the main waste from vehicle repair shops.

Activities	Main wastes	Polluted environment
General maintenance	- Grease rags contaminated with oils -Used tires -Plastic packages - Dead batteries - General rubbers -Oily residue from the oil and water separator system - Unserviceable parts -Glass -Scrap metals	Water and soil
Oil change	-Used lubricating oil -Grease rag contaminated with oil -Oily residue from the oil and water separator system	Water and soil
Washing	- Effluent with oil, solids and detergents -Solids removed from the sandbox -Oily residue from oil and water separator system	Water and soil
Painting	-VOCs - Empty contaminated cans -Saturated activated carbon and filters - Paint splatters from the paint booth -Solvents used - Particulate material	Water, soil and atmosphere
Body shop	- Particulate material	Atmosphere

Among body shop owners, we found a lack of understanding of these issues, as well as a lack of inspection by licensing agencies, so widespread contamination such as that described above is not surprising (Belfi et al., 2014). On the other hand, more citizens are concerned about the environment and how to minimize the negative impact of the services provided. Environmental control can be achieved through licensing and inspection, but this must be linked to education.

Therefore, this work aimed to identify problems in car repair shops in relation to current environmental regulations to provide compliance guidelines. To accomplish this, we carried out a data survey in car garages for small vehicles with low polluting potential in the City of Rio de Janeiro – RJ (Brazil). By evaluating physical facilities, environmental control mechanisms and

environmental management of waste, or the lack thereof, our results shed light on the key sources of pollution created by these establishments and how such pollution can be controlled by compliance with legislation applicable to this sector.

Methods

The survey of data was carried out through an analysis of administrative processes involved in the environmental licensing of car repair shops, in particular those of small and medium size located in planning area AP4 that covers. Rio de Janeiro's West Zone, including Barra da Tijuca, Jacarepaguá and Recreio.

These administrative processes are part of Simplified Environmental Licensing (*Licenciamento Ambiental Municipal Simplificado* - LMS) promulgated by the Environmental Control Coordination (*Coordenadoria de Controle Ambiental*) in association with the Municipal Secretary for the Environment (*Secretaria Municipal de Meio Ambiente* - SMAC) and followed by MA/SUBMA/CMFA/GTR-3– 3ª *Gerência Técnica Regional* (Regional Technical Management). To access these data, a formal consultation was carried out through administrative process 14/03/000.347/2016. Permission was granted by the General Coordination of Environmental Control on December 22, 2016.

The criteria used to select the administrative processes to be analyzed and, respectively, the automotive repair shops evaluated in this work are described below.

Vehicle repair shops installed in the AP4 region, registered in SMAC's internal document system- administrative licensing processes: Selection was based on processes from vehicle repair shops classified as small or medium-sized with low polluting potential. Using municipal environmental legislation as our reference, we analyzed the administrative procedure of establishments covered by the LMS (RIO DE JANEIRO, 2016a).

Classified as small and medium-sized and of low polluting potential by the LMS: These establishments carry out some or all of the following activities: mechanical, electrical,

painting, body shop, oil change, balancing, alignment, tire change, battery change, auto glass repair, and car washing activities.

Types of services offered: Establishments underwent thorough technical inspection between January 2014 and December 2016. Because only a few inspectors can be allocated, our choice of shop was randomized, but the establishment must have passed inspection on the date prior to the mentioned "agreement." These were all routine inspections.

Technical survey of inspection (from January 2014 to December 2016): Fourteen shops were selected and analyzed, comparing the results to the requirements of the regular legislation governing environmental licensing.

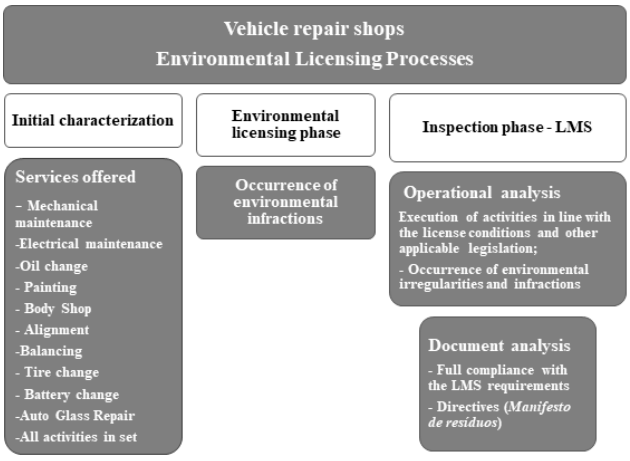

Figure 1 Requirements analyzed in the environmental licensing processes for vehicle repair shops. Initially, a general characterization was made regarding the services offered: painting; body shop; oil change; tire change; washing; balancing; alignment; mechanical and electrical; battery change. During the inspection phase, it was verified whether these activities were performed in accordance with the conditions of the issued license, as well as other applicable laws.

