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The Absence of a National Industrial Effluent Policy: Imminent Risk to the Brazilian Bodies of Water

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***Abstract*—**The existing legal gap regarding thes treatment and final disposal of industrial effluents in Brazil promotes legal uncertainty. The government has not structured itself to guarantee environmental protection. The current legal system and public policies must guarantee the protection of bodies of water and an effective treatment of industrial effluents. This is because economic progress, eco-efficiency and industrial ecology are inseparable. The lack of protection for the water bodies weakens environmental protection, with abuses by companies that do not give due treatment to their effluents, or fail to present the water balance of their factories. It is considered necessary to enact a specific law on industrial effluents related to a National Industrial Effluent Policy, because it is the location of the largest Integrated Industrial Complex in the Southern Hemisphere. The regulation of this subject cannot be limited by decrees of the local Executive Branch, allowing the inspection of the industrial activity or enterprise to be affected fundamentally by environmental self-control, or by private institutions.

***Keywords*—**Effluent policy, environmental law, environmental management, industrial effluents.

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I. Introduction

THE objective of this article is to provide an analysis of the actual situation of the Brazilian environmental policy regarding the treatment and final disposal of industrial effluents.

The Industrial Pole of Camaçari had global investment of more than 16 billion dollars. It has installed capacity above 12 million tons per year of basic and intermediate chemical products and petrochemicals. This pole has installed capacity for 240,000 tons/year of electrolytic copper in the metallurgy segment and 250 to 300 thousand vehicles/year in the automotive segment. Exports account for 30% of the total exported by the State of Bahia and are destined for practically the whole world. This industrial pole contributes annually with over 90% of the tax collection to the public coffers of the municipality of Camaçari, besides employing 15,000 people directly and 30,000 people through contracted companies [1].

It is important to point out that industrial effluents lack extensive legal regulation in Brazil, being a still embryonic legal matter, incapable of protecting bodies of water.

The study of industrial effluents is intrinsically linked to the condition of bodies of water, including: treatment and water quality, the National Water Resources Policy, the protection of the environment and environmental impacts.

A serious fact in the Brazilian environmental regulatory framework is the absence of a National Industrial Effluent Policy. For Brazil to have a governmental policy with legal powers, a law establishing this government policy must be promulgated. In this way, the National Congress, represented by the Chamber of Deputies and the Senate should vote a federal law, which must then be sanctioned by the President of the Republic. This legislative gap over the absence of a National Effluent Policy does not conform to the overall provisions concerning the preservation of the environment. Today one cannot speak of industrial development without addressing the management of the treatment of effluents generated by petrochemicals and industries in general. It is up to the public agencies to interact with one another in order to create uniform national regulations.

With regards to the interrelationship among federal entities, in defense of the environment, there is Complementary Law 140 of December 8, 2011. Article 6 of the mentioned law stipulates that the Union, the States, the Federal District and the Municipalities must interact in order to fulfill the legal objectives and guarantee sustainable development, harmonizing and integrating all of the government management measures [2].

The first step in the creation of a National Industrial Effluent Policy would be the design of an information system at a national level. Brazil already has the National Information System on the Environment [3], which is one of the instruments included in the National Environmental Policy, provided for in item VII of article 9, of Law 6938/81 [4]. Information on the Brazilian environment should be shared at a federal level, through the National Environmental System (called SISNAMA).

SINIMA is the organ that manages the information and data of SISNAMA, orchestrating this aggregation of data and information on industries that produce industrial effluents, creating environmental indicators, with the scope of implementing the principle of the monitoring of the state of environmental quality, being one of the principles of CONAMA, regulated in art. 2, section VII of the Law 6938/81.

For there to be a National Industrial Effluent Policy, a cohesive management of information at a national level must be consolidated. SINIMA could organize these data referring to the industrial companies generating industrial effluents, collecting from each of them: the area of industrial engineering; the industrial sector they operate; the locality; chemicals cataloged in their effluents; the entity responsible

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for the treatment of effluents; technical procedures used in the treatment; forms of packaging of industrial effluents; paths in which industrial effluents are transported; and mode of transport thereof. In turn, SISNAMA aims at environmental protection and improvement of environmental quality. SISNAMA has the National Environmental Council as its advisory and deliberative body, so that the National Environmental Policy is consolidated.

