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Physicochemical and Microbial Characteristics and Social Perception of Treated Ablution Wastewater Reuse in Solo, Indonesia

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ABSTRACT

The increased demand for water stimulates the use of treated wastewater as an alternative resource. However, there has been a constant concern from communities regarding the quality of the treated water. Thus, we present an investigation of community perception on reusing treated wastewater from ablution wastewater. This study aims to treat the ablution wastewater using the continuous electrocoagulation method and to investigate community perception of the treated wastewater. A laboratory experiment was conducted to observe the physical, chemical, and biological properties of the treated wastewater, while focus group discussions (FGD) with 10 respondents from two different mosques in Solo were carried out to understand the community perception if the treated wastewater to be reused for ablution water. The laboratory results showed that the electrocoagulation coupled with the chlorination process successfully diminished the wastewater's physical and chemical properties. the results meet the standards set by the Ministry of Health of the Republic of Indonesia through Regulation No. 32/2017 on Water Quality Standard for Sanitary Hygiene Purposes. On the other hand, the FGD results revealed two different perspectives regarding the application of treated wastewater. Over half of the respondents agreed to reuse the ablution wastewater, while the remaining declined. The decisions of those who agreed are highly affected by the Indonesian Ulema Council Fatwa regarding the status of the treated wastewater. Meanwhile, those who refused argued that currently, there is no urgency to use the treated wastewater since they are not aware of the seriousness of the issue. Furthermore, the respondents are also concerned about the possibility of virus contamination on the treated wastewater, making the water unsafe to be used.

1. INTRODUCTION

Given the importance of water to society, water scarcity is a concerning issue and climate change is known to exacerbate the problem [1]. In addition, the contamination of water sources and groundwater depletion due to excessive water withdrawal and reduced recharge also contribute significantly to the problem. On the other hand, water demand has consistently increased due to population growth. These, in turn, stimulates the use of treated wastewater as a resource alternative [2]. Furthermore, reusing resources, like water, has been suggested as a way to deal with a lack of resources, improve the economic and environmental performance of water supply and treatment, and ensure water resource management's sustainability. The United Nations also recognize the strategy through The Sustainable Development Goal 6 (SDG 6), which promotes access to clean water and sanitation for all and recognizes water recovery and reuse as a strategy to combat water scarcity [3]. However, the implementation is often challenged by non-technical obstacles, such as community perception of the treated wastewater reuse. This factor should be taken into account for sociocultural acceptance can be a factor in the practice's success [4].

Muslims perform ablution before each of their five daily prayers. The rituals require a massive quantity of clean water. The number will likely rise multifold in the time ahead since the number of Muslims performing the act also increases. Every pilgrim is estimated to use between 3.9 L and 4.42 L of water daily for ablution [5, 6]. This means approximately 7,800-8,840 L of clean water should be provided by a mosque with a capacity of 400 worshippers every day to support the daily prayers. As a result, the mosque requires a constant supply of clean water. However, some mosques in Solo, Central Java, Indonesia rely on seasonal wells to secure water, which flow is affected by the seasons. Consequently, when the dry season arrives, the ablution rituals have to be minimized as the water supply decreases. However, in many places, this issue often goes unnoticed by the pilgrims, for even though the water is lessening, there is still usually water they can use to perform ablution.

The concept of SDGs can be utilized to address the lack of access to clean water in mosques in urban areas of Indonesia, which is a barrier to ablution. Currently, most of the ablution wastewater in mosques is discharged untreated into the environment and those not released are deserted because of their high level of organic matter. One way that the State Islamic University (UIN) Raden Mas Said Surakarta may help the government to implement sustainable development is by reusing the water from the mosque's ablution fountains for other purposes within the university precinct.

One of the options for treating wastewater from ablution is using the continuous electrocoagulation (EC) method. This approach is environmentally friendly, effective, efficient, and economical. Water processed using electrocoagulation can be used for various uses, including ablution.

Several previous studies have applied electrocoagulation methods to several wastes, such as domestic wastewater [7, 8], steel industry wastewater [9], drinking water [10], poultry processing wastewater [11], synthetic wastewater [12], textile industry wastewater [13], oil emulsion wastewater [14] and brackish water [15]. However, studies of ablution wastewater treatment using continuous electrocoagulation have yet to be investigated.

Water that has been recycled still needs to be widely accepted. Studies on the acceptability of treated wastewater have been carried out several times, including research conducted by Faria et al. [4, 16-19]. Nonetheless, these studies only discussed the acceptance aspect of the treated wastewater but have yet to examine the quality of the treated wastewater.

Researchers believe it is crucial to understand whether the treated wastewater is acceptable. Therefore, the goals of this study are to (1) to treat ablution wastewater using the continuous electrocoagulation process and (2) examine the community's openness to the use of reprocessed wastewater for ablution purposes.

