Quality of water produced by air conditioning equipment for non-potable purposes

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ABSTRACT
Air conditioner is an equipment which is present in most buildings around the world, either serving to provide greater thermal comfort to its users, or as part of industrial processes. This equipment while in operation produces water from the condensation of the air in contact with its coil, which has the potential to be used for non-potable purposes within the buildings. This study aims to evaluate the quality of condensate water from air conditioners for non-potable purposes. Water collection was carried out in the water harvesting system of a hospital type building located in the city of Recife-PE, Brazil. The applied methodology analyzed the physicochemical parameters that include: pH, color, odor, turbidity, electrical conductivity, total dissolved solids, ammonia, nitrite, nitrate, alkalinities, total hardness, carbonate hardness, non-carbonate hardness, chloride, sulfate, carbonate, bicarbonate, calcium, magnesium, sodium, potassium, total iron, manganese and, in the microbiological analysis, the presence of coliforms. In addition, the applied methodology compared the results of this and other studies found with the same theme, with the maximum limits provided for in Ordinance No. 888/2021 of the Ministry of Health of Brazil. The results showed an excellent quality of the condensate water, approaching in most parameters of drinking water, and thus, it can be used for non-potable purposes such as: garden irrigation, floor washing, replacement in cooling towers, among others.

KEYWORDS: Air Conditioner. Condensate water. Water use.

1 INTRODUCTION

Several places around the world still deal with problems related to water shortage, making them more sensitive to the solutions proposed to minimize the impacts caused by it. Brazil, for example, has one of the largest hydrographic basins in the world, the growth in water demand, climate change, urbanization, storage and distribution problems, poor water management and the inconsequential use of the resource result in regions in state of water crisis. Within this perspective, adopting new techniques aimed at the rational and conscious use of water is needed, and one of these alternatives is the use of condensate water from air conditioning equipment. In Brazil, several legislations that decide about this type of water use are being proposed: the most recent one was in 2019, in the State of Pernambuco. These actions demonstrate that unconventional solutions for water use are being considered in the State, in Brazil and all around the world.

The increase in alternatives applied to the use of water for non-potable purposes, in order to contain its waste, is based on sustainable principles, which are described in the Global Agenda 21, which has proposed "Promoting water conservation through better plans and more efficient water use and waste minimization for all users, including the development of water saving mechanisms" (Global Agenda 21, 2003).

The United Nations, 23 years later, presented 17 sustainable development goals (SDGs) in its 2030 agenda. Among them, goal 6, which aims to ensure the availability and sustainable management of water and sanitation for all. It proposes the increase in the efficiency of water use in all sectors, ensuring more sustainable withdrawals, expanding international cooperation in activities and programs related to water collection, desalination, efficiency in water use, effluent treatment, recycling and reuse technologies as goals until 2030 (ANA 2019).

Air conditioners produce a significant amount of condensation from the coils in hot and humid climates. Instead of pouring this water into the sewage system, this water can be collected and used in different non-potable applications. (Kham 2013).

In Brazil, some states such as Rio de Janeiro and São Paulo have legislation on the condensate formation by air conditioner, determining that the water is directed to the drainage to avoid dripping on public roads, avoiding inconvenience to citizens. In addition to them, the State of Ceará (2018) approved Law No. 16,603 determining the use of water coming from the air conditioning condensation, and the State of Pernambuco (2019), Law No. 16,584/19 containing the same provision, both states are located in northeastern Brazil.

Water use can be subdivided into the group of consumptive and non-consumptive uses. Consumptive use for building supply needs to meet parameters pre-established by regulatory bodies that present water quality indicators so that it is suitable for human consumption, or for the consumer point to which the water resource is intended.

In order to comply with the Brazilian criteria for water potability, concessionaires or users that use wells as a supply source must meet the indicators of their region current legislation, such as the water potability parameter established through Ordinance No. 888 (2021) of the Brazilian Ministry of Health (MH), which determines control and surveillance procedures for the quality of water for human consumption and its potability standard.

According to Lopes Junior and Miguel (2013), Ordinance No. 2,914/2011 determines a number of extremely detailed tests, which go beyond the evaluation of water and its storage. The National Health Surveillance Agency *(from the original, Anvisa)* determined a minimum number of mandatory tests, which include: pH, apparent color, turbidity, free residual chlorine, total dissolved solids, total bacteria count, total coliforms, presence of *E. coli* , thermotolerant coliforms.

For the microbiological indicators, it must be ensured that drinking water does not have pathogenic microorganisms or bacteria that indicate fecal contamination such as *Escherichia coli*, which according to Ordinance 888/2021, must present the absence of total coliforms and *Escherichia coli* in 100 mL of water sample for human consumption (FUNASA 2013).

Considering purposes of water use, other than human consumption, other parameters of use must be evaluated for use in a building. Such parameters to be evaluated will depend on the type of building and the activity where the water resource will be used. Non-potable sources can be: reuse of wastewater, use of rainwater, condensation from air conditioning systems, among others.

At the national level, some non-potable alternative sources have water quality indicators. The Brazilian Association of Technical Standards *(from the original, ABNT)* presents, in the Brazilian Regulatory Standard *(from the original, NBR)* 15527, quality parameters for the use of rainwater, leaving the physical-chemical and microbiological characteristics of the water to the discretion of the designer, according to the activity to be carried out, in addition to determining the type of disinfection. (ABNT 2007).

In buildings there are several activities that do not require a superior quality as potable water, such as: washing floors and sidewalks, watering the garden, washing the car, among others. In the industrial sector (goods and services), several factors can influence the quality of the water to be consumed, this variability can be due to the technology used, the technique applied, the branch of activity and the local climate conditions. (MIERZWA e HESPANHOL, 2005).

Regarding water from the condensation of air conditioners, in Brazil, there are no norms and legislation that pre-establish the physical-chemical and microbiological parameters for the use of water in the various consumer points in a building, however some authors have presented analyzes in their studies on the use of condensate water.

2 OBJECTIVES

This work aims to present the quality of the condensate water produced by air conditioners, having as a case study a hospital building

in the city of Recife - Brazil. Furthermore, analyzing the condensate water quality standards presented by the studies carried out in this area, comparing the results with the potability classification limits presented by Ordinance 888/2021 of the MH in Brazil, considering the hypothesis that, if the parameters are within potable limits, it will serve any non-potable purpose presented by the building.

3 METHODOLOGY

3.1 Building

The hospital where the condensate water samples were collected for the study belongs to a private healthcare group. The building was founded in 2011, and has 22,000 m² of constructed area, spread over 15 floors, where there are 204 beds, 10 operating rooms, 258 parking spaces in the Garage Building, as well as 516.55 m² of green area . His choice was motivated by the fact that the building has a water treatment system that collects water for non-potable use in the building. One of these consumer points for non-potable water use is the cooling tower, which belongs to the building air conditioning system.

3.2. Air Conditioning Equipment

The HVAC system of the building is made up of indirect expansion equipment, supplied by the chilled water system, and direct expansion equipment powered by refrigerant gas. One ton of refrigeration (1 TR) corresponds to 12,000 BTU/h (British Thermal Unit per hour), which is the most commercially used unit.

The number of air conditioning equipment in the building is 339, and they have varying thermal capacities. The sum of the thermal capacity of the equipment served by the chilled water system is 763.54 TR, and the sum of the equipment that use refrigerant gas is 161.71 TR, totalling a thermal load value of 925.25 TR in the building, which corresponds, in British thermal unit, to 11,103,000 BTUs.

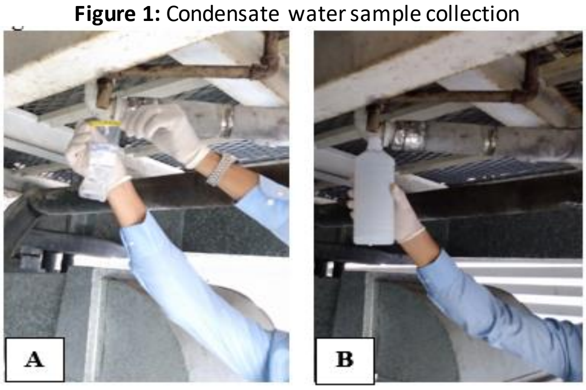
3.3. Condensate water quality analysis

The water quality analysis was carried out based on the physical-chemical and microbiological parameters of Ordinance No. 888/2021 of the Ministry of Health, which includes: pH, Color, Odor, Turbidity, Electrical conductivity, Total dissolved solids, Ammonia, Nitrite, Nitrate, Alkalinities, Total hardness, Carbonate hardness, Non-carbonate hardness, Chloride, Sulfate, Carbonate, Bicarbonate, Calcium, Magnesium, Sodium, Potassium, Total iron, Manganese, absence of fecal coliforms and *Escherichia Coli*, the latter two considered in 100 mL of water.

The physical-chemical and microbiological analyzes were performed on three water samples, which were collected from the HVAC equipment and from reservoirs in the system that collect water from the equipment and send the condensate water to the building's treatment system. Among the three water samples analyzed, a sample was randomly selected using the function "=RANDBETWEEN(BOTTOM, TOP)" in the Excel computer program, a sample that integrates a predetermined group of equipment that has a thermal capacity above 5 TR, and that are not in internal areas of the hospital, not interfering with the normal operations of the building.

The first sample collection in the selected equipment number 2, corresponding to a fan coil with a thermal capacity of 25 TR, was carried out on May 3, 2019, as shown in figure 1 A, which corresponds to the collection for microbiological analysis, and in 1 B for physical-chemical analysis.

Figure 1: Condensate water sample collection



Source: Authors

The other two samples were collected in reservoirs that make up the building's water treatment (reuse) system, on July 29, 2019. The collections were carried out in the general drainage of *PT* south and north, as shown in figures 2a and 2b respectively.

Figure 2: Other water sample collection points

Source: Authors

4 RESULTS

4.1. Physical-chemical and microbiological analysis

The physical-chemical and microbiological analysis of water is extremely important, especially for its use in a hospital environment. In a hospital there are several processes that require specific needs for the use of water, such as special treatments for using in hemodialysis. Other activities, such as cooling towers, may use water with a lower quality than potable water.

Table 1 presents the results of analyzes carried out by different authors on different types of air conditioning equipment, as well as the results obtained in this research. The focus was to compare the results found with the maximum values allowed by Ordinance No. 888/2021 of the Ministry of Health, Brazil.

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Table 1: Condensate water quality indicators by references.

Parameters	Maximum value allowed by Ordinance No. 888	References								Current study		
		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	A*	B*	C*
Conductivity (µs/cm)	-	40,00	78,00	36,00	20,76	60,20	20,25	32,39*	25,50	26,20	26,20	213
TDS (mg/L)	500	19,00	58,80	21,00					17,50	8,00	16,0	77,0
Ph	6,0 - 9,5	7,20	6,87	7,60	7,18*	7,22	6,69	6,69*	7,10	5,60	6,00	7,40
Chloride (mg/L)	250	0,60	10,14	<0,50	0,00		0,00	5,10*		0,7	3,0	19,1
Color (uH)	15		7,32	<1,00						<5	5	12,5
Turbidity (uT)	5	4,28	1,95	1,00		0,29	0,85	0,38*	0,70	<0,2	0,3	<2,5
Alkalinity	-	27,60	26,00	14,50	0,96		1,25	15,00*		0	<9	15,9
Calcium	-		2,44	<0,10						1	<1	2,49
Free Chlorine (mg/L)	3		0,00									
Total Hardness	500	40,00	10,00	9,00	9,30		5,10	2,62*		3,7	2,59	11,9
Total Iron	0,03	0,09	0,09	0,07						<0,01		
Manganese	-	0,09	0,97							0,3		1,38
Nitrite	1		0,06							0,01	<0,05	<0,05
Nitrate	10	3,10	0,43							0,4	0,57	9,77
Silica	-		<0,01									
Sodium	200		13,20							1,2		
Potassium	-		0,20							0,4		
Sulfate	250		<0,01							0,1		
Hydroxide ($CaCO_3$)	-			<0,10								
CO_2	-			0,70								
Copper	-	0,26		0,002								
Sulfur	-			10,16								
Ammonia (mg/L)	15										0,75	0,51
Bicarbonate (mg/L)	-										4,32	9,86
Consumed Oxygen	-	6,15		1,10					7,62			
BOD	-	22,00				10,20			0,019			
OCD	-	6,23				30,00						
Coliforms (NPM/100 ml)	Ausente (A)					<1,8			866,40			
***Escherichia Coli* (NPM/100 ml)**	Ausente (A)								(A)	(A)	(A)	(A)
Heterotrophic	Ausente (A)								88,00			

[1] Akram et al. (2018), Rajshahi – Bangladesh; [2] Costa et al. (2016), Minas Gerais – Brasil; [3] Bolina et al. (2016), Goiás – Brasil;[4] Fontes, Jardim e Fernandes (2018), Unspecified location;[5] Cunha, Klusener e Schröder (2018), Indústria – Brasil; [6] Pergoretti et al. (2016), Tocantins – Brasil; [7] Carvalho et al. (2016), Pernambuco – Brasil; [8] Bastos, Túlio e Franci (2015), Espírito Santo – Brasil; A * - 25 TR fan coil condensate water sample; B * - Water sample from the drainage of PT south equipment; C * - Water sample from the drainage of PT north equipment.

Source: Authors

The physical-chemical analyzes presented by the references, and in the present study, show an excellent water quality resulting from the condensation process that occurs in air conditioning equipment when the sample results are compared to the potability parameters required by the current Brazilian legislation.

Although the current study aimed to use water for non-potable purposes in the building, it is important to evaluate that, if the water quality reaches the potability parameters according to the current regulations in Brazil, it can be used for more noble purposes. Therefore, the results of the analysis will indicate whether the condensate water can be used for other purposes in the hospital building, except for processes that require differentiated quality, such as hemodialysis.

The results of this study showed few alterations that, with simple treatments, would qualify the water for human consumption. The pH result of the water collected in the 25 TR fan coil, PT south, showed a pH level below the recommended (pH = 5.60), which would require a pH correction through the addition of Hydrated Lime (Ca (OH)2) or Calcium Hydroxide so that this parameter is within the range stipulated by the legislation, which is between the range of 6 to 9.

Another parameter was the total iron content, which was observed above the maximum allowed value. The studies by Akram *et al*. (2018), Costa *et al*. (2016) and Bolina *et al*. (2016), found values of 0.09, 0.09 and 0.07 mg/L respectively, however the legislation allows a value of 0.03 mg/L. According to Madeira (2003), when iron ions are found in water above a concentration of 0.03 mg/L, some problems begin to become evident, such as stains on sanitary ware, deposits in pipes, astringent metallic taste; development of bacteria of the genera Crenotrix, Leptothrix and others inside the distribution pipes. The correction of this parameter could be performed using a charcoal filter.

The other physical-chemical parameters analyzed are within the maximum limit allowed by Ordinance No. 888 of the Ministry of Health of Brazil (2021) for potable use, that is, they would meet the non-potable demands proposed by this study without any problems (floor washing, mopping, watering the garden and replenishing the water in the cooling tower of the HVAC system). Furthermore, to meet reuse classes 1,3 and 4 of NBR 13969/1997 where the demands are inserted, it would only be necessary to correct the pH of 5.60 to fully meet class 1 where floor washing is included.

The analyzes of the microbiological parameters in order to verify the presence of Coliforms in the condensate water were carried out in this study and by the authors Cunha, Klusener and Schröder (2018) and Bastos, Túlio and Franci (2015). The presence of coliforms of the *Escherichia Coli* type was not detected in the current study, this result is aligned with those found by Bastos, Túlio and Franci (2015). However, in the studies by Cunha, Klusener and Schröder (2018) and in Bastos, Túlio and Franci (2015) the Coliform count (NPM/100mL) was recorded, whereas for heterotrophic coliform, its presence was recorded in the study by Bastos, Túlio and Francis (2015). Nevertheless, as the studies that showed the presence of coliforms do not have further details on how to collect the samples, such as whether the tubing was exclusive to the equipment, whether the maintenance was carried out correctly within the foreseen period or the location of the equipment, it is not feasible to deduce the possible reasons for the presence of coliforms, since all the water collected comes from the condensation of the air in contact with the coil.

4.2. Studies on air conditioner water quality

In recent years, some studies on the feasibility of using the water generated by air conditioners have been developed. Through them, it was verified that this water, depending on the class of use, could supply the water demand of the building. Therefore, many studies have included in their scope the analysis of the physical-chemical quality of this water, even though in a preliminary way.

Alom, Ahsan, and Imteaz (2021) in Gazipur, Bangladesh examined the quantity and quality of water collected by split air conditioners with 3, 4, and 4.5 tons. Totaling 270 water samples collected from June to July 2017, the authors managed to cover an area of 1,694.55 m² and analyzed the parameters: pH, color, turbidity, presence of *Escherichia coli*, total iron, electrical conductivity and BOD . The authors found that without treatment, air conditioner water is not safe to drink, however, it becomes safe if filtered and boiled.

Merheby (2021) studied water from air conditioners as an additional source for irrigation of public gardens in the city of Tripoli, Lebanon. The author analyzed the parameters: pH, color, total dissolved solids, hardness and total coliforms. The results confirmed that the amount of water generated by air conditioners would meet daily irrigation needs, but there was no social acceptance for adapting water collection systems from air conditioners in existing buildings, mainly due to lack of awareness of the respondents about the quality of this water.

Sabnis et al. (2020) analyzed quantity and quality of water from air conditioners in Mumbai, Pune Anjar, Kochi, Madurai and New Mumbai, India through the parameters: pH, total dissolved solids, total hardness, electrical conductivity, *Escherichia Coli* and total Coliforms. The authors concluded that air conditioners generate significant amounts of chemically and microbiologically pure water during their normal operations, which would enable the capture and use of this water from the source for domestic and industrial purposes.

Galvão *et al*. (2020) quantified and evaluated the quality of the water produced in the air conditioning system used in the acclimatization of the library at the FI Sertão PE, Ouricuri campus, as an additional water source in the irrigation of ornamental plant seedlings. The authors analyzed the parameters: pH, electrical conductivity, presence of iron, manganese and copper. As a result, the authors obtained an average flow of condensation in the afternoon shift of 1.45 L/h, pH 8.15, a value that is similar to that of tap water, they observed low electrical conductivity values of, of the salts: Na, Ca and Mg and the presence of Iron, Manganese and Copper was not detected. Thus, the authors concluded that the water coming from the air conditioners is appropriate for the irrigation of ornamental plants.

Bolina et al. (2016), at the Physical Space Management Center of the Federal University of Goiás, evaluated two Split air conditioner equipment with capacities of 12,000 and 60,000 BTUs, in dry and rainy seasons in the years 2015 and 2016. The volume of water produced in the dry and rainy seasons was, respectively, 1,591 and 2,713.96 L/ per month. The quality analysis showed the presence of sulfur, which would make it infeasible for potable consumption, but still being of excellent quality for non-potable purposes.

