ISSN 1808-8546 (ONLINE) 1808-3765 (CD-ROM)

QUALITY OF GRAY WATER GENERATED BY THE FAMILY BIOWATER SYSTEM FOR AGRICULTURAL REUSE IN CEARÁ.

ANDRÉIA DE ARAÚJO FREITAS BARROSO [1]; FRANCISCO JONATHAN DE SOUSA CUNHA NASCIMENTO [2]; JARBAS RODRIGUES CHAVES [3]; PAULO DE FREITAS LIMA [4] AND HOSINEIDE DE OLIVEIRA ROLIM DOS SANTOS [5]

[1] Environmental Sanitation Technology Course, LABOSAM – Environmental Sanitation Laboratory, Federal Institute of Education, Science and Technology of Ceará – IFCE Limoeiro do Norte Campus, Rua Estevam Remígio, N° 1145, Limoeiro do Norte – CE, CEP: 62930-000, Brazil, email: andreiabarroso@ifce.edu.br
[2] Environmental Sanitation Technology Course, LABOSAM – Environmental Sanitation Laboratory, Federal Institute of Education, Science and Technology of Ceará – IFCE Campus Limoeiro do Norte, Rua Estevam Remígio, N° 1145, Limoeiro do Norte – CE, CEP: 62930-000, Brazil, email: francisco.jonathan@ifce.edu.br
[3] Environmental Sanitation Technology Course, LCA – Environmental Control Laboratory, Federal Institute of Education, Science and Technology of Ceará – IFCE Campus Limoeiro do Norte, Rua Estevam Remígio, N° 1145, Limoeiro do Norte – CE, CEP: 62930-000, Brazil, email: jarbasrodrigues@ifce.edu.br
[4] Environmental Sanitation Technology Course, IFCE Campus Limoeiro do Norte, Rua Estevam Remígio, N° 1145, Limoeiro do Norte – CE, CEP: 62930-000, Brazil, email: paulo.lima@ifce.edu.br
[5] Environmental Sanitation Technology Course, IFCE Campus Limoeiro do Norte, Rua Estevam Remígio, N° 1145, Limoeiro do Norte – CE, CEP: 62930-000, Brazil, email: hosineide@ifce.edu.br

1 SUMMARY

reuse has been an alternative for several sectors of the economy, which was stimulated mainly by LAW No. 9,433/1997, which established the National Water Resources Policy. This research aimed to evaluate the quality of gray water in a family biowater system for agricultural reuse in Ceará. The samples were collected from April 2018 to March 2020. The parameters analyzed were EC, pH, TTC and geohelminth eggs in the Environmental Sanitation Laboratory at the IFCE *Campus* Limoeiro do Norte. The gray water analyzed showed higher values of EC, pH and geohelminth eggs at P2. reuse tank than at P1. grease traps, noting that they should receive greater attention in relation to their use in irrigation. In this way, the family biowater system provides an alternative for reusing gray water in regions where water is not available, as it is recommended because it involves simple, low-cost treatment and requires little maintenance, and as for irrigation systems, it is recommended. was located by dripping to prevent water with a high EC from causing toxicity to crops via foliage, as well as in compliance with the microbiological standard specified by the Resolution of the State Council for the Environment - COEMA 02/2017.

Keywords: Effluent, Social Technology, Irrigation.

BARROSO, A. de AF; NASCIMENTO, FJSC; CHAVES, JR; LIMA, PF; SANTOS, H. de OR
QUALITY OF GRAY WATER GENERATED BY THE FAMILY BIOWATER SYSTEM FOR AGRICULTURAL REUSE IN CEARÁ.