It is perceived that there is a legal provision for the creation of a national information system, which could serve as the primary basis for a future National Industrial Effluent Policy. For example, there is the National Environmental Policy, which regulates "the establishment of environmental quality standards, the licensing and review of activities that are effective or potentially polluting and the Federal Technical Register of activities potentially polluting or users of environmental resources" [4].

To demonstrate the embryonic state of Brazilian legislation, in relation to industrial effluents, comparison is made to the US environmental regulation. In the US there is the Toxics Release Inventory (TRI), existing for over 30 years (created on October 10, 1986), currently listing exactly 696 chemical agents that can affect the quality of life and the environment [5].

In Brazil there are only 32 chemical agents formally registered in the National Council for the Environment (CONAMA), through Resolution 430/2011 [6], including a succinct table on "standard effluent release", with inorganic parameters and maximum values (article 16, II). Unfortunately, this cataloging has few chemical elements. In addition, there is no national effluent inventory in Brazil.

The high potential harm to the environment of industrial effluents is indisputable, it is imperative that a federal law cab be established to regulate these effluents, even in order to really strengthen the National Environmental Policy, by regulating all aspects involving the environmental impacts arising from the production of the chemical and petrochemical industries.

II. Brazilian Environmental Regulations

There is a legal provision on public access to data and information cataloged in the organs and entities that are members of SISNAMA, through Law 10650 of April 16, 2003 [7].

The greater the quality of information available to the population, the greater the ability to monitor whether the industries are fulfilling their socio-environmental role, particularly because business activities these days should also bring this concern to the environment. This environmental awareness guides the legal regulations, in order to bring the requirement of a series of procedures that attest to the treatment of the effluents before disposal in the bodies of water. At the same time, public authorities should closely monitor these activities of the chemical and petrochemical industries, through the competent authorities, in order to apply the Polluter Pays Principle, where applicable, with the aim that the agent responsible for the environmental tax, at its own expense, should implement measures for that ecosystem to return to its original status. Thus, the direct, indirect, and foundational Public Administration bodies, members of SISNAMA, have the obligation to inform, allowing public access to records that are stored in their documents, processes or administrative procedures. It is nothing more than the implementation of the Principle of Transparency imputed to the Public Power in general.

SISNAMA is obliged to allow public access to documents that deal with environmental matters, in accordance with Law 10650/2003. Interestingly, access to information on the emission of liquid effluents is ensured by virtue of this law and, among other aspects, data relating to the quality of the environment as well as to toxic or dangerous substances can also be sought. However, government public policies do not have the data on their official websites.

CONAMA Resolution 430/2011 reveals that the competent authorities may impose greater rigor in regulating the disposal of effluents in bodies of water, including in relation to the carrying capacity of the receiving body, as the maximum value of pollutant that the water body can receive without compromising the quality of the water and its specific uses.

A lower concentration of the chemical compounds of the effluent per cubic meter is a key factor for water quality; therefore CONAMA's Resolution 430/2011 supports the aforementioned supporting capacity, which is recommended by the effluent concentration in the receiving organ. The receiving body is the surface water body where effluents will be released. Noting that the mixing zone will vary according to each parameter previously regulated in the specific case (for example, it will depend on the industrial segment, the types of chemical substances contained in the effluents, the extension of the respective body of water, the process chosen for the treatment of effluents, production capacity and, consequently, the volume of industrial effluents produced, and the interested entrepreneur must inform the competent authorities about the list of chemical components that may be present in their effluents). CONAMA's Resolution defines the mixing zone as "the region of the receiving body, estimated based on theoretical models accepted by the competent environmental agency, which extends from the point of effluent discharge, and delimited by the surface where the equilibrium mixture is reached between and chemical parameters, as well as the biological balance of the effluent and those of the receiving body" [2].