Akran et al. (2018) developed their study in the city of Rajshahi, Bangladesh, studying the production and quality of condensate water in an air conditioner with the capacity of 24,000 BTUs. It was observed that the average of water produced was 3 L/ per hour. The results of their physical-chemical analyzes showed that the properties of the water can be similar to those of distilled water, and that the non-potable suggested use for this water resource was for car batteries and radiators, boilers, toilet flushing and laundry.

Costa *et al*. (2016), developed a study at the Alagoas Federal Institute in the city of Batalha, aiming at creating a low-cost irrigation system for vertical green areas. The results were considered satisfactory for the implementation of the air conditioner water collection system, with an annual volume greater than 16 m³ being found. Water quality analyzes, according to Ordinance 888/2021, referring to the water potability standard, verified the favorable viability of this water as an irrigation source, even if the use does not require this level of quality.

Carvalho et al. (2016) studied air conditioners from a higher education institution in Pernambuco. Device capacities are 36,000 BTUs, 48,000 BTUs and 60,000 BTUs, all Split air conditioners. Water collection was performed at two different points (drains), one in the afternoon and the other at night. From the qualitative analysis, it can be concluded that it is feasible to reuse water from air conditioners for non-potable use, such as: general cleaning service of the institution, gardening and toilet flushing, activities that are currently carried out using treated water.

Fontes, Jardim and Fernandes (2015) collected condensate water for use at washbasin and garden consumer points. The water quality was considered adequate for the intended use, however it is necessary to verify the presence of metals, including aluminum that may have been carried in the condensation process. The amount of water captured for storage was 44.5 L per working day. It was concluded that two reservoirs with a volume of 100 liters each would be needed for this project, due to the arrangement of air conditioners. Project implementation costs were estimated at BRL818.10, with a payback period of approximately 6.76 years. The authors did not mention the building typology of the building under study.

Cunha, Filho and Schröder (2016) sought to analyze the potential for using water in split air conditioners in the administrative building of an industry. Measurements were carried out in equipment with a capacity of 12,000 and 36,000 BTUs. Analysis of physical-chemical and biological parameters of the water was also carried out in accordance with Ordinance nº 888/2021 MS and NBR 15.527/2007. The analysis results indicated a sample without contaminating potential. From the measurements it was possible to estimate that in a period of eight hours, the volume found would be approximately 64.5 L/day. The authors did not link the use of the volume produced to any non-potable demand.

Bastos, Túlio and Franci (2015) evaluated the potential use of condensate water in a dental clinic located in the state of Espírito Santo, Brazil, as an alternative source to the consumption of 2,600 liters of treated water, used in general maintenance: toilets cleaning, facades, sidewalks, garages and gardens. The physical-chemical and microbiological parameters, flows and demands of condensate water were analyzed. The average flow for condensate water is 33 liters/hour, considering 10 hours/day of operation, production reaches 330 liters/day. So in 25 days/month, the total would be 7,260 liters/month. By the water quality results, it was inferred that the analyzed condensate water should receive treatment for disinfection since it will be stored and manipulated inside the building for the proposed purpose, general maintenance (cleaning) and partial replacement of the water used in the toilet flushes.

Loveless, Farooq and Ghaffour (2013) used the ERA-INT climate model in their study to identify areas around the world with high potential for condensation collection, with a maximum value of about 380 L/L-s¹/year, because condensation collection technologies can offer numerous potential benefits for regions with high humidity. The author states that large-scale benefits can only be realized once collection systems are in place.

The model revealed that four regions (Arabian Peninsula, West Africa, Southeast Asia, Central America and South America) would be good locations for collecting condensation. It then carried out water quality tests to identify possible uses for the collected water. The high quality of the condensate water identified in the analyses suggests that the implementation of a condensation collection strategy would bring several advantages, such as reducing environmental impacts, reducing the costs of industrial processes, among other benefits. Relatively simple post-treatment methods can be applied to correct the parameters of condensate water, which could even be used for human consumption.

