USE OF ALTERNATIVE WATER SOURCES OF IFPB CAMPUS CAJAZEIRAS (PB) - FOCUS ON SUSTAINABILITY.

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***Abstract*—The current water crisis entails the need for rational use of natural resources, being water reuse today a major target for environmental researchers around the world. That has been tracing methods in the search for a better quality of life not only for current generation but also to ensure future generations and the welfare of the planet. Applied in this context, water brings with it an extreme problem, since it becomes more valuable than any other natural property considering its scarcity. In this context, this research proposes an analysis of the quality of residual water generated by air conditioners and distillers to establish their potential for reuse in laboratories and irrigation activities within the Campus of IFPB - Cajazeiras, thus reducing the losses of potable water generated by the distillers. Since these laboratory equipment such as distillers and condensers account for a significant part of the water consumption of the research and teaching laboratories, in these processes little or nothing changes in the water characteristics, it is important for solids that due to the physical processes used they can present values higher than the originals. If the studies show that the distillers discard a considerable amount of effluent with a quality that allows its reuse in the laboratory facilities, where the equipment is installed, we will implement a water conservation program, involving the reuse of these effluents to the apparatus itself the use of pumps and other equipment to facilitate the return of drinkable water, another option is to use this water for irrigation of the IFPB campus vegetation.**

Keywords—Water Quality, Reuse, Sustainable Development.

I. INTRODUCTION (*HEADING 1*)

Sustainable development through the rational use of natural resources is today the great target of environmental researchers from all over the world that has been drawing methods in search of a better quality of life not only for the current generation but also to guarantee future generations and the welfare of the planet. Applied in this context, water brings with it an extreme problem, since it becomes more valuable than any other natural property considering its scarcity.

Brazil, in particular, enjoys a large part of the world's water availability, but in the general context, it is facing a crisis

arising from the different geographic and climatic dimensions, easily observed in cases of floods and water shortages in several parts of the national territory.

To relieve the impact caused by the scarcity that we have in our country we are studying the laboratories of the campus where research experiments are carried out as a routine procedure to distillation to obtain the distilled water from treated water. The process is characterized by having a high energy cost and consumption of treated water. Where we also deal with the use of the air conditioner that has long been extremely necessary in hot climates such as the city of Cajazeiras – Paraíba for thermal comfort in administrative environments, classrooms, offices and doctor’s office.

As a result of the operation of these appliances, we have the moisture of the air condensed and sent to the external environment where it is wasted. This water once characterized through physicochemical analysis may have a destination focused on the preparation of solutions, rinsing of laboratory utensils and use in autoclave, etc. In this way, the use of the treated water of electric power, used in the production of the distilled water used in the laboratories where it is used, is avoided.

The Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, functionally consists of administrative environments, laboratories, teachers environments, and classrooms belonging to existing undergraduate courses. Practically, in all environments there are air conditioning devices providing high demand for condensation water, which today, is without destination.

II. MATERIAL AND METHODS

A. Water And Its Reuse (Heading 2)

The planet Earth has 1.4 million cubic kilometers of water, but only 2.5% of this total is of a sweet nature. The rivers,

lakes and reservoirs from which mankind derives what it consumes only correspond to 0.26% of this percentage. Hence the need to preserve water resources. All over the world, around 10% of the water available for consumption is destined for public supply, 23% for industry and 67% for agriculture (GOMES, 2011). Brazil is estimated to concentrate between 12% and 16% of the total volume of water resources on the planet according to Clarke; King (2005). Its distribution, however, is not uniform throughout the national territory. The Amazon, for example, is a region that holds the largest river basin in the world. The water volume of the Amazon River is the largest in the world, being considered an essential river for the planet. At the same time, it is also one of the least inhabited regions of Brazil (GOMES, 2011).

The spatial distribution of Brazilian water resources does not coincide with the demands of the population. The North region, with only 7% of the Brazilian population, accounts for 68% of the country's freshwater in the Amazon basin. The Northeast, with 29% of the population, has only 3% of fresh water. In the Southeast, the situation is even worse: 43% of the population and less than 6% of fresh surface water (SANASA, 2006). In addition to this misallocation of resources, it can be said that the 19 million Northeastern people who live in areas with rainfall levels that do not exceed 800 mm annually according to Brazil (2015), and where the largest contingent of poor National territory.