Therefore, this study was conducted in two steps to achieve the goals. The first step was to perform laboratory work to obtain the waste water's biological, physical, and chemical properties. The results of this step were used as references when conducting the next step, focus group discussion (FGD). FGD was aimed at collecting community perception regarding wastewater reuse for ablution.

2. METHODOLOGY

The ablution wastewater was collected for the pilot study from Imam Bukhori Mosque of UIN Raden Mas Said Surakarta in the city of Sukoharjo, Indonesia. Focus group discussion (FGD) to analyze social perception of the recycled ablution wastewater were conducted at the Grand Mosque of Surakarta and the Imam Bukhori Mosque of UIN Raden Mas Said Surakarta.

2.1 Electrocoagulation process for treating ablution wastewater

A tube-shaped electrocoagulation reactor (EC) with an inlet and an outlet was used for this study. The electrolysis time and voltage were controlled via an adapter (Kayama, Japan) with a range of 0-60 minutes and 0-30 V, respectively. The adapter was linked to iron (Fe) and stainless steel (St) electrodes. Both electrodes were completely submerged in the ablution wastewater. The electrodes were cleaned thoroughly using ethanol and water to eliminate any surface contaminants. This process was repeated every time a step involving the electrodes was carried out. All procedures were performed at room temperature.

Using a constant 1 l/min flow rate and a 12 V DC pump, the ablution wastewater was pumped to an EC reactor. Once the experiment was complete, the fluid was filtered after the sediments settled. The ablution wastewater was filtered, and then chlorine was added as a bactericide to kill any remaining bacteria. The step was repeated three times to ensure accuracy. The highest value of the standard deviation was 4%.

2.2 Evaluation of water quality

To produce ablution water that complies with physical, chemical, and biological standards regulated by the Ministry of Health under law No 32/2017 on Water Health Quality Standards for Sanitary Hygiene, the ablution wastewater was treated using the continuous EC method. To identify the optimal electrical power and electrolysis time needed, the wastewater was treated between 0 and 60 minutes. Analysis was performed on both the raw ablution wastewater and the wastewater that had been treated with EC.

Physical parameters, such as turbidity (NTU), was measured with a turbidimeter (Hanna, USA); total suspended solids were measured with a gravimetric method [20]; color was measured with the SNI 06-6989.24-2005 method; temperature was measured with a thermometer (SNI 06-6989.23-2005); taste and smell were tested with a triangular test evaluated in the laboratory. Total Coliform and Escherichia coli, which belong to biological parameters, were tested using the SNI ISO 9308-1:2010 method. Lastly, chemical parameters, including pH was measured by a pH meter (Trans Instrument, Singapore) (SNI 06-6989.11-2004) iron using the SNI 6989.4:2009 method, fluoride using the SNI 06-6989.29-2005 method, hardness using the SNI method 06-6989.12-2004, manganese using the SNI 06-6989.5-2009 method, nitrate using the SNI 06-6989.9-2004 method, nitrite using the SNI 06-6989.9-2004 method, cyanide using the SNI 6989.77:2011 method, detergents using the SNI 06-2476-1991 method and pesticides using the SNI 06-2509-1991 method. All parameters were tested triplo. Data obtained from the analysis was tabulated using Microsoft Excel® software and the result was displayed in a table. Origin® software was also employed to analyze the optimum time and electric power to treat the wastewater.

2.3 Focus Group Discussion (FGD) on the social perception of recycled wastewater for ablution

FGD is a qualitative research method and was conducted at two mosques in Solo, Indonesia. Participants of the FGD were community members of the university mosque and the Grand Mosque. The FGD method was used to determine the perception of the recycled water. This is because the method could engage a large number of participants while providing richer information related to the issue since the discussion is focused on only one research topic. The method also requires a relatively short time to implement.

The number of respondents of the FGD was ten people. The number was based on the previous studies by Wilson et al. [21, 22]. Wilson and Pfaff [21] used eight respondents to determine religious, philosophical, and environmental perspectives regarding the reuse of potable wastewater in Durban, South Africa. Meanwhile, Mitro et al. [22] used nine respondents to determine the barriers and facilitators of chlorine tablet distribution and use in emergencies.

Data obtained was analyzed in the following orders [23]: 1) Transcribing the recorded statements. The transcription process of one group discussion took several hours and several pages of writing to finish; 2) Coding. The transcription was coded. Codes are labels or short fragment markers in writing that help summarize and form the data's structure; 3) Notes review. This was carried out by the researcher and members of the research team during the study; 4) Analyzing and interpreting the qualitative data [24, 25]; 5) Determination of validity and reliability of the data.