Results

Among the services performed by the vehicle repair shops, it appears that oil change was a significant activity in that it was provided by 50% of the analyzed shops. In descending order, we have mechanics, balancing and alignment services offered by 43% of the shops; 36% offer washing, electrical services and tire change; 28% painting, body shop and battery change; and only 7% offer the auto glass repair services (**Figure 2**). Most establishments offer more than one service, and it is noteworthy that none of the shops offered all the listed services concurrently.

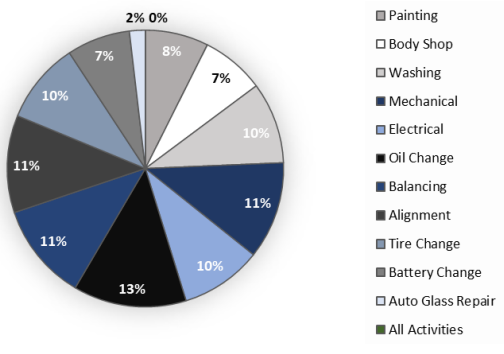

Figure 2. Services offered by vehicle repair shops in the Rio de Janeiro's West Zone: Painting; Body Shop;

Washing; Mechanical, Electrical, Oil Change; Balancing; Alignment; Tire Change; Battery Change; Auto Glass Repair; All Activities.

The services performed in vehicle repair shops generate considerable waste. Table 2 shows the main hazardous waste generated, and correct storage and disposal. NBR 10004 (ABNT, 2004) classifies waste in general, including the main waste generated in vehicle repair shops. NBR 11174 and 12235 (ABNT, 1990; 1992) provide for the storage of noninert and inert waste and hazardous solid waste, respectively.

Table 2. Hazardous waste generated in vehicle repair shops: adequate storage and disposal taken from data of Rio de Janeiro City.

Wastes	Storage and disposal
Lubricating oil	Packaged in a tank or containers with a lid in a sheltered area and provided with a containment system; Collection by lubricant oil re-refining companies, in compliance with *Conama** Resolution number 362 (Brasil, 2005a), keeping the receipts available for inspection
Solvents Cans contaminated with paints	Storage in containers with lids in a sheltered area; Collection by companies licensed by the environmental agency, keeping the receipts available for inspection
Saturated filters and activated carbon	
Plastic packaging, grease rags, parts, paper and cardboard contaminated with oil	
Saturated oil filter/used	
Oily residue and bottom sludge from the oil and water separator system	Periodic cleaning of the oil and water separator assembly; Collection by companies licensed by the environmental agency, keeping the receipts available for inspection

NBR 11174 and 12235 (ABNT 1990; 1992), Rio de Janeiro (2004); Brasil (2005a). **Conselho Nacional do Meio Ambiente* (National Environment Council, Brazil)

During the analysis of the licensing process to obtain the LMS, none of the vehicle repair shops committed an environmental violation that would have resulted in the application of sanctions described in Law 9,605/1998 (Brasil, 2017), such as warning, fine, pausing of work or activity, or partial or total suspension of the activity. However, during the inspection, which is carried out after the issuance of the LMS with a view to monitoring the conditions relative to licensure and the maintenance of environmental control devices, irregularities were found in 7 (50%) of 14 surveyed vehicle repair shops. Among

irregularities found, 1 (one) was related to the inadequate execution of one of the licensed activities, namely the use of the environmental control device, possibly resulting in environmental pollution. Two performed activities not revealed during the analysis of environmental licensing and, therefore, were not included in the scope of activities licensed by the vehicle repair shop. Four involved storage of hazardous products, such as new oil, or waste in locations other than those permitted by the licensing authority, improper facilities, and structural problems related to the lack of suitable control of equipment. (**Figure 3A**). After the finding of irregularities and verbal and/or written communication to the person in charge, three were promptly adjusted, three were adjusted after application of administrative sanction by Notice of Infraction, and only 1 (one) did not subsequently comply (**Figure 3B**). It should be noted that the latter vehicle repair shop, within the period of analysis of the environmental licensing processes indicated in the methodology, was still in the process being monitored, with no disposition as to the service.