The standard of potability in Brazil established by the Ministry of Health Ordinance No. 2914 of 12/12/2011 foresees a maximum hardness of 500 mgCaCO3/L; total dissolved solids of 500 ppm. Chloride with indices below 250ppm. In relation to the special chemical compounds, Ordinance No. 2914 of the Ministry of Health has as potable water that which has concentrations below 0.3ppm of iron and a maximum allowed sodium concentration of 200ppm. The sulfate has its maximum allowed value of 250 mg/L. The phosphorus present in the domestic sewage (5 to 20 mg/l) comes mainly from the urine of the contributors and from the use of detergents usually used in cleaning tasks. Its determination is a fundamental parameter for the characterization of residuary, raw and treated water, although its presence is not a very important sanitary problem in the case of water supply (FERNANDES, 2009)

In relation to water, WHO - World Health Organization (1973) apud MANCUSO (2003) classifies the reuse in:

- Indirect: it occurs when water already used, one or more times for domestic or industrial use, is discharged into surface water or groundwater and used again downstream in a diluted form;
- Direct: is the planned and deliberate use of sewage treated for certain purposes such as irrigation, industrial use, aquifer recharge and potable water;
- Internal recycling; is the reuse of water internally to industrial facilities, aiming at saving water and controlling pollution. Therefore, water can be reused for agricultural, industrial, domestic and even public use in view of its utility network. Large volumes of treated water can be spared by reuse when lower quality water is used for meeting the purposes that can be dispensed with it within the potability standards (CETESB, 2013).

B. *Distilled Water*

Distilled water is widely used in laboratories in the preparation of solutions for a wide range of purposes, including biochemical testing and preparation of culture media. Although the distillation removes the microorganisms from the water, they are found in distilled water due to storage. In this case, the presence of microorganisms of any kind could cause undesirable changes in the results of analysis (BELLINCANTA,1996).

According to Nunes et.al (2006), in a water distiller, only a small part of the amount of water is transformed in distilled water, the rest is used only for cooling, being totally discarded. Distilled water for use as reagent water in laboratory routines, for Clesceri et al. (1998), is classified by the values of electrical conductivity, being of reference for reagent water with high, medium and low quality.

C. *Air condittioners*

As Olgyay (1973) treats in his paper struggling to achieve biological equilibrium, several physical and psychological reactions happen, which determine the condition of physiological effort of the human organism to maintain comfort, the appearance of the air conditioners in the the first decade of the twentieth century was based on this struggle in the need for better thermal comfort, thus promoting physiological and psychological influences reflected in an improvement of style and quality of life. The air conditioning systems bring with them great advantages in various activities. The economic evolution of large commercial corporations, due the improved comfort offered to employees and customers; the possibility of providing surgery rooms, hospital rooms and clinics with ideal conditions for patient recovery; the industry evolution, with improvements of the worker class, as well as better equipment operation; among other benefits to different sectors are positive examples (LEÃO JÚNIOR, 2008).

In the northeast region, characterized by Brazil (2015) climatically by high temperature and relative moisture below 70%, the use of air conditioners has been massifying with primary object aimed at the cooling of environments. However, at the same time it promotes refrigeration, air purification and dehumidification processes take place. In the cooling process the environment air comes in contact with a cold surface, at a temperature equal to or greater than its dew temperature. To do this, it uses serpentine evaporator (direct expansion chiller); ice water serpentine (indirect expansion chiller); ice water sprays; serpentine cooled with water sprays.

D. *General Objective*

To analyze the quality of residual water generated by air conditioners and distillers to establish their potential use in non-potable purposes (irrigation, campus washing, among others), thus reducing the waste generated by them.

E. Specific Objective

Collect and determine the volume of wastewater discharged (air condenser and distiller) as a function of time;

- To determine the physicochemical quality and the exit water through analysis of pH, turbidity, electrical conductivity, total alkalinity, hardness, total dissolved solids, chlorine, calcium, magnesium, sodium and potassium;
- Relate the observed indices in water and in the collective collection in laboratory environments;
- Suggestions for the use of waste water from air conditioners for laboratory activities, based on the results of the analysis.
- And a way to reuse water from the distiller.

The air dehumidification process seeks to reduce the moisture content of the air. It is obtained by means of cooling, by chemical means and by absorption. The purification process consists in the elimination of solid particles (dust, smoke and fumes) and even liquid and suspended material. To do this, it uses dust retention chambers, dry filters, activated carbon filters, wet filters, air scrubbers and electrostatic filters described by Costa (1991). At the end of the process, the environmental humidity is condensed and thrown into the non-usable environment.

III. METHODOLOGY

It is a bibliographical research, as well as, present in this project the research by qualitative and quantitative nature. The main point of this article is to show ways to reuse water, with the implementation of a water reuse system from the condensation process of air conditioners and water distillers.

The development site of the project is the Instituto Federal de Educação, Ciência e Tecnologia da Paraíba – municipality of Cajazeiras - PB. The IFPB is currently one of the largest public higher education institutions in the city of Cajazeiras, with an emphasis on Engineering. For design titling of the project, a survey will be made with the Operational Department of the institution regarding the total number of rooms and laboratories in operation at each shift. The college has several rooms, didactic labs and administrative rooms.

A. Results and Discussion

A count of air conditioning equipment in the IFPB - Campus Cajazeiras was performed, but for this research only 10 rooms were used because of the type of apparatus that are similar or almost always the same and this has a great influence on the volume of the same, since the most appliances are Electrolux type and 3396 W power. Soon after the counting of the device, the fluid was collected through pet bottles in which it obtained the volume to calculate the flow rate of each device according to the time that was determined for each container.

The first two analyzes were carried out for a maximum of 1 hour, as it observed a large volume of water according to table 1, therefore reducing the time to 30 minutes for another two, thus concluding four analysis for each apparatus, calculated whether a mean as a function of time finding thus the value 50, 9l of water per day for an appliance and approximately 480l for the rooms used in the project.

TABLE I. AVERAGE OF GENERATED FLOWS.

Collect	Volume (l)	Time (h)	Flow (l / h)
1	***2,022***	***1***	***2,022***
2	***2,060***	***1***	***2,060***
3	***2,350***	***1***	***2,350***
4	***2,055***	***1***	***2,055***
Average			**2,122**

TABLE II. RESULTS OF WATER ANALYSIS.

Parameters	Units	Results	Ordinance 518/05
PH	(AT*)	7,5	6,0 – 10,0
Alkalinity	mg / l	0,95	(AT*)
Toughness	mg / l	0,8	500
Chlorides	mg / l	0	250
Conductivity	µs / cm	22,1	(AT*)

(AT * = does not admit unit.)

Fig. 1. Material used for collecting and analyzing water. *(figure caption)*

Then, the census was carried out in the 3 blocks and laboratories, investigating the number of distillers on the campus where three appliances can be found, but in operation only two were found that we used for the purposes of this research. Their theoretical production capacity in liters / hour was also determined for each 100L of drinking water, 1.9l of distilled water. In this empirical way, the effluent produced from 53 ml is used to generate 1L of distilled water.

After checking the quality of the pipe where we can see that most of the pipes were in a good state of conservation where they were clean and without sludge and also well installed near the soil where the soil was permeable there were drainage ditches that facilitate the drainage of the fluid that has the function of draining more rainwater from the campus was taken advantage of.

IV. CONCLUSION

The use of water from air conditioners and distillers should be pointed out as a measure to alleviate the lack of water in Brazil, especially in the northeast region, since the scarcity of water resources is very worrying. The project presents a simple solution that would have a low cost application for the entrepreneur if it were implemented in the campus, being his greater benefit to the reduction of the water consumption.

Public policies should encourage society and entrepreneurs in the elaboration of models that provide

the protection of this natural resource so degraded, since implicit the urgency of the application of these sustainable measures in our country.

The use of sustainable techniques also improves the image of the institution facing society and the Ministério da Educação (MEC) in the case of universities, since it encourages the rational use of public resources and the establishment of a collective social-environmental consciousness.

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