3. RESULT AND DISCUSSION

3.1 Physical and chemical parameters

Before the continuous EC treatment, studies investigating the ablution wastewater samples' physical, chemical, and biological properties were performed. The results were as follows; TDS concentration and pH of the ablution wastewater were 602 mg/L and 8.4, respectively. The ammonia and color concentrations were 4.72 mg/L and 45 TCU, respectively. Meanwhile, the identification tests of E. Coli and Coliform bacteria were both innumerable (Too Numerous To Count/TNTC). The initial test findings revealed that the levels of ammonia, color, E. Coli, and Coliform bacteria exceeded the quality limits specified in the Water Health Quality Standard of the Republic of Indonesia No. 32/2017.

The examination results of the ablution wastewater after being treated with the continuous EC based on the Water Health Quality Standard of the Ministry of Health of the Republic of Indonesia No. 32/2017 is shown in Table 1. All of the parameters tested meet the standard.

Table 1. Physical and chemical content of the treated ablution wastewater

Parameter	Results	Standard	Unit
Fluoride	0.30	1.5	mg/L
Turbidity	0.37	25	NTU
TDS	363	1000	mg/L
Iron	0.239	1	mg/L
Cyanide	0.006	0.1	mg/L
Manganese	0.010	0.5	mg/L
hardness	116	500	mg/L
Nitrite (NO2)	0.003	1	mg/L
Nitrate (NO3)	1.31	10	mg/L
Color	10	50	TCU
Detergent	0.007	0.05	mg/L

3.1.1 Turbidity, TDS and color

The turbidity of the processed ablution wastewater was measured using the SNI 06.6989.25.2005 method. The measurement results show that the turbidity level of the treated ablution wastewater is 0,32 NTU. This number is 78 times lower compared to that of the standard, 25 NTU. The TDS value of the treated wastewater is 363 mg/L. TDS concentration decreased by 60.6% compared to the original TDS concentration (TDS concentration of the untreated wastewater was 602 mg/L). The treated value is only 1/3 of the standard value of 1000 mg/L. The color parameter standard set by the Ministry of Health No. 32/2017 is 50 TCU. Meanwhile, the color measurement results using the SNI method 06.6989.24.2005 is 10 TCU. This means that the color content of the processed wastewater has met the standard.

These results are supported by numerous studies employing the EC techniques to remove turbidity, TDS and color from various types of water. The results generally are equally high for each study. Pirkarami et al. [26-28] reported that the percentage of turbidity removal using iron as electrodes is 97%, 95% and 95% in dye, mining, and synthetic wastewater respectively. Similar trends are also identified in TDS and color. EC with iron as one of the electrodes reduces TDS level significantly (91.5%) in pharmaceutical effluent [29]. Nidheesh et al. [30] stated that EC can remove color in textile waste up to 99.8%. Rodrigues et al. [31] reports that dye removal efficiency is 98% with 0,2 minutes of residence time.

3.1.2 Fluorine

Human metabolism process requires a certain amount of fluorine. However, excess amounts of fluoride lead to numerous undesirable health effects, such as teeth and bone fluorosis [32], gen alterations [33], and chronic kidney diseases [34]. Thus, it is essential to ensure fluoride concentrations in the treated waste water comply with the standard.

The fluorine concentration in this study was measured using the SNI 06.6989.29.2005 method. The results showed that fluoride concentrations detected were 0.3 mg/L after the continuous EC treatment. The value is one fifth lower than the standard set by the Ministry of Health of 1,5 mg/L. This shows that the EC treatment is able to reduce fluoride concentrations in the wastewater.

The elimination of fluorine happens because of the formation of metal hydroxides in which the metal cations were produced by strong dissolution at the anode [35]. The formation of metal hydroxides also destabilizes the particles, which also increases the elimination of the particles. Some studies report the elimination of fluorine from wastewater using EC presents relatively high results at 85.9% [36], 97.86% [37] and 93% [38].

3.1.3 Iron

The concentration of iron in this study was analyzed using the SNI 6989.4:2009 method. While iron does not particularly pose a harmful effect to human health, its presence is usually undesirable in water. This is because the presence of the metal can change the taste, color, and appearance of water [39]. Results of the laboratory analysis show that the level of iron detected in the treated wastewater is 0,239 mg/L which meets the standard set by the Ministry of Health No. 32/2017 at 1 mg/L. This shows that the EC can eliminate iron. Other studies employing iron and steel as electrodes also report similar findings where they successfully remove 99.2% [40] and 98.8% [39] iron from drinking water and 99.89% [41] iron from metal plating industrial wastewater.

3.1.4 Cyanide

Cyanide and its derivatives have long been proven to be toxic to all organisms [42]. Therefore, it is necessary to ensure cyanide levels in water used for hygienic purposes meet the health standard. The cyanide concentration standard set by the Ministry of Health No. 32/2017 is 0,1 mg/L. Meanwhile, the concentration of cyanide observed in the ablution wastewater treated using the EC is ≤ 0,006 mg/L. This number is nearly 100 times lower than that of required. This means that the EC process can effectively remove cyanide from the wastewater.

The removal process could happen because ