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STUDY OF POLLUTER ACTIVITY POTENTIAL OF LIQUID FUELS RESALE IN THE CITY OF NATAL (RN): JUSTIFICATION FOR THE IMPLEMENTATION OF ENVIRONMENTAL LABELLING (GREEN SEAL)

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Abstract. *This paper presents the analysis of data collected by Federal University of Rio Grande do Norte experts and the Public Prosecutors concerning the situation of the gas station for liquid fuel, its forms of storage and its apparatus for the performance of primary functions (supply vehicles) and secondary (car washing, used oil storage, oil change etc.). The data presented was analyzed considering the city of Natal (RN) and taking into account characteristics and weaknesses. Thereafter, it was discussed qualitatively the pollution potential of liquid fuels resale in the city and the laws aimed at implementation of the Green Seal. The discussion mainly involves three agents: environmental, legal and technical, directed at 110 retail fuel stations analyzed.*

Keywords: *Environment, fuel, environmental impact*

1. INTRODUCTION (TIMES NEW ROMAN, BOLD, SIZE 10)

One of the main causes of soil contamination by gas retail liquid fuel leakage is presented in storage tanks and / or piping of these fuels. Furthermore, there is the disposal of used water in car washing, oil filters, cleaning materials, waste fuels in times of receipt and the vehicle supplies fuel tankage areas. Spills of this nature in installations that do not have adequate environmentally facilities to resale transaction represent two imminent dangers to the population: can cause contamination of groundwater by fuel seeping into the soil through the cobblestones and also represents the potential risk of explosion and fire.

In the 1990s were estimated underground tanks in the order of 100,000 units, according to Sandres and Mainer, apud Yukizaki (1993). In 2009, there were in Natal 473 fuel tanks installed in 110 resale stations. According to Sandres and Mainer (2005), these leaks represent somehow a danger to the population, not only because they can cause contamination to groundwater, but also because of the risk of explosion and fire.

The high number of fuel tanks installed in urban centers put themselves at risk, the environment and the population of its surroundings. Generally, according to Sandres and Mainer (2005), the fuel leaks happened in retail fuel stations for the environment can be sourced from: internal or external corrosion of pipes and underground tanks; failures and / or small cracks in parts welded; errors operating assembly and / or maintenance in underground tanks and surface spill fuel during supply procedure of these underground tanks. It is necessary to add even possible contamination by overflow when receiving fuel and pollution vents by the tanks and / or discharges unsealed.

Contamination due to uncontrolled releases can go to underground installations galleries of the city, and the possibility of contaminating the groundwater is quite significant. Other risks are inherent to these leaks, as the risk of fire and explosion by the amount of gasoline vapor confined in pipes and galleries.

The underground fuel tanks are generally subject to internal and external corrosion, respectively, for the products and the prevailing environmental conditions, as presents Mainier et al (1994). The use of appropriate coatings, correct sizing to resist attack fuels and corrosive contaminants are design criteria that reduce the possibility of future leaks.

In underground tanks, two types of corrosion can occur: the electrochemical and the electrolytic, since the corrosion process is a function of soil characteristics (wet, sandy, saline etc.), PH, soil permeability, presence of bacteria and the presence of pollutants.

This paper addresses the potential environmental problems caused by improper storage of liquid fuels in fuels sales, using as a basis the work presented by Coriolanus (CORIOLANO, 2005). To check the real situation of water sources in the region, present research proposes a monitoring including water harvesting in water wells near gas stations. (CORIOLANO, 2005).

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2. REVIEW

The fuel filling stations correspond to a potentially polluting activity of groundwater that can occur for the following reasons: 1. infiltration of fuel in the underground for improper handling of fuel: stroke (leakage "drops") for the supply of car, 2. fuel leaks and seepage due technical defects (pipes): underground storage tanks and pumps, bilge pump, 3. infiltration of fuel in the underground or in the drainage system of rainwater due to accidental spills occurring during supply of underground storage tanks (over-supply), 4. infiltration of the wasted gas (e.g. used oil, oil filters) in the basement due to improper storage or improper handling of wasted gas (e.g. in the area of oil change, car wash). Figure 1 shows some of the main types of leaks emphasizing where they come from and what promotes.

Figure 1. Some types of leaks occurring in gas supply of liquid fuels.