Pergoretti et al. (2016) analyzed the condensate water in equipment installed in an educational institution located in the state of Tocantins, Brazil. The results showed that there were no important variations in the physical-chemical parameters during the analysis in comparison with the current country potability legislation, which means that the water we commonly reject from condensing devices has great potential to offer society in general a viable alternative use.

The AquaPOLI research group from the Polytechnic School of Pernambuco, linked to the University of Pernambuco, has already developed some work on the use of air conditioner water for non-potable purposes, seeking to present proposals for this problem in public administration buildings in the state of Pernambuco with varied typologies, including administrative buildings, schools and hospitals.

Soares (2017), analyzed the potential of using condensate water from the Training Center for Public Servants and Employees of the State of Pernambuco *(from the original, CEFOSPE)* for the point of use in watering gardens, with an estimated consumption demand of 1,616 L/month, while the estimate of water produced by air conditioners was 9,829.8 L/month. This value corresponds to 16.43% of the total produced value of condensate water in relation to the estimated demand (SOARES, 2017).

Silva (2018), verified that one of the alternatives to reduce water consumption in the Palácio do Campo das Princesas, Headquarters of the Government of the State of Pernambuco, is the use of condensate water. The volume of water produced by the devices that are usually working is approximately 1220 L/day of water. Measure that over a month with 22 working days accumulates a volume of 26.8 m3 of water with high potential for reuse. This volume represents 8% reduction in the demand that is used to irrigate the gardens on a monthly basis.

Ferraz (2017), carried out his study at the Federal Institute of Pernambuco, Recife campus, analyzing the production of condensate water in equipment with a capacity of 36,000 BTUs, installed in classrooms and administrative offices. The best condensation flow, 2.7 L/h, was obtained by adjusting the equipment at 21°C, with an average air flow. The best ratio between condensation volume and energy consumption was obtained close to 1 L/kW, which can be achieved by operating the equipment at 24 °C and low air flow. Under these conditions, it would allow energy savings of 33.4% compared to usual conditions, producing 1.94L/h.

It is possible to verify that these works mentioned above did not present data on the quality of the water coming from the air conditioners, but they become relevant, since they are researches carried out in the same city of this article study.

4.3. Condensate water system contaminants

It is important to point out that in order to preserve the quality of the water in the air conditioning equipment, some agents that are considered a potential polluting source are used, therefore, it is necessary to carry out a prior treatment before this water is directed to consumer points depending on the class of use. Preventive maintenance stipulated by Ordinance No. 3,523/1998 of the Ministry of Health and more recently reinforced by Law 13,589 (2018) makes the Maintenance, Operation and Control Plan *(from the original, PMOC)* of mandatory air conditioning systems in Brazil.

The maintenance of these equipment is carried out by direct contact with technicians (refrigeration, mechanics, etc.) who use chemical products such as concentrated detergents for internal cleaning of the equipment and its heat exchangers (coil). All water used to clean the equipment is also directed to the general drainage, being diluted by joining with the condensation from the other equipment, thus allowing some degree of contamination.

5 CONCLUSION

As the dual challenges of population growth and climate change limit the planet's resources and threaten livelihoods, simple and decentralized technologies will be an important part of the solution to the water shortage problem.

This study analyzed the quality of the water generated by air conditioners in a hospital building in the city of Recife, whose methodology can be replicated for other building types, in different locations in Brazil and the world.

Through this study and other ones, it is observed that the quality of the water generated by the air conditioner has most of its physical-chemical and microbiological standards within the acceptable ranges for potable water according to the current legislation by the Brazilian agency. Thus, with regard to the quality of the water in the air conditioner, the more conventional non-potable demands existing in a building, such as: watering the garden, cooling towers, washing the floor, among others, are met without major problems.

Given this, it appears that investments related to the use of water from air conditioning equipment have great potential. Therefore, it is important to invest in easily feasible technologies that can have a significant impact not only in reducing water waste, but also a sociological impact as it will encourage more people to focus on the ideals of conservation and minimizing the consequences to the environment.

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