Revista Brasileira de Agricultura Irrigada
Brazilian Journal of Irrigated Agriculture
ISSN: 1982-7679 (on-line)
v.18, p. 123 - 127, 2024
Fortaleza, CE - www.inovagri.org.br

DOI: 10.7127/rbai.v1801370

QUALITY OF WATER GENERATED BY AIR CONDITIONING DEVICES, FOR PREDICTION OF UTILIZATION AT IFCE CAMPUS LIMOEIRO DO NORTE

QUALIDADE DA ÁGUA GERADA POR APARELHOS DE CONDICIONADORES DE AR, PARA PREVISÃO DE APROVEITAMENTO NO IFCE CAMPUS LIMOEIRO DO NORTE

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ABSTRACT: In tropical regions, the use of air conditioners for thermal comfort promotes the generation of water resulting from condensation, which in most cases is wasted on the ground or drained into storm sewers. This work aimed to analyze the viability of using water from air conditioners, aiming at reuse and the reduction of problems generated by undue dripping. The research was carried out from 2017 to 2022 at the IFCE CampusLimoeiro do Norte, where the volumes of water drained by the devices were collected and the parameters verified: Electrical Conductivity, pH, Total Dissolved Solids, Chlorides, Turbidity and ThermotolerantColiforms – TtC. The samples were analyzed at the Environmental Sanitation Laboratory of the IFCE Limoeiro do Norte Campus, following the APHA methodology (2023). Based on the estimate made, it is possibletCampus. The reuse of this water can save resources and preserve a resource that is scarce. The collected water showed contamination by TtC at some points, requiring a simplified treatment to ensure its disinfection. Therefore, it is evident that the use of water from air conditioners is a viable and safe alternative for non-potable purposes, generating not only financial benefits, but, above all, socio-environmental benefits.

Keywords: Refrigeration, Alternative source of water, Use of non – potable water.

RESUMO: Em regiões tropicais, o uso dos aparelhos de ar condicionado para conforto térmico promove a geração de água resultante da condensação, que na maioria das vezes é desperdiçada, no solo ou então drenada para galerias pluviais. O presente trabalho teve como objetivo analisar a viabilidade do aproveitamento da água proveniente dos condicionadores de ar, visando o reúso e a diminuição dos problemas gerados por gotejamentos indevidos. A pesquisa foi desenvolvida desde 2017 a 2022 no IFCE Campus Limoeiro do Norte, onde foram realizadas coletas de volumes de água drenados pelos aparelhos e verificados os parâmetros: Condutividade Elétrica, pH, Sólidos Dissolvidos Totais, Cloretos, Turbidez e Coliformes Termotolerantes – CTT. As amostras foram analisadas no Laboratório de Saneamento Ambiental do IFCE Campus Limoeiro do Norte, seguindo a metodologia do APHA (2023). A partir da estimativa realizada é possível coletar aproximadamente 2.133,76 L dia-1 de todos os aparelhos analisados do Campus sede. O reúso dessa água pode gerar economia de recursos e a preservação de um bem que é escasso. A água coletada apresentou em alguns pontos, contaminação por CTT, sendo necessário um tratamento simplificado, para garantir sua desinfecção. Portanto, evidencia-se que o aproveitamento da água de aparelhos de ar condicionado constitui-se uma alternativa viável e segura de aproveitamento para fins não potáveis, gerando benefícios não somente financeiros, mas, sobretudo socioambientais.

Palavras-chave: Refrigeração, Fonte alternativa de água, Uso de água não potável.

Protocolo 1370.18-12-2023- Aprovado em 18-12-2024
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Editor de área: Ana Nascimento

INTRODUCTION

In recent years, in places with high temperatures, the excessive increase in the use of central air conditioning units has been notable, along with the feeling of well-being and thermal comfort caused by this equipment, comes the undesirable drips coming from the device.

According to Fortes et al., (2015) during the refrigeration process of the air conditioning unit, the air comes into contact with the evaporator coil, its temperature reduces to the dew point, causing water drains, and generally this liquid causes a series of inconveniences, from the deterioration of the building, to the accumulation of sludge on sidewalks, hindering pedestrian passage.

In this way, to avoid the waste of water generated by air conditioners, as well as to preserve the water sources that, given the scenario of water scarcity present in the reality of the Brazilian northeast region and regions located in Baixo Jaguaribe – Ceará, are carried out It is necessary to use water for non-potable purposes such as the samples analyzed in this study, its correct applicability for various uses as established by COEMA Resolution 02/20217.

Given this perspective, the present work was developed at the Federal Institute of Education, Science and Technology of Ceará – IFCE CampusLimoeiro do Norte, with the objective of analyzing the feasibility of using water from air conditioning units in order to adapt to quality of the effluent, optimizing reuse for agricultural and other purposes, considering that the water that is released through the drains has a random destination, which generates great waste and the accumulation of water puddles, which can cause possible breeding grounds for disease-transmitting mosquitoes, in addition, the excessive accumulation of water has caused the generation of sludge, gradual deterioration of the building's structure, which could lead to possible accidents.

MATERIAL AND METHODS

The study was carried out at the IFCE CampusLimoeiro do Norte, in the state of Ceará, where it is approximately 200 km from the capital of Ceará. The institution has a total area of 12,000.00 m2, with 6,692.46 m2 of built area, divided into 12 blocks, with infrastructure equipped with classrooms, basic and specific laboratories for the various courses, video conference room, auditorium, space community, industrial canteen, library, among others.

The research was carried out from 2017 to 2022 by surveying the number of air conditioning units installed in the Headquarters Unit of the IFCE CampusLimoeiro do Norte, with their respective brands, powers and time of daily use, where the amount was subsequently quantified. volume of water drained by the devices and collecting it for analysis. Eight blocks were selected and water samples were collected in 20 refrigeration units.

The devices have different brands and powers. Collections were always carried out in the morning, where bottles were placed at the drain outlet so that the water could be collected (Figure 1).

Figure 1. Air conditioning water sample collection point, IFCE Campus Limoeiro do Norte, 2023.
Source: Author's collection, 2023

To carry out the physical, chemical and microbiological analyzes of the condensation water, the following parameters were analyzed: EC, pH, TDS, Cl, Turbidity and CTT. The samples were analyzed in duplicates at the Environmental Sanitation Laboratory at IFCE CampusLimoeiro do Norte, following the methodology proposed by APHA (2023). The results were evaluated according to the possibility of reusing water generated by air conditioners for irrigation of vegetables that are consumed raw and other crops in accordance with COEMA Resolution 02/2017, as well as other uses for non-potable purposes in accordance with NBR 13969/97, in its Class 2, which establishes standards on the reuse of treated effluents for washing floors, sidewalks and garden irrigation, maintenance of lakes and canals for landscaping purposes, except fountains.

RESULTS AND DISCUSSIONS

The water flow rate of each refrigeration plant was analyzed with the aid of a test tube and from this the estimated daily flow rate was calculated, taking into account that each plant was in operation for at least 8 hours/day. However, the total estimate of water accumulated per day, in the 20 points analyzed, was approximately 286.41 L day-1, using Equation 1.

$$Q = \frac{V}{t} x(8\ h\ x\ 20\ \boldsymbol{appliances}) \rightarrow\ Q = \frac{L}{\boldsymbol{dia}^{-1}}\ \boldsymbol{Equação}\ 1$$

Where:
Q = Flow;L/day-1
V = Volume of water; L
t = Tempo; dia

From this result it is possible to analyze that on average, each device produces 14.32 L day-1, and evaluating that the IFCE Campus Limoeiro do Norte, has around 149 air conditioning plants, of the most diverse models, it is estimated that they are produced an approximate value of 2,133.76 L day-1. However, not all devices are used daily.

To characterize the water quality, several parameters were determined, which represent the physical, chemical and microbiological characteristics of the water collected from the Campus's air plants (Table 1).

Table 1. Results of the physical, chemical and microbiological parameters of the water generated by air conditioners, IFCE *Campus*Limoeiro do Norte.

Points	CE µS/cm	pH	SDT mg/L	CHLORIDES $mmol_c/L$ Cl^-	Turbidity uT	CTT NMP/100 mL
*e** COEMA02/2017 ***NBR 13969/97	**Until 3000 -	**6,0 a8,5 -	- >200	- -	- ***Bottom a 5	*No Detected ** Até 1000 ***Bottom a 500
P_{01}	0,03	8,71	36,67	0,03	0,25	2
P_{02}	0,44	7,18	60,67	0,00	1,47	0
P_{03}	0,02	6,94	40,00	0,00	1,04	0
P_{04}	0,05	6,58	78,67	0,00	1,31	0
P_{05}	32,86	7,94	21,36	0,10	0,34	0
P_{06}	9,75	9,23	6,34	0,04	0,39	0
P_{07}	33,90	8,46	206,02	0,07	0,37	26
P_{08}	9,75	9,23	22,00	0,00	1,03	0
P_{09}	0,03	8,12	32,00	0,06	1,51	0
P_{10}	81,50	8,25	26,00	0,00	0,67	2
P_{11}	51,70	8,42	62,00	0,00	0,65	0
P_{12}	96,90	8,10	206,00	0,00	1,17	2
P_{13}	156,80	7,53	34,00	0,00	8,50	2
P_{14}	97,00	7,81	63,05	0,40	1,51	300
P_{15}	0,09	8,07	129,00	0,27	6,66	170000
P_{16}	0,05	8,07	42,00	0,25	1,18	8000
P_{17}	40,58	8,85	26,38	0,02	0,84	1600000
P_{18}	18,18	7,70	11,82	0,00	0,39	0
P_{19}	0,03	8,27	14,00	0,14	0,43	0
P_{20}	39,35	7,88	25,58	0,00	0,53	7
AVERAGE	**33,45**	**8,07**	**57,18**	**0,07**	**1,51**	**88917**
STANDARD DEV.	**43,69**	**0,68**	**58,06**	**0,11**	**2,14**	**357685**
CV	**1,31**	**0,08**	**1,02**	**1,61**	**1,41**	**4**
Maximum	**156,80**	**9,23**	**206,02**	**0,40**	**8,50**	**1600000**
Minimum	**0,02**	**6,58**	**6,34**	**0,00**	**0,25**	**0**

Source: Prepared by the authors.

In this study, a comparison was carried out with parameters that establish the limits for water quality for irrigation of vegetables that are consumed raw, in accordance with COEMA Resolution 02/2017 and NBR 13969/97.

These parameters are quality indicators and prove the existence of impurities when they reach values higher than those established for a given use.The pH ranged from 6.58 to 9.20, but the average was 8.01, within the range stipulated by COEMA Resolution 02/2017, with the exception of P1, P6, P8 and P17 which exceeded the larger range. TDS values ranged from 6.34 to 206.02 mg/L, with an average value of 57.18 mg/L. Also, it was observed that Cl values varied from 0.00 to 0.40 mmolc/L, the average value obtained was 0.07 mmolc/L.

It is worth mentioning that of the 20 points analyzed, none of them had restrictions for use in irrigation and according to Ayres & Westcot (1999), waters with Cl values greater than 3.0 mmolc/L represent limitations regarding

use for irrigation. According to NBR 13969/97, in its Class 2 which deals with the reuse of treated effluents for washing floors, sidewalks and garden irrigation, maintenance of lakes and canals for landscaping purposes, except fountains: establishes Turbidity below 5 uT , however analyzing the results described in the table, it was noticed that the average Turbidity value was 1.51 uT and in only two points (P13 and P15), were above the standard established by the aforementioned NBR.

For CTT (Table 1), only three points were above the value established by NBR 13969/97 (P15, P16 and P17), where the established standard was lower than 500 NMP/100 mL. Therefore, effluents that fall into Class 2 can be used for washing floors, sidewalks and irrigating gardens, maintaining lakes and canals, as well as for landscaping purposes.

It was also observed that 50% of the samples analyzed had values within the standard established by COEMA Resolution 02/2017, which is the absence of CTT NMP/100 mL, for irrigation of crops to be consumed raw whose part consumed has contact directly with the irrigation water. The remaining cultures can be cultivated with the exception of three samples (P15, P16 and P17) whose values exceeded the limit designated by the Resolution, which was up to 1000 NMP/100 mL.

CONCLUSIONS

In general, we can see the great potential for reusing this water not only for irrigating crops that will be ingested raw, but also for various purposes such as landscaping irrigation, sanitary flushing, cleaning patios and walkways on the institution's premises, cleaning laboratory glassware, among others in compliance with the points above the specific legislation requiring prior treatment, depending on its intended use.

However, it is suggested that management implement projects where effluents generated from waste water from air conditioners are captured, so that they have a suitable destination for each type of use and provide great viable potential for utilization, directly contributing to water conservation and not to mention savings in spending on this resource.

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