The pipelines and tanks are used for transport and storage of petrol and extended to fuels and other products with different formulations of gasoline and ethanol, diesel oil and lubricating oils in the process of discarding.

For this reason, the design of pipelines and tanks is not just limited to the transport, storage and manufacturing costs, but also to their resistance to corrosion, safety, environment, social responsibility, maintenance procedures and final destination. Importantly, the associated technical, legal and regulatory supervision is required by the Environmental Management System that manages gas storage of liquid fuels.

In the universe of a gas station, the implementation of this management system is closely linked to the training with gas station attendants and managers, environmental action plans, preparation of plans for the practice of supply, transportation and storage of fuels, operational training; expert advice, monitoring of environmental legislation, environmental education awareness of environmental responsibilities, implementation of projects that promote products, processes and services that have the least aggressive effect on the environment and a close relationship with certain public bodies dealing with environmental issues.

The soil contaminated by gasoline is considered one of the greatest potential risks to water quality of the aquifer due to the formation of five phases of gasoline, when in contact with the ground. These phases can be classified as: free, residual, vapor, dissolved and adsorbed (Sandres and Mainier, 2004).

- The free and the residual phases: these stages correspond to the pure product surface, with the difference that in first step the product is free of mobility, which may be removed by flowing and pumping, while the residual phase corresponds to dripping or pooling of several drops isolated on the porous, non-mobile.
- Vapor phase: it is represented by the product volatilized and present in the unsaturated zone of the aquifer.
- Dissolved phase: it is the phase that corresponds to the product dissolved in groundwater and transported by it.
- Adsorbed phase: corresponds to the product molecules that adhere to the aquifer solids, preferably organic matter and clay, in that order.

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3. MATERIALS AND METHODS

In the ordinance 518 of March 25, 2004, the Ministry of Health establishes the procedures and responsibilities for the control and surveillance of water quality for human consumption and its potability standards, and other measures such as regulatory guidance on the quality of water for human consumption.

Among the elements analyzed is the standard of benzene, a constituent of gasoline highly carcinogenic. With the purpose of evaluating and controlling water contamination by petroleum products in the city of Natal, the prosecutor, in 2009, partnering with UFRN and Semurb, initiated an action to investigate the situation of all gas stations in town.

The evaluations carried out by entities and coordinated by the District Attorney were approved by legal guidelines and regulations of CONAMA and ABNT, which range from process installation and licensing system stores oil products to the general principles for the selection of each respective system equipment.

At first we investigated 110 gas stations installed in the city of Natal, the largest quantity appearing in the register of Petroleum Derivatives Retail Syndicate of Rio Grande do Norte (Sindipostos / RN), corresponding to eighty-six (86) fluids gas stations associated with the entity and established in Natal (data collected on 10/08/2011 in http://www.sindipostosrn.com.br). Table 2 depicts some data after 1 year of investigative work in the search for environmental suitability of retail fuel stations in Natal (RN).

Table 1. Data from the first year of work of State Prosecutor.

Posts with the occurrence of leaks in pipes/connections;
Problems with posts tightness in CNG station;
Stations with CNG stations prohibited for explosion hazards or other problem;
Stations with tanks used lubricating oil (burning oil) interdicted;
Tour with the Installation License (LI) has issued for replacement installation;
Posts in the process of completion of facilities to receive Green Seal;
Posts who underwent only research and environmental liabilities still missing sign the Term of Conduct Adjustment to install the ecological equipment (ZPA Posts located in Environmental Protection Zone);
Stations that showed evidence of soil and water contamination;
Stations that had free phase (fuel on the water surface);
Stations with additional problems.

3.1 Analysis of the potential polluter of oil gas exchange (OL)

Considering the group of stations investigated in the city of Natal, ninety-seven (97) had capacity to store at least three (3) tons of lubricating oil each and three of them stored in built masonry – one with tiled walls and two uncoated.

Unquestionably, there is the possibility of oil leakage into the environment through the retaining walls of the tanks with direct damage to the soil and groundwater, at first, and their surroundings, later. To get an assessment of the severity of this situation just consider that 1 liter of 1km2 OL can contaminate water surface and the same volume can deplete oxygen more than a million liters of water. Whereas much larger volumes as, for example, 1 ton of OL is sufficient to promote a pollutant load to a population of 40,000, approximately 5.09% of the population of Natal.