A normative caveat is made in article 6 of Resolution 430/2011, which exceptionally provides for the discharge of effluents outside the regular parameters, six of which are allowed, these being: relevant public interest; accomplishment of the intermediate and final goals related to the disposal of the effluents in the recipient water body; formatting of environmental analysis paid by the interested party; robust indication of the treatment process that will be implemented in the effluents; establishment of the maximum period for this situation to last, respecting the established parameters; and, indication of procedures that neutralize possible environmental.

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It is important to note that in the State of Bahia, where the Camaçari Industrial Complex (the largest integrated industrial pole in Latin America) is located, there is no specific law that regulates a State Policy on Industrial Effluents, unlike solid waste, in that since 2014, a State Policy on Solid Waste has been regulated, by Law 12932/2014 [8].

Both the Brazilian federal government and the state government of Bahia do not have any legal regulation controlling the treatment and final disposal of industrial effluents.

The government of the State of Bahia admits that it is not possible to state where there is an effective commitment or degradation of soils and waters, since there are no systematic field studies, with statewide coverage, to evaluate such reality. In this case, it is necessary to carry out studies that deal with aspects such as soil compaction, effective erosion and soil contamination by pesticides, fertilizers and industrial effluents, as well as the creation of a state network for the monitoring of deforestation and fires, the universalization of access to solutions for adequate disposal of solid waste, adapting them to the environmental, social and economic reality of each location [9].

At the state level, the largest concentration of industrial effluents is located at the Industrial Pole of Camaçari. The legal discipline of industrial effluents from the State of Bahia cannot be dissociated from the regulations regarding the disposal of industrial effluents of the Municipality of Camaçari.

The Environment and Water Resources is an autarchy of the State of Bahia. Its role in environmental law today is enormous, including accessibility of information on the environment of the State of Bahia, which may be requested by any interested party. According to the protocol established, the interested parties should not have commercial purposes, must file an administrative dossier for each request and attach supporting documentation requested in the specific case, such as a copy of the identity and proof of the purpose for which the information is sought.

A very unusual aspect is that in the State of Bahia there is non-governmental body that controls the emission of industrial effluents in the industrial center of Camaçari, being this function under the responsibility of two private institutions: CETREL and COFIC (acronym that means Committee of Industrial Development of Camaçari).

CETREL is a joint-stock company responsible for environmental monitoring and treatment of industrial effluents at the Camaçari Industrial Complex, and is answerable for water supply, treatment and final disposal of effluents and industrial waste, distribution and reuse of water, besides all the environmental monitoring of the Industrial Pole of Camaçari and its area of influence, and reaches other Brazilian states [10].

CETREL is accountable for the treatment of industrial effluents of the Industrial Pole of Camaçari, managing six lifting stations to treat 4500 m³/h of industrial effluents. CETREL management allowed photographic registrations of the installations (of the aeration tanks and biological reactors); besides making possible the technical visits.



Fig. 1 Chemical effluent treatment station at CETREL

The role of CETREL is fundamental for the inspection of the industries and for the treatment of effluents from the Industrial Zone of Camaçari. Nowadays, the petrochemical industries should, whenever requested, submit to the Institute of Environment and Water Resources the respective water balance, in addition to maintaining the liquid effluent systems interconnected with those of CETREL. These obligations aim at complying with the standards for the discharge of effluents in the Organic System and in the Uncontaminated Water System of CETREL.

CETREL is part of COFIC, collaborating in the oversight of the petrochemical industries of Camaçari. And if there are technological difficulties in complying with the technical instructions, the specific parameters should be regulated in individual licenses related to the companies concerned, by means of special standards, provided that these activities are in line with the standard of treatment established by CETREL, and that concurrently there is the seal of the Institute of the Environment of the State of Bahia.

COFIC accompanies the performance of the Hydraulic Barrier, which serves to prevent the propagation of underground aquifer chemical components, related to the influence polygon of the Industrial Pole of Camaçari. COFIC is a private entity, whose purpose is to promote the development of the Industrial Complex of Camaçari, which represents more than 80 companies. With the interest of guaranteeing environmental protection and closely supervising the handling and treatment of industrial effluents, the objectives of COFIC are: "to promote the sustainable growth of associates; represent the associates with the governmental authorities; promote best practices in safety, health and the environment; encourage transparent communication and a favorable image in society; promote qualification and qualification of persons for the associates" [1].

COFIC works together with CETREL. All companies are obliged to inform CETREL and the local authorities of the reports on self-monitoring of effluents (environmental self-control), organic or inorganic, in addition to data on atmospheric emissions.

As the Brazilian government has not yet instituted the National Policy on Industrial Effluents, the Ministry of the Environment published Resolution 430/2011, which in its article 24 states that: "Those responsible for sources polluting

the water resources should carry out the self-monitoring for periodic monitoring and control of the effluents released into the receiving bodies, based on representative sampling of the same" [2].

It is observed that there is a greater concern with the implementation of the Technical Report of Environmental Guarantee and its dissemination in the media and electronic media. This item is important for the transparency of the measures adopted, as well as to encourage popular participation. In fact, in order to give any protective measure to the environment, public awareness and popular participation are essential conditions. This dissemination in media tends to encourage a more democratic management.

III. Discussion

A. The Environmental Balance

In foreign law, there are some examples of this quest for environmental balance through an adjustment of industrial practices to environmental laws, such as the Common Law system in the United States, regarding water use and its relation to health, the Safe Drinking Water Act, created to protect the quality of drinking water in the United States. This law focuses on all waters actually or potentially intended for use, the consumption of which is from surface or subsoil sources. It is intended to establish safety and purity standards required of all owners or operators of public water systems to comply with primary public health standards [11].

Another corollary of the appropriateness of the involvement of business practices towards environmental preservation is the Extended Producer Responsibility (EPR), implemented in the United States, which arose from concerns about the environmental impacts of industrial products. The implementation of public policies aimed at raising awareness of the consumer market regarding the disposal of products that threaten the environment could result in a decrease in effluent generation [12].

It is important to emphasize that the legal provision alone does not guarantee the implementation of the precepts related to the protection of the ecosystem. The mere existence of sanctions to be imputed to those who pollute the environment does not rule out predatory practices, thus, society's awareness and participation are necessary in the struggle for the preservation of the environment. In addition, there is the relationship between environmental balance and productivity. Depending on the place occupied by a given industry in the distribution of productivity, the level of pollution control expenditures is likely to be directly related to its size and may affect its profitability. The differences may be due to economies of scale, where larger business societies are better able to afford the costs of environmental regulations than smaller ones. Notwithstanding this fact, standardization becomes fundamental for the protection of the environment [13].

The socio-environmental rules, regardless of the country, must adjust to productive activities, as guidelines, even before the start of business activities, through the study of environmental impacts. The general business response to the pressure of environmental regulation may also depend on certain conditions of the internal structure of the business society, in order to appropriately adapt learning to the economy of scale and, consequently, to define dominant projects in emerging "green markets" [14]. From this perspective, the development of "green markets" results in a strong potential for new forms of environmental regulations if designed in the right way [15]. Opportunities can determine what new types of direct policies will cover many aspects, aiming for innovative technological performance.

It is necessary to change the production process itself, aiming at mitigating environmental impacts and optimizing the results of the industries.

In the intermediate steps there are measures that try to modify the productive process itself, within a factory or productive chain. It seeks to identify losses and inefficiencies that end up being transformed into environmental impacts, in order to correct them at source. This type of approach aims to prevent the generation of waste by making better use of raw materials and energy. In addition to reducing the impact at launch points, the impact of raw material extraction is reduced [16].

The Strategic Environmental Assessment includes a set of methods and approaches that are designed to check, in general terms, whether certain plans and programs are in conformity with the principles of development without environmental degradation and, in particular, to verify the intensity of the impact of these plans and programs on the environment [17].

It is of social interest to install facilities necessary for the abstraction and conduction of water and treated industrial effluents, proving the legal authorization for the use of water, when necessary. This normative limitation aims to reduce the irregular consumption of water, as well as the reduction of effluent generation, the mitigation of waste of raw materials, and the reduction of production of toxic products, targeting at environmental preservation.