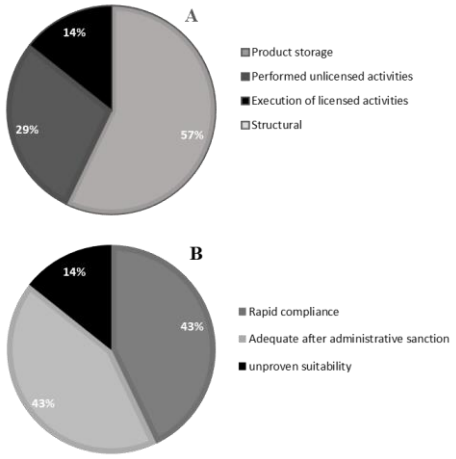

Figure 3. Irregularities committed by the vehicle repair shops found during the follow-up survey of the issued LMS (*Licenciamento Ambiental Simplificado*) in Rio de Janeiro. A. Profile/types of irregularities found; B. Number of shops that complied after irregularities found.

As a follow-up to environmental inspection, 11 vehicle repair shops presented all the requested documents to prove compliance with LMS requirements, out of which 2 (two) partially complied, and 1 (one) did not present any documentation to prove compliance by the deadline (**Figure 4A**). Again, however, this shop was still being monitored with no disposition at the time of this writing.

Most vehicle repair shops were found to be in compliance with the *Manifestos de Resíduo*, i.e., governmental directives which require proper disposal of waste according to NBR 11174 and 12235. Papers proving compliance with this

aspect of environmental control were highlighted here because this issue is an indicator of significant contamination. Of the 13 vehicle shops that delivered the requested documents, totally or partially, 8 presented all of their papers with the necessary fields properly filled in, and 3 (three) delivered their papers, but only partially completed. Only 2 shops delivered complete paperwork (**Figure 4B**). In general, for partially completed paperwork, the signature and stamp of the final recipient were missing. Therefore, it cannot be concluded that waste was properly managed. During the period analyzed, no shops were banned by the environmental inspectors, nor were licenses canceled and businesses closed.

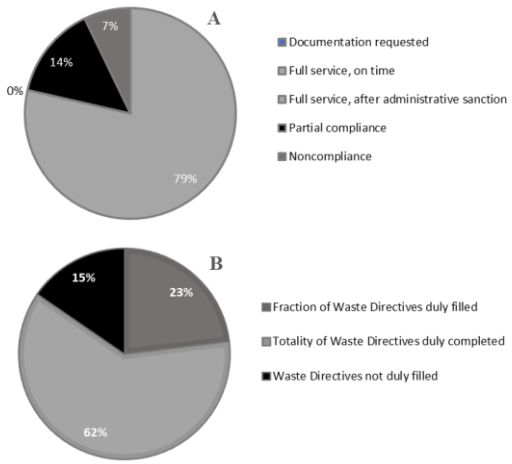

Figure 4. Quantitative analysis of vehicle repair shops that presented documentation in compliance with the conditions of the issued LMS in Rio de Janeiro. A. Full/partial/noncompliance with the requested documentation. B. Presentation of Waste Directives (*Manifestos de Resíduo*) duly filled.

Discussion

Both car production (Zorpas and Inglezakis, 2012) and maintenance generate significant environmental contamination. Vehicle repair shops are potentially polluting establishments, in particular deposition of solid residues, effluents and air pollutants generated in the performance of their normal activities. Although most shops are small enterprises, when added together, the quantity of pollutants becomes significant, not to mention the areas of waste disposal, often unknown. The relevant laws in force are related to the environmental control of these processes in order to properly manage their environmental impacts on the environment.

Through the analysis of administrative processes, it was found that none of the vehicle repair shops committed an environmental violation that resulted in the application of the sanctions described in Law 9,605 during the time elapsed between the opening of the process and the issuance of the environmental license. In other words, during the period of environmental

licensing to obtain the LMS, no irregularities were detected in shop activties. However, it is noteworthy that during post-license inspection, irregularities were found in 50% of these vehicle repair shops. Thus, even though licensed, those responsible for management and delivery of services did not have a complete understanding of their obligations under the law, let alone the implementation of effective control measures.