It is observed that the geographical constitution of Natal is susceptible to environmental impacts of significant magnitude. Its soil has good constitution, dune infiltration, storage and movement of water and is responsible for supplying the aquifer, being easily contaminated by materials of different types. This contamination may be such that liquid is absorbed with greater facilities, transferred to the natural water reserves.

In the case of gas storage, the big risk is the leakage of liquid fuels due to damage incurred in their respective tanks and pipes transport. Therefore, the tanks in the city of Natal should be mandatory ecological, which are double-walled tanks, also called jacketed. Figure 2 shows a sectional jacketed tank.

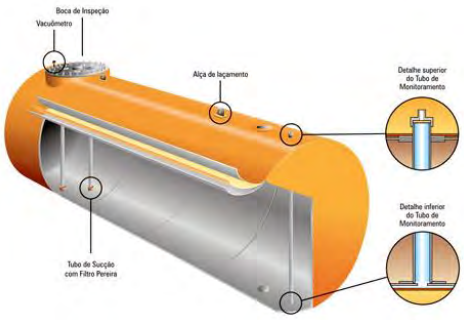

Figure 2. Sectional jacketed tank.

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3.2 Tightness tests performed on the tanks and/or pipelines

The leak test is an investigation conducted in closed containers attentive to existing leaks. These tests are applied, for example, in storage tanks and pipes for the transport of liquid or gaseous substances. The results presented by testing confirm if there is or not leaks in containers, but do not guarantee their resistance to corrosive attacks and the consequences of shocks.

The leak test is performed in several situations when you want to ensure adequate volume stability at a time when a system goes into operation, as well as throughout his acting process, including new stops and new departures. In tightness tests in the tanks of Natal, were detected and interdicted 34 of them, equivalent to 7% of the tanks of the city, which had an average leak of 12 liters/day.

Assuming a 360-day year and the leak of 12 liters per day, totaling to 4,320 liters / fuel tank scattered on the ground and probably the groundwater. And in all of the 34 tanks with the same capacity, the annual leakage was prevented 146,880 liters/year. The analysis is extended to pipeline transportation fuel and concluded that only one station, the 110 examined, presented their pipes without leaks.

Assuming a drop leak of 3ml/minute across the pipe by post – in the case of Natal would be 109 jobs –, in one year would exist a total volume of 169,517 liters / year of fuel released into the environment.

It can be argued that it was avoided environmentally launch a total of 316,397 liters of fuel – gasoline, ethanol and diesel – a year in the ground, in the city's aquifer and water bodies.

It is noteworthy that some critical points were identified in the action of expertise, such as: the largest leaks in tanks was presented at a checkpoint in the Ribeira district, with approximately 14 liters per day; we visited posts that attendants had not trained for maintenance, operation and environmental performance in an accident, but also there was no attendant directed to perform cleaning and operation of oil separation tanks and water behave all the pollution load from various locations of the post.

3.3 Analysis of the basic parameters of safety, environment and legislation

The safety of the posts was also evaluated by the skill and it were found some abnormalities, including: from 110 visited posts in Natal City, only 12 of them had lightning rod system; almost all establishments had the Occupancy Permit – document issued by the fire department – with outdated date of validity and eventually almost all attendants could not yet operate a fire extinguisher.

The main function of the UFRN experts, who worked and still work in checking the premises of gas stations supplies from the city of Natal, is to assess whether all stations are visited according to their normative references.

The partnership between state prosecutors, Semurb and UFRN culminate in attributing the Green Seal to establishments having all ecological equipment required by the standard and using it with the proper parameters. So, being a Green Seal post means that the Operating License is valid and the establishment is approved in Conformance Testing.

The action of the state prosecution, Semurb and UFRN promotes a shift in consumer's attitude when he knows that a particular post, where he is a customer, acquired or not the Green Seal.

Awareness of the environmental actions of a particular business segment – whether positive or negative – motivates the customer to intensify their loyalty or to change personal habits on the basis of mutual benefits that can be generated.

3.4 Analysis of the fragility of groundwater exposed to liquid fuels storage in underground metal tanks

The most common practice performed by liquid fuels resale gas station is to perform fuel storage in underground tanks throughout its area of action (patio gas stations). The tanks used for liquids combustible storage are made of metallic materials (ordinary steel) and susceptible to corrosive actions, caused by soil acts as the electrolyte system.