B. Environmental Self-Control in the State of Bahia

Even though there is no National Industrial Effluent Policy that regulates the treatment and final disposal of industrial effluents, the government of the State of Bahia has adopted regulations that attenuate this normative absence. It establishes that all the companies working in the petrochemical area of Camaçari must previously format their project for the implantation and disposal of effluents.

A number of constraints were reviewed, through Directive 5,148/2013 [18] of the Institute of Environment and Water Resources, in particular regarding changes in the patterns of effluent release in the Organic System and in the Uncontaminated Water System. The obligation of all the companies that work in the Industrial Complex of Camaçari was to: adapt their activities to the deliberations of the Technical Committee of Environmental Guarantee of COFIC; prepare environmental self-control reports; inform, in advance of 45 days, to the local authorities about the control plan of scheduled stops for maintenance; participate in the air

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monitoring program and in the program of management of the water resources of the Industrial Pole of Camaçari, coordinated by the COFIC.

In order to effectively implement environmental self-control in the State of Bahia, the respective Technical Commission for Environmental Guarantee must be set up in private or public institutions, in accordance with Decree 14024 of June 6, 2012 [19], which approves the regulation of the Environment and Protection of Biodiversity Policy of the State of Bahia. In its article 160-A, it is stated that this commission has the "objective of coordinating, executing, monitoring, and evaluating the programs, plans, projects, undertakings and potentially degrading activities carried out within its area of activity." Thus, the Technical Commission of Environmental guarantees the continuous inspection of the activity or the enterprise, in the sense of avoiding or mitigating possible risks that may affect the ecosystem and quality of life of a given region.

Regarding the disposal of industrial effluents in the ocean environment, the government of the State of Bahia issued Ordinance 5,148/2013 forcing CETREL to play the following roles: be responsible for the final disposal of industrial effluents treated in the ocean; present to the local government a timeline for the implementation of the interceptor that will connect the Uncontaminated Water System to the Ocean Disposal System, whenever the hydraulic capacity of the Effluent Treatment Station reaches 70% of the Organic System flow; submit to the government of the State of Bahia, quarterly reports of the monitoring program for water resources; implement the zoning program for water resources, updating it every three years, and inform COFIC about the data collected during this period.

By virtue of Governmental Decree 5,148/2013, all companies located in the transportation sector, in the Industrial Complex of Camaçari, must be included in the Water Resources Monitoring Program and, under no circumstances, may use their groundwater region. Therefore, the production of wells was deactivated with the advent of this Ordinance. In addition, these companies are obliged to: treat their industrial effluents or must implement works and procedures so that their effluents are directed to the CETREL facilities; and are required, each year, to submit to COFIC proposals for the control and elimination of primary and secondary sources of contamination of the underground aquifer, in order to promote the Annual Monitoring Program.

The indisputable fact is that if these industrial effluents come into contact with the ecosystem it would certainly bring environmental encumbrances, causing risks to human health. The role of CETREL is precisely to prevent these untreated effluents from reaching the surrounding area, once these are contaminated waters, the use of which is impracticable, both for human consumption and for the watering of animals or irrigation of crops.

C. Environmental Assurance Technical Reports

Based on the information provided by COFIC, the latest environmental assurance technical reports analyzed in this research were 2015, 2016 and 2017, issued on 03/22/2016, 03/27/03/2017 and 03/12/2018, respectively.

The Environmental Assurance Technical Reports include the analysis of the water balance of the plants, in line with the model approved by COFIC, according to condition II.1.c of the Ordinance 12,064/2009 [20]. It was verified that from a total of 77 industries (associated and not associated to COFIC) involved in the Report for - 2015, 55 of them sent the information (associates), while 22 did not (13 are associated and 9 are not associated). For the sake of confidentiality of the information, the industries that did not comply with this requirement regarding the annual water balance of the factories will not be named.