Recebido em 05/09/2023 e aprovado para publicação em 11/09/2023
DOI: http://dx.doi.org/10.15809/irriga.2023v28n3p592-601

2 ABSTRACT

Water reuse has been an alternative for several sectors of the economy, which is stimulated mainly by law N° 9,433/1997, which established the National Water Resources Policy. This research aimed to evaluate the quality of gray water in a family biowater system for agricultural reuse in Ceará. The samples were collected from Apr/2018 to Mar/2020. The parameters analyzed were EC, pH, TTC and geohelminth eggs in the Environmental Sanitation Laboratory at the IFCE *Campus* Northern Lemon Tree. The gray water analyzed showed higher values of EC, pH and geohelminth eggs at P2. reuse tank than at P1. grease traps, noting that they should receive greater attention in relation to their use in irrigation. In this way, the family biowater system provides an alternative for reusing gray water in regions where water is unavailable, as it is recommended due to its simple, low-cost treatment and low maintenance requirements. Therefore, a localized drip irrigation system is recommended to prevent water with high salinities from causing toxicity to crops via foliage, as well as in compliance with the microbiological standard specified by the Resolution of the State Environmental Council - COEM A 02/2017.

Keywords: Effluent, Social Technology, Irrigation.

3 INTRODUCTION

reuse is becoming increasingly necessary, where our freshwater reserves must be preserved. According to the UN, it is estimated that by 2050, water consumption on the planet should increase between 20% and 30% (Fusati, 2021). Reusing water avoids waste, as it saves money on drinking water, reduces pollution in waterways, and saves money for large companies, as the water will be reused in manufacturing processes, etc. According to the National Water Agency, approximately 40% of treated water is wasted in Brazil; for this and many other reasons, water reuse is a great choice for companies and the people who use it (Agência Brasil, 2003).

reuse has been an alternative for several sectors of the economy, which is stimulated mainly by the National Water Resources Plan, established by Law No. 9,433/97, and with the scarcity present in the northeast region, more precisely in the Baixo Jaguaribe region – CE, municipalities of Potiretama and Tabuleiro do Norte, where the lack of water is part of the reality of these municipalities. Therefore, the implementation of water reuse systems with the technologies of the family biowater system entails environmental benefits as long as they are technically and economically viable, enabling an increase in the supply of drinking water available in springs, which, with due treatment of liquid effluents, decreases release into bodies of water.

In this sense, the rational exploitation of all the potential of the semiarid region of Baixo Jaguaribe with grain production and irrigated fruit growing, among other factors, the existence of abundant labor, the entrepreneurial capacity of producers and the associative mobilization of communities, are factors of attraction for the implementation of social technologies that favor the reuse of domestic effluents. In this way, Bioágua Familiar is another social technology developed to improve the lives of rural communities and families; ensure greater food security, environmental protection, and supplementary family income; contribute to efficient water management; and rescue agroecological practices based on the principles of coexistence with the semiarid region.

Biowater is very efficient in agricultural management and can be used for the cultivation of vegetables and tubers; the advantages of this system are that, in addition to minimizing pollution problems, measures to control gray water (any effluent generated by a residence, except sewage health) and low implementation and maintenance costs (Bioágua Familiar, 2012). This research aimed to evaluate the quality of gray water from the Family Biowater system for agricultural reuse, which consists of an alternative to reusing water for nonpotable purposes in agricultural use.

4 MATERIALS AND METHODS

The collections were carried out in the municipalities of Potiretama and Tabuleiro do Norte in 14 family biowater systems from April 2018 to March 2020. A total of 46 effluent samples were collected, with 23 samples representing the P_1 grease trap and 23 representing the P_2 reuse tank. The analyses were carried out at LABOSAM at the IFCE *Campus* Limoeiro do Norte following the APHA methodology (2012), and the parameters analyzed were EC, pH, TTC and geohelminth eggs, as per Table 1 and what established COEMA Resolution n° 02/2017.

Table 1. Conditions and standards for reuse: The external reuse of sanitary effluents for agricultural and forestry purposes must comply with the following specific parameters.

Parameters	Unit	*Standard release
Thermotolerant coliforms (CTT) - Crops to be consumed raw whose consumed part has direct contact with irrigation water.	NMP/100 mL	Not Detected – ND
Geohelminth eggs - Crops to be consumed raw whose consumed part has direct contact with irrigation water.	geohelminths/L of sample	Not Detected – ND
Thermotolerant coliforms (CTT) - other cultures.	NMP/100 mL	Up to 1000
Geohelminth eggs - other crops.	geohelminths/L of sample	up to 1 egg
Electrical conductivity (EC) - other crops.	μS/cm	Up to 3000
pH - other cultures.	-	6 to 8.5