The corrosive action causes (or accelerate) the process of metal container deterioration, culminating in the appearance of fissures, cracks or flaws on the surface of the tank. These weak points are the paths traveled by liquid fuels into the environment. Fuels – petrol, diesel or alcohol – are organic compounds consisting of hydrocarbons (benzene, toluene, ethylbenzene and xylene) which, in contact with the environment, cause health risks, especially benzene, which is a proven carcinogen.

Besides contaminating soil, the fuel that leaks from storage tanks or pipes can reach the water table, such as the one of Natal, which is located on a surface of sand dunes with high potential for permeability.

Natal City aquifer (Dune/Barrier), which is the deposit of groundwater used for various purposes, has a very distinctive feature: the unconfined aquifer mixes with the deeper aquifer. In other urban centers aquifers are well defined and called Free Aquifer (groundwater) and Confined Aquifer (with greater depth and protected by two impermeable layers).

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3.5 Analysis of contamination by the absence of Maintenance Plans, training and adequate infrastructure

The entire area of a retail fuel station is used for equipment installations and structures of media services provided by the company. There are buried tanks, liquid fuel pumps, natural gas fueling nozzles, directing water channels, gas storage grills, dikes for washing vehicles, exchange points of lubricating oil, tire stores, among other facilities that aim to focus on one place – the Tour Sale – all the necessary services to the client.

Each of these facilities has the ability, inherent in its nature, to promote a particular impact on the environment and why, by law, any installation and storage system derived from petroleum and other fuels also is considered as an enterprise or part potentially polluting generator and environmental accidents.

The daily life of a retail fuel station involves multiple processes that may result in the disposal of accidental and trivial materials such as fuel, lubricating oils, gases, waste water with contaminants, combustible materials (grease storage cans, used tow etc.) shown in Figure 3, among others.

Figure 3. Improperly discarded materials in a retail fuel station.
Source: State Prosecutor.

The leaking fuel, either directly or diluted in water, is the most common form of land contamination that is not less important than the contamination of water bodies in the underground, surface and air.

The occurrence of leaks in sale stations is that of liquid fuels in the form of vapor or gaseous state, emphasizing the possibility of fires and explosions. This situation is further aggravated by the fact that several stations are installed in densely populated areas, as presents various districts at Natal.

Several sale stations feature a poor operating structure due to the lack of a proper maintenance plan (as shown in Figure 4), the training of staff involved in the procurement process and other environments of the post, obsolescence of equipment and systems used in supply and storage processes, as well as being observed that the leak detection systems do not have reliable fuel Council (CONAMA 273rd, 2000).

Figure 4. Details of the metal structure of a retail fuel station; the charge level of a fire extinguisher located in a retail fuel station; electric system found in a retail fuel gas station and electric system found in a gas fuels reseller.
Source: State Prosecutor.

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3.6 The prevention of leaks, spills and overflows

In the city of Natal, the aquifer is intensively used for human consumption and any leakage in storage tanks and / or piping of liquid fuels can promote contamination cranes in different soil and water. As a result, it is necessary to replace the metallic single walled tanks for double-walled tanks, the tanks called ecological (NBR 13,785, 2003 and 319 RESOLUTION CONAMA, 2002).

The legislation further indicates that tanks installed (green) and the equipment and accessories used for environmental protection and safety, as well as all supply pumps and filtering elements of diesel oil (filters), must have containment vessels and an electronic environmental monitoring for leaks at any point or element of the supply system Underground Fuel (CASS) (NBR 13785, NBR 2003 and 13,312, 2003).

The facilities of a Fuel Station are subjected to weathering of nature, ineffectiveness or obsolescence of some equipment, lack of staff training, among other factors that can lead to environmental and groundwater contamination due to possible leakage of storage tanks and / or pipelines.

The observation of the storage tanks must be performed very carefully and should not be limited to only those elements, but across the CASS. To detect a leak in the system it is important that agents which act directly on the gas notice if:

- Some variations a rise not known volumes in fuels that are confined to the supply tanks, using the "inventory control", called the Book of Changes Fuel (CML), which establishes the balance in full and volume in each tank;
- A sensor has been installed in the storage tank, the containment of fuel pumps and diesel oil filters, in order to activate an alarm if liquid leak CASS;
- The inventory data have been periodically analyzed using statistical criteria to verify the normality of the volumetric balance of the fuel stored;
- There were conducting leak tests for full certification or finding leaks.