In the evaluated shops, the main service offered was oil change (50%). Correspondingly, the main irregularity involved the improper storage of dangerous products or waste without the exercise of proper environmental control. On the other hand, the vast majority of shop owners presented all documents to prove compliance with LMS requirements. Specifically, regarding the Waste Directives, 8 (eight) presented all of their paperwork duly completed in all necessary fields. It appears that the biggest problem is related to day-to-day operations since we noted a high compliance with the required documentation. In their environmental diagnosis in the municipality of Novo Hamburgo – RS (Brazil), Kohl et al. (2017) also found that vehicle repair shops had flaws in managing the waste generated, essentially because their storage areas did not meet the required specifications. Also, they did not adequately treat oil-contaminated effluents. In Monte Carmelo – MG (Brazil), all shops carried out oil changes, but only 40% of shops correctly disposed of the used oil for re-refining, and 33% had a water and oil separator box (Miranda Filho et al., 2011). In an analysis of establishments that performed oil changes in the city of Cabo Frio – RJ, Oliveira and Souza (2015) found that 50% of the collection points were unaware of the destination of the used/contaminated oil, as well as packaging from the oil change (38%). As for the waste generated, 56% did not perform proper disposal. In the city of Pombal – PB (Brazil), Silva et al. (2014) reported that 60% of the 68 vehicle repair shops performed an oil change in an area with non-waterproofed floors, favoring the infiltration of oil into the soil. Another 40% reported that the used oil was intended for re-refining, but no proof was presented. Based on such outcomes, studies have concluded that the environmental protection strategies implemented are still inefficient, likely

because such activities are viewed as increasing operational costs, thus overlapping economic and environmental issues (Ferreira, 2009; Machado, 2013). In this study, irregularities were found, and either verbal or written warnings were given to owners. Then, out of seven shops, 3 owners readily complied, and three complied after notice of infraction. These data imply that education is a major part of ensuring compliance with environmental ordinances involving proper inspection and communication.

Additionally, we mention the effects of the economic crisis in recent years with consequent rise of unemployment. Laxity in the performance of licensing obligations has also increased. In fact, according to the Union of Industry of Repair of Vehicles and Accessories of the State of Paraná (*Sindicato da Indústria de Reparação de Veículos e Acessórios do Estado do Paraná*, SINDIREPA-PR) in the last 10 years, the number of vehicle repair shops operating at the margins of the law has doubled in the metropolitan region of Curitiba City, representing 70% of the total of vehicle repair shops in that region (Kowalski, 2018). Thus, we see implications for environmental issues, but also economic issues. Owners have responsibilities toward employees and toward ensuring the safety of customers. Although it is not the focus of this work, it is worth mentioning that the working conditions in car shops for employees can be dangerous. Conditions of sanitation and comfort were unsuitable according a previous studies (Binder et al., 2001). This neglect in working conditions contributes to relaxing attention to problems that affect the environment.

Conclusion

Environmental pollution is the inevitable result of operating a vehicle repair shop. Oil change is the most recurrent activity, representing 50% of total services, and this service alone results in the pollution of water and soil owing to oil present in waste water and oil separator systems, even contaminated towels. Air pollution mainly results from gaseous emissions of volatile organic compounds (VOCs) and particulate matter emitted during the process of body shop

and painting of vehicles, which represented 20% of services.

Although such businesses are licensed and regularly inspected by different sectors of the *Secretaria Municipal de Meio Ambiente* (SMAC) to ensure compliance, a large number shops operate in total hiding, without environmental control mechanisms and necessary licenses. An increase of clandestine vehicle repair shops was observed in the last years in Brazil. Even among establishments that are licensed, we have seen compliance irregularities, thus increasing the routes of environmental pollution.

Getting a proper license is a mandatory procedure for vehicle repair shops, the operations of which can harm the local environment. It anticipated that the present study will stimulate the development of new educational materials aimed at the services of small companies that are often marginalized and in need of guidance. Indeed, a booklet has already been published to raise awareness of the damage caused by body shops, including the risks to human health. It presents measures that must be adopted to reduce these problems and shows that several of these measures are easy to implement. The booklet can be found at UEZO (2020) site.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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