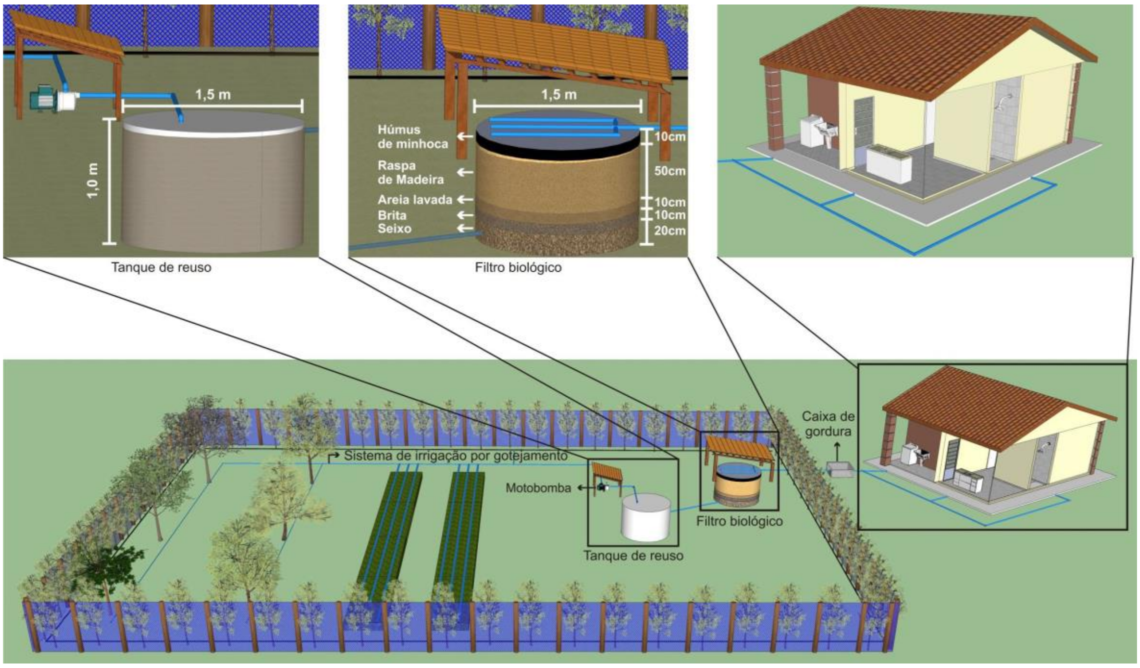
Source: COEMA Resolution n° 02/2017.

The samples were obtained from effluents generated by the Family Biowater System, which filters gray water through physical and biological prevention mechanisms for the waste present in it.

The biowater system is composed of a biological filter that can be considered the heart of the biowater system and has dimensions of 1.5 m (width) and 1.0 m (height), as illustrated in Figure 1 and its layers. The water processing unit is where wastewater is filtered, and nutrients from humus are also added, which contributes to the fertilization of irrigated soil, as well as wood scrapings. In addition to filtering, the system allows fertigation. The filter consists of a water distribution fork under filtering layers filled from bottom to top: 20 cm of pebbles, 10 cm of crushed stone, 10 cm of washed sand, 50 cm of wood chips, 10 cm of humus and 1 kg of Californian red earthworm (*Eisenia foetida*), where the entire filter structure is covered to avoid solar incidence.

The biowater system also has a reuse tank with dimensions of 1.5 m (width) and 1.0 m (height) that is used to store water from the filter, which is coupled to a motor pump set and a water supply system. drip irrigation to avoid direct contact between the operator and the effluent (Figure 1), as well as the use of reused water in an agroecological yard. It is worth mentioning that the family biowater system follows the same standard and was installed in all homes that were used in this research.

Figure 1. Family Biowater System.



Source: IBV – Instituto Bem Viver.

RESULTS AND DISCUSSION

The parameters analyzed from the tests are shown in Tables 2 and 3: EC, pH, TTC and geohelminth eggs from Bioágua Familiar effluents for the collection points in the P $_1$ grease trap and P $_2$ reuse tank, respectively.

Table 2. Quality of effluent generated in the Family Biowater system in the municipalities of Potiretama and Tabuleiro do Norte – CE in the period from Apr/2018 to Mar/2020 in P_1 grease traps.

Sample ID **P_1 fat box**	**CE** **µS cm $^{-1}$**	**pH**	**CTT** **NMP/100 mL**	**Geohelminth eggs** **egg/L**
1.P_1 Pot. 04/04/18	598.80	5.98	6000	* nd
2.P_1 Pot. 04/04/18	424.20	8.70	4000	* nd
3.P_1 Tab. 04/04/18	554.25	7.65	1600000	* nd
4.P_1 Tab. 04/04/18	474.05	6.91	1600000	* nd
5.P_1 Pot. 05/08/18	301.55	7.22	16000000	* nd
6.P_1 Pot. 05/08/18	1345.00	7.30	3000000	* nd
7.P_1 Pot. 06/05/18	427.05	6.92	220000	* nd
8.P_1 Pot. 06/05/18	171.00	7.48	1600000	* nd
9.P_1 Pot. 06/05/18	516.95	9.43	1600000	* nd
10.P_1 Tab. 03/12/18	256.50	9.17	30000	0
11.P_1 Tab. 03/12/19	643.50	7.74	1600	0
12.P_1 Tab. 03/12/19	677.50	7.55	160000	0
13.P_1 Pot. 03/26/19	1000.50	5.03	1600000	0
14.P_1 Pot. 03/26/19	611.00	6.65	500000	0
15.P_1 Pot. 2 03/6/19	737.00	5.26	0	0
16.P_1 Tab. 04/11/19	1336.00	6.10	3000000	* nd
17.P_1 Tab. 04/11/19	1572.00	8.04	0	0
18.P_1 Pot. 11/27/19	545.00	7.57	20000000	* nd
19.P_1 Pot. 11/27/19	1297.00	5.57	11250000	* nd
20.P_1 Pot. 11/27/19	1468.00	6.88	37500	* nd
21.P_1 Pot. 03/03/20	1359.50	7.77	100000	* nd
22.P_1 Pot. 03/03/20	797.00	5.88	2000000	* nd
23.P_1 Pot. 03/03/20	1358.00	7.63	625000	* nd
Average	803.10	7.15	2823221.74	0.0
Deviation Pad .	436.37	1.15	5371499.38	0.00
Coef . var .%	54.3	16.1	190.3	0.0
No. samples	23	23	23	7
Min value	171.00	5.03	0.00	0.00
Max value	1572.00	9.43	20000000	0.00

Source: The authors; Pot. = Potiretama; Tab. = Tabuleiro do Norte; * nd = not detected.

Table 3. Quality of effluent generated in the Family Biowater system in the municipalities of Potiretama and Tabuleiro do Norte – CE in the period from April 2018 to March 2020 in the $_{P2}$ reuse tank.

Sample ID **P $_2$ reuse tank**	**CE** **µS cm $^{-1}$**	**pH**	**CTT** **NMP/100 mL**	**Geohelminth eggs** **egg/L**
1.P $_2$ Pot. 04/04/18	1044.00	6.49	4000	* nd
2.P $_2$ Pot. 04/04/18	953.70	6.79	0	* nd
3.P $_2$ Tab. 04/04/18	950.05	6.67	900000	* nd
4.P $_2$ Tab. 04/04/18	1171.00	6.55	1600000	* nd
5.P $_2$ Pot. 05/08/18	1139.50	6.22	400000	* nd
6.P $_2$ Pot. 05/08/18	877.90	7.01	40000	* nd
7.P $_2$ Pot. 06/05/18	1645.50	7.34	1600000	* nd
8.P $_2$ Pot. 06/05/18	1041.60	7.07	27000	* nd
9.P $_2$ Pot. 06/05/18	857.05	6.84	50000	* nd
10.P $_2$ Tab. 03/12/18	1231.50	7.30	800	0
11.P $_2$ Tab. 03/12/19	2025.00	7.45	50000	0
12.P $_2$ Tab. 03/12/19	1414.00	6.73	50000	0
13.P $_2$ Pot. 03/26/19	1942.00	7.30	12000	0
14.P $_2$ Pot. 03/26/19	1194.00	7.49	0	0
15.P $_2$ Pot. 2 03/6/19	1580.00	7.03	1600000	0
16.P $_2$ Tab. 04/11/19	3600.00	7.67	21250	0
17.P $_2$ Tab. 04/11/19	1508.50	9.44	1625000	* nd
18.P $_2$ Pot. 11/27/19	1332.00	8.01	6250000	1
19.P $_2$ Pot. 11/27/19	1539.50	7.53	750	6
20.P $_2$ Pot. 11/27/19	1391.50	7.13	25	0
21.P $_2$ Pot. 03/03/20	1375.00	7.27	0	* nd
22.P $_2$ Pot. 03/03/20	1080.00	7.44	1000	* nd
23.P $_2$ Pot. 03/03/20	1193.50	7.55	625	* nd
Average	1395.08	7.23	618802.17	0.7
Deviation Pad .	572.62	0.64	1374384.11	1.76
Coef . varies .	41.0	8.9	222.1	251.5
No. samples	23	23	23	10
Min value	857.05	6.22	0.00	0.00
Max value	3600.00	9.44	6250000.00	5.60