3.7 Campaign Analysis of the Green Seal in the City of Natal (RN)

The state prosecutor noted that, in Natal (RN), there were not many posts with Environmental Licenses and they are in risk situations that go beyond the physical limits of their facilities. In March 2011, signed up a partnership between the Federal University of Rio Grande do Norte (UFRN), the Municipal Environment and Urbanism (Semurb) and state prosecutors. This time, the prosecution disclosed the educational campaign of Green Seal as order to encourage the consumer to fill up at gas stations that do not pollute the waters of groundwater.

The partnership between UFRN, Semurb and state prosecutor objective evaluation and control of water contamination by petroleum products in the city of Natal (RN). Speaking at the launch, and testimony to the Official Gazette of Natal, Professor Angelo Roncalli said "were also detected and interdicted 34 tanks leaking on average 12 liters per day. This means that we can prevent 146,880 liters of fuel were to water table, only this year, and further harm the water is for our consumption" (Diário de Natal, Edition of Tuesday, March 22, 2011).

4. RESULTS AND DISCUSSIONS

The results of the parameters analyzed by UFRN technicians and the inspections that were carried out in liquid fuels gas storage in Fuel Stations of Natal (RN) that reflect the situation of such establishments regarding potential polluter on the resale of fuel liquid are detailed below and in condensed figures.

4.1 Stations that showed leaks in pipes/connections

Were counted one hundred and nine stations that had leaks along their lines (pipes) and their connections. Leaks in pipes are due to corrosive attacks on buried pipes or air. Figure 5 shows details of the state of a pipe used in gas stations in inspections.

Figure 5. Details of the status of pipe used in gas stations.

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4.2 Posts that have had problems with inadequate electrical installations for hazardous areas

During the observations, the engineers and technicians noticed some elements outside the safety standards, such as: installation of electrical systems outside the normative parameters, electrical equipment for purposes of refrigeration (refrigerators, freezers etc.). Next to the gas station, there was a lack of grounding or improper grounding in certain electrical elements, among others, as shown in Figure 6. Thirty-six sites were indicated with at least one inconsistency cited.

Figure 6. Wiring and electrical system found inappropriate in a retail fuel station.

4.3 Posts that have CNG stations (NGVs) banned because of the risk of explosion or other problem

Throughout the visits were problem identified twelve (12) posts that did not meet these and other policy recommendations and, therefore, were banned due to the possibility of explosion or other problem that could jeopardize the environmental and human integrity.

4.4 Storage tanks for fuel and oil

In the set of stations observed, three tanks for used oil storage were banned. They were built of brick with tile flooring. During the research carried out by UFRN and state prosecutors technicians, has been found a metallic underground tank, intended to fuel storage, which showed leak more than 100 liters of gas in less than 10 hours. The Figure 7 shows the state of corrosion of a tank buried for storing liquid fuel at a gas station in Natal (RN).

Figure 7. Corrosive state of a buried tank used for the storage of liquid fuel at a gas station in Natal (RN).

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4.5 Total Green Seal posts

Green Seal is awarded to the post that has all the equipment required by ecological standards, as shown in Figure 8. To purchase Green Seal, the post should have an Operating License (LO) valid and pass the Compliance Test, when the prosecution experts check if all the facilities are in accordance with the corresponding standards. Of the 110 posts of Natal, only 44 have been adequate and environmentally acquired the Green Seal, also shown in Figure 8, until the closing of this research.

Figure 8. The legal and illegal jobs and adhesive featuring an environmentally friendly gas.

4.6 Stations with the Installation License (LI) has issued for replacement installation

The Installation License (LI) authorizes the installation of the project or activity in accordance with the specifications of the plans, programs and projects approved, including environmental control measures and other conditions, which are decisive reason. Of the posts evaluated until the closing of this research (March/2012), only 70 had the LI for the exchange of facilities (tanks, pipelines etc.).

4.7 Posts in the process of completion of facilities to receive Green Seal

Receiving the Green Seal is subject to adjustments that posts should accomplish. In the city of Natal, through the month of February 2012, 35 posts were close to completing their facilities to receive the Green Seal. The evolution and speed of this process in the environmental agency can be observed by the situation in March 2011, when the number was 25 posts.

The partnership between the entities seeks to assess and monitor water contamination by petroleum products in Natal (RN). "We already have 22 stations with installation licenses issued to effect the exchange of facilities. Of the total, 25 stations are almost ready to receive the Green Seal and possibly receive in 15 days, with only three that already have", said Carlos Ney, who is responsible for licensing private works of Semurb (Diário de Natal, Edition of Tuesday, March 22, 2011. MP combat leaks in gas).

For a station be able to receive the Green Seal is necessary that it meets certain requirements, among them: **the presence of checkvalve to prevent possible leaks; replacement of metal pipes for HDPE pipes; installation of containment units (sumps) units supplying, installation of Chamber Sidewalk Spill Containers; use of jacketed tanks with interstitial; adequacy of concrete floor and installation of channels; installation of separating oil and water box; installation of discharge assembly sealed with seal in the nozzle; installation of anti-overflow valve; adequacy or installation of vapor recovery valve; adequacy of electrical installations in hazardous areas; installation or adequacy of electrical discharges protection systems (lightning rod); installation or adequacy of systems against collision of breathers with terminals containing vapors.**

4.8 Stations who underwent only investigation of environmental liabilities and that there is still signing the Term of Conduct Adjustment to install the ecological equipment (ZPA Posts located in Zone of Environmental Protection) or a history of contaminants

Of the stations analyzed, all conducted investigations into the environmental liabilities and 25 showed evidence of soil and water contamination. These posts have gone for the second phase of the investigation of liability. Of the total, three stations showed additional problems.

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4.9. Stations that had free phase

Of all the stations analyzed by MP, three had fuel on the water surface (phase free).

4.10 Graphical representations on the situation of retail fuel gas liquids stations in the city of Natal

Figures 9, 10 and 11 show the situation of unfilled liquid fuel resale at Natal city regarding the parameters analyzed during entire inspection phase.

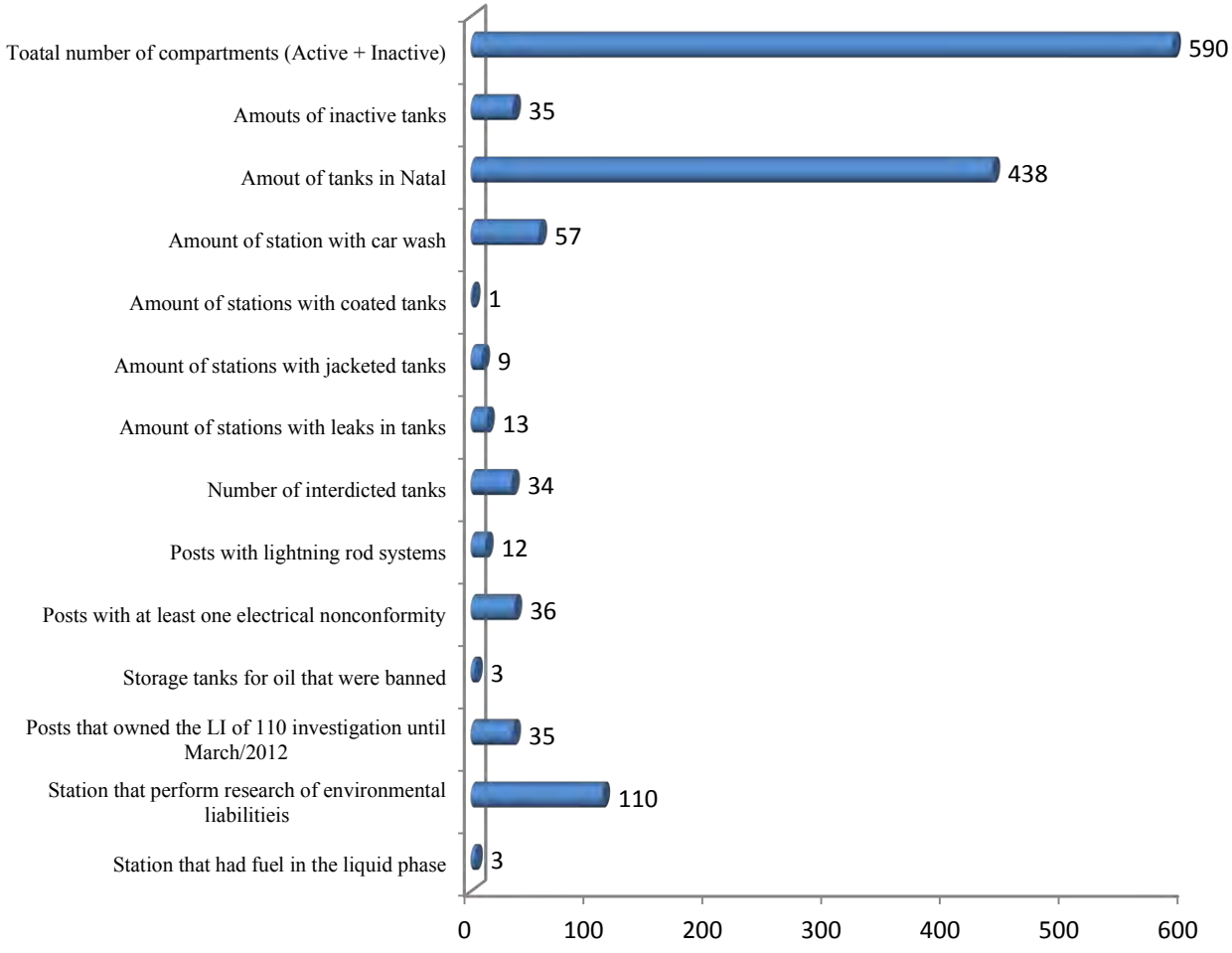

Figure 9. Situation of liquid fuels gas storage in the city of Natal.

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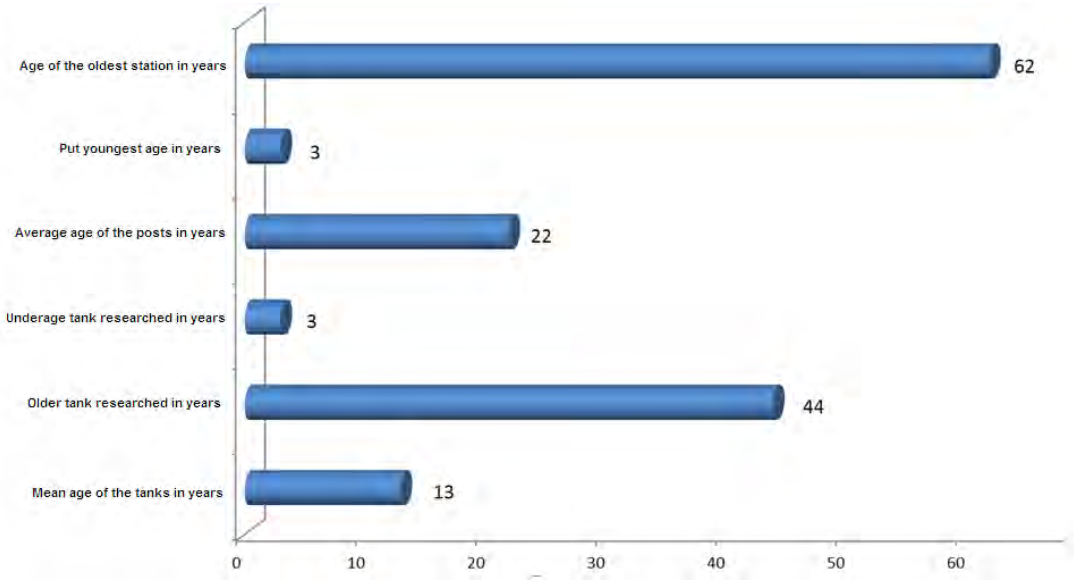

Figure 10. Age of underground storage tanks for liquid fuels in Natal.

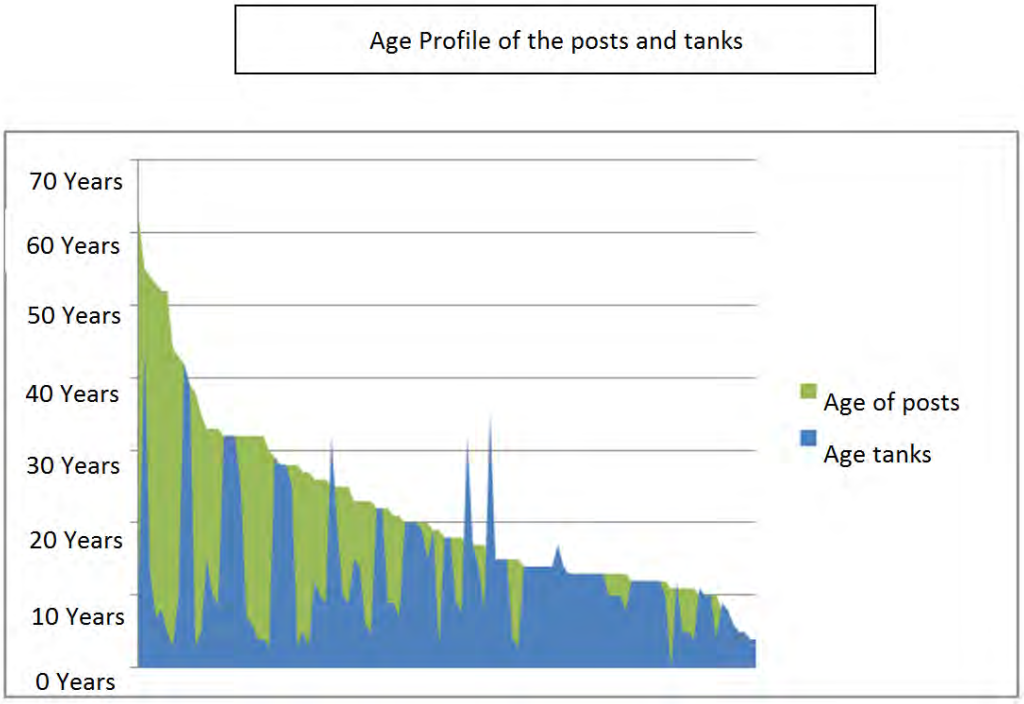

Figure 11 - Comparison Chart of old posts x age of tanks

5. CONCLUSIONS

1. One difficulty presented to the delay in the progress of the Operation License is presented in the Human Resources department of the agency responsible for the execution of the said document;

2. It is undisputed that Natal, due to urban growth, as well as economic and social, is at the same level of urban centers, mutatis mutandis, on environmental problems;

3. Among the many environmental problems is presented susceptibility of soil and groundwater and the potential means that contamination is the storage of combustible liquids in buried tanks;

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4. The profile of the liquid fuels storage by gas resale until the intervention of the state prosecutors was still done in metallic tanks underground;

5. The storage media of liquid fuels and the elements and peripheral actions of these are present in everyday life of the population of Natal City;

6. Of 110 gas stations evaluated, very few of them had jacketed tanks;

7. Three storage lubricating oil tanks were interdicted due to distortions and inadequacies constructive techniques presented by them;

8. Numerical results raised by Semurb and UFRN experts justified discussions around the environmental issue and liquid fuel resale posts in Natal but also justified the deployment of the Green Seal program;

9. With the adjustment of conduct held positions in liquid fuel retail was reduced, as well as rationalization of tank storage volume in Natal.

5.1 Suggestions

1. The government needs to create in Natal the systematic monitoring of liquids gas stations always guided by legal and normative documents that discuss the storage of liquid fuels in order to keep the effort already made by state prosecutor;

2. It is required the urgent awareness of owners and future entrepreneurs to put on the practice of ideal storage, security and training body of employees who work in these establishments;

3. It is essential to create study groups and working technical mechanisms to structure, preventive, management and educational to minimize, or perhaps eliminate, the impacts caused by liquid fuels storage;

4. It is necessary to deploy management tools geared to the environment in order to minimize negative impacts promoted by retail fuel station and its various parallel activities;

5. It is necessary to the population be aware that proper storage and proper structuring of the fuel station will promote greater environmental conservation, and more precisely in the water they consume;

6. It should become mandatory requirement to submit jobs to public consuming and the regulatory agencies actions in settings in their environments in terms of legal and regulatory requirements;

7. It is essential to create an educational program aimed at showing people the need for interaction between environmental conservation and the activities of retail stations that are beyond fuels storage, such as washing of vehicles and storage of used oil.

8. Extend actions like this to clandestine washing vehicles establishments that are in the vicinity of the stations, but do not belong to them, so that fit similarly to projects already framed by prosecutors.

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