Notwithstanding the fact that most of the industries of the Camaçari Pole have sent their factory water balances in 2015, it was found that 29% did not do so, which is an alarming situation, against the serious environmental impacts that inappropriately disposed effluents can cause. There is considerable risk hovering over the bodies of water located in this region. In addition, the Environmental Guarantee Technical Report for 2016 included 77 corporate companies, associated and not associated to COFIC, and 56 associated companies sent information about their water balance of the factories. Of the institutions that did not submit, 10 are associated and 11 are not associated to COFIC. It is noticed that, in 2016, 27% of the industries did not send information on water balances, with a small reduction in the number of industries in default with this normative obligation. However, it is still a significant percentage of noncompliance to this regularly instituted obligation. Further, in relation to the submission by industry of information on the water balance of the plants in the Technical Environmental Guarantee Report for 2017 (issued on 03/12/2018), it was verified that the number of companies fell from 77 (in the data for 2015 and 2016) to 75 in 2017.

In 2017, 53 companies submitted their respective water balances, while 22 companies did not comply with this obligation (16 industries are associated and 6 are not associated with COFIC) proving that default increased in 2017 to 29%.

It was verified that in 2017 two industries were no longer associated with COFIC and that the percentage of noncompliance related to the annual delivery of the water balance of the factories is significant, constituting a potential risk attributed to the environment. Fig. 2 represents this situation (covering 2015 to 2017).

It is noticed that the number of industries associated to COFIC that sent the respective water balance fell. It also increased the default percentage of this obligation with respect to the associated industries. Another worrying factor was the exit of two industries from this general role in 2017.

Note that until a law that regulates a National Industrial Effluent Policy is regulated, the tendency is precisely to increase this default, in addition to the continuation of inaccessibility information to the general population.

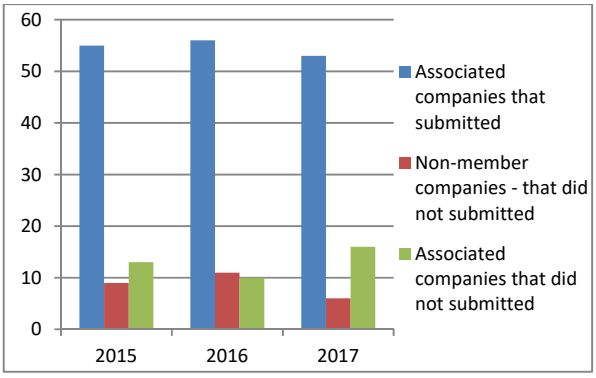


Fig. 2 Evolution of 2015 to 2017 regarding the delivery to the COFIC of the water balance of the factories

IV. Conclusion

The UN official website in Brazil states that "around the world, about three out of ten people, out of a total of 2.1 billion, do not have access to safe drinking water at home, and six in ten, or 4.5 billion, have no safe sanitation", according to a new report from the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) [21].

According to official data from the Brazilian National Water Agency, "Brazil has a good amount of water globally. It is estimated that Brazil has about 12% of the planet's freshwater availability" [22]. In addition, the analysis of human health risks must permeate the treatment of the effluent streams, by eliminating the contaminating components, avoiding the maximum degradation of the environment. The optimization of advanced techniques in the treatment of effluents aggregates strategies of recovery of resources and the protection of the bodies of water. Investigations such as this serve to alert authorities in Brazil and other countries about the irreparable risk of drinking water sources in Brazil, should a National Industrial Effluent Policy for Brazil not be regulated. However, economic development depends on the activity of large industries. These activities generate a great amount of chemical effluents, which is justified due to the economic development and the increasing consumption demand in the current society. These effluents cannot be released directly into nature, because they contain several heavy materials that are harmful to human health. There are criteria that define the percentage of materials per liter that can be released into nature. To achieve these indexes, the effluent must undergo the previous process of treatment by specialized organizations.

It is necessary to monitor the performance of these organizations dealing with chemical effluents. Consequently, it is fundamental that a legal organization puts into practice the preservation of the environment, especially in the case of chemical effluents. In this sense, legislation is needed to monitor the industries' activities, curb abuses and apply the relevant sanctions.

In Brazil, it is necessary that governmental authorities implement a National Industrial Effluent Policy. This legislative gap is not in line with the general provisions concerning the preservation of the environment.

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