Source: The authors; Pot. = Potiretama; Tab. = Tabuleiro do Norte; * nd = not detected.

According to the results in Tables 2 and 3, the gray water analyzed presented EC values in both the P $_1$ grease trap and P $_2$ reuse tank, within the standards required by COEMA resolution n° 02/2017, which is up to 3000 µS/cm. However, in relation to the EC parameter, the waters in P $_1$, in terms of their use for irrigation purposes for crops that are not consumed raw, were of better quality than those in P $_2$. This change is possibly due to the effluent acquiring dissolved organic components when passing through the biological layer of the filter.

For the pH parameter, the average values in the P $_1$ grease trap (Table 2) and P $_2$ reuse tank (Table 3) were within the standards for agricultural use of crops to be consumed raw whose consumed part has direct contact with the irrigation water and other crops, as well as for the parameter Geohelminth eggs where the average in P $_1$ and P $_2$ obtained values within the established standards both for crops to be consumed raw whose part consumed has direct contact with the irrigation water and for other crops according to COEMA n° 02/2017.

The average TTC values were better in the P_2 reuse tank than in the P_1 grease trap; however, these values are outside the standards established by COEMA Resolution 02/2017, chapter II, Art. 39 for crops to be consumed raw, the consumed part of which has direct contact with irrigation water as well as other crops. Similar values were found by Gomes *et al.* (2019), who analyzed samples of effluent generated by washing ETA filters in Limoeiro do Norte and observed that the CTT values were above those established by COEMA Resolution No. 02/2017, which addresses the standards for releasing effluents arising from washing of ETA filters and reuse for agricultural purposes.

From the tests carried out, the results were separated by municipality (Potiretama and Tabuleiro do Norte) to determine which effluent presented the best quality, as shown in Tables 4 and 5.

Table 4. Average values of EC, pH, TTC and geohelminth eggs analyzed in effluent generated in the Family Biowater system by the municipality of Potiretama and Tabuleiro do Norte – CE during the period from Apr/2018 to Mar/2020 in the P_1 grease trap.

Sample ID P_1 fat box Pot.	**CE µS cm $^{-1}$**	**pH**	**CTT NMP/100 mL**	**Geohelminth eggs egg/L**
Average	809.85	6.95	3658906.25	0.0
Deviation Pad .	432.28	1.21	6270254.99	0.00
Coef . var .%	53.4	17.3	171.0	0.0
No. samples	16	16	16	3
Min value	171.00	5.03	0.00	0.00
Max value	1468.00	9.43	20000000.00	0.00
Sample ID P_1 fat box Tab.	**CE µS cm $^{-1}$**	**pH**	**CTT NMP/100 mL**	**Geohelminth eggs egg/L**
Average	787.69	7.59	913085.71	0.0
Deviation Pad .	480.23	0.95	1176890.25	0.00
Coef . var .%	61.0	12.5	128.9	0.0
No. samples	7	7	7	4
Min value	256.50	6.10	0.00	0.00
Max value	1572.00	9.17	3000000.00	0.00

Source: The authors; Pot. = Potiretama; Tab. = Northern Board.

Table 5. Average values of EC, pH, CTT and geohelminth eggs analyzed in effluent generated in the Family Biowater system by the municipality of Potiretama and Tabuleiro do Norte – CE during the period from Apr/2018 to Mar/2020 in the P2 reuse tank.

Sample ID P 2 reuse tank Pot.	**CE μS cm $^{-1}$**	**pH**	**CTT NMP/100 mL**	**Geohelminth eggs egg/L**
Average	1261.67	7.16	624088.50	1.0
Deviation Pad .	303.55	0.44	1594066.66	2.24
Coef . var .%	24.1	6.1	255.0	224.0
No. samples	16	16	16	6
Min value	857.05	6.22	0.00	0.00
Max value	1942.00	8.01	6250000.00	6.00
Sample ID P 2 reuse tank Tab.	**CE μS cm $^{-1}$**	**pH**	**CTT NMP/100 mL**	**Geohelminth eggs egg/L**
Average	1700.01	7.40	606721.43	0.0
Deviation Pad .	903.31	1.00	757110.84	0.00
Coef . of vari .%	53.1	13.5	125.0	0.0
No. samples	7	7	7	4
Min value	950.05	6.55	800.00	0.00
Max value	3600.00	9.44	1625000.00	0.00

Source: The authors; Pot. = Potiretama; Tab. = Northern Board.

An analysis of the average values of EC, pH, TTC and geohelminth eggs in the P1 grease traps in the municipalities studied revealed that, according to Table 4, the values of EC and CTT were greater in Potiretama than in Tabuleiro do Norte, unlike the average pH values, which were lower in Tabuleiro do Norte. However, for the average values of geohelminth eggs, both municipalities had values of 0.0. In this way, the effluents generated in the P 1 grease trap, according to the parameters of EC, pH and geohelminth eggs, for both municipalities are within the standards established by COEMA n° 02/2017, both for crops to be consumed raw whose part consumed has direct contact with irrigation water, as for other crops, unlike CTT, which did not comply with standards.

An analysis of the EC and pH parameters in the P2 reuse tank (Table 5) for both municipalities revealed that the average values for the municipality of Tabuleiro do Norte were greater than those for Potiretama; at the same time, the average values of CTT and geohelminth eggs were greater in Tabuleiro do Norte than in Potiretama.

Pereira *et al.* (2019), in an airborne evaluation of geohelminth eggs in a system of stabilization ponds in the municipality of Riacho da Cruz, RN, observed that the concentrations of helminth eggs met the guidelines of the World Health Organization (WHO); thus, the effluent, in relation to this parameter, can be used in agricultural areas; however, longer monitoring, including physical-chemical variables, is recommended in addition to carrying out analyses along the profile of the water column.

Santos *et al.* (2018), analyzing the quality of effluent from swimming pool cleaning for reuse in landscape irrigation at the IFCE *campus* Limoeiro do Norte – CE, observed that the EC values were above those established by COEMA Resolution No. 02/2017 for water reuse (3000 μS cm $^{-}$

[1]), which can lead to salinization of the soil irrigated with this effluent.

In this way, it can be inferred that the average EC and pH values at points P_1 and P_2 for both municipalities are within the standards established by COEMA Resolution 02/2017, for crops to be consumed raw whose part consumed has direct contact with irrigation water as well as other crops. However, the average CTT values in P_1 and P_2 for both municipalities are outside the standards established by COEMA Resolution n° 02/2017. The average values for geohelminth eggs were within the standards set by COEMA No. 02/2017. It can be used in crops to be consumed raw, the consumed part of which has direct contact with irrigation water, as well as for other crops, with the exception of P_2, the municipality of Potiretama, which can be used for other crops.

6 CONCLUSIONS

According to the results obtained, it can be concluded that gray water from family Biowater Systems presented average EC and pH values within the standards established by COEMA n° 02/201, both for irrigation of crops to be consumed raw and for direct contact with irrigation water for other crops, as well as the average values for other crops for the Geohelminth Eggs parameter. The average CTT values were outside the standards established by COEMA 02/2017.

In view of the results obtained, it is suggested that improvements be made in terms of operation and maintenance, as well as the appropriate management of the Family Biowater system, seeking a better quality of reused water and thus enabling the implementation of crops eaten raw, such as cherry tomatoes, lettuce, and carrots. among others, in accordance with the microbiological standard specified by COEMA Resolution No. 02/2017. The use of crops on agroecological farms that are tolerant to water salinity as well as those that require little water for their production is recommended since, in semiarid regions, as was the case in this research, there is a shortage of water in terms of quantity and quality. .

7 REFERENCES

BRAZIL AGENCY. **ANA director reveals that 40% of treated water is wasted.** Brasília , DF: Empresa Brasil de Comunicação, 2003. Available at: https://memoria.ebc.com.br/agenciabrasil/noticia/2003-03-24/directora-da-ana-revela-que-40-da- treated-and-wasted water. Access on : 14 Feb . 2022.

APH A. **Standard Methods for the Examination of Water and Wastewater** . 10. ed. Washington, DC: American Public Health Association , 2012.

FAMILY BIOWATER: **Reuse of gray water for food production in the Semiarid region/Fábio dos Santos Santiago** . Recife: Dom Helder Câmara Project, 2012.

BRAZIL. Law No. 9,433, of January 8, 1997. Establishes the National Water Resources Policy, creates the National Water Resources Management System. regulates item XIX of Article 21 of the Federal Constitution, and amends Article 1 of Law No. 8,001, of March 13, 1990, which modified Law No. 7,990, of December 28, 1989. **Official Federal Gazette:** Section 1, Brasília, DF, n. 6, p. 470, 9 Jan. 1997. Available at: https://www.planalto.gov.br/ccivil_03/leis/l9433.htm. Accessed on: 19 Feb. 2022.

CEARÁ. State Environmental Council. **Resolution No. 02, of February 2, 2017.** Provides for standards and conditions for the discharge of liquid effluents generated by polluting sources, revokes SEMACE Ordinances No. 154, of July 22, 2002 and No. 111, of April 5, 2011, and amends SEMACE Ordinance No. 151, of November 25 , 2002. Fortaleza: State Superintendence of the Environment, 2017. Available at: https://www.semace.ce.gov.br/wp-content/uploads/sites/ 46/2019/09/COEMA-02-2017.pdf. Accessed on: 19 Feb. 2022.

FUSATI. **The Importance of Wastewater .** Piracicaba: Grupo Fusati , 2021. Available at: https://www.fusati.com.br/o-que-e-agua-de-reuso/. Accessed on: 11 Jan. 2022.

GOMES, MTR; ROLIM, HO; NASCIMENTO , FJSC Quality of water from filters at the Water Treatment Plant for agricultural reuse purposes in the municipality of L imoeiro do N orte , C eará . *In:* BRAZILIAN CONGRESS OF SANITARY AND ENVIRONMENTAL ENGINEERING, XXX, 2019 , Christmas . **Annals** [...]. Natal: ABES, 2019. p. 1-7. Available at : https://repositorio.ufc.br/bitstream/riufc/55008/1/2019_eve_mtrgomes.pdf . Access in : 1 9 Jan. 202 2 .

PEREIRA, FRC ; PAIVA, DS; DOMBROSKI, SAG; CAVALCANTE, FL; PINHEIRO, MK da R. **Evaluation of the removal of coliforms and parasites in a system of stabilization ponds in the municipality of Riacho da Cruz, RN** . Riacho da Cruz: Water Treatment Portal. 2019. Available at: https://tratamentodeagua.com.br/artigo/removal -coliforms-parasites-lagoas-stabilization/. Accessed on: 19 September. 2021.

SANTOS, AK; SILVA, MHB; ROLIM, HO; NASCIMENTO, FJSC; BARROSO, AAF; NOGUEIRA, GA Quality of effluent from swimming pool cleaning for reuse in landscape irrigation at the IFCE *campus* Limoeiro do Norte – CE. *In:* NORTH-NORTHEAST CONGRESS OF RESEARCH AND INNOVATION , 2018. Recife. **Annals** […] . Recife: Instituto Federal Pernambucano, 2018. p. 1-8. Available at: https://dados.ifpe.edu.br/dataset/anais-connepi-2018/resource/bbffd467-2c73-4098-8097-e4c686e0b1bf. Accessed on: 19 Jan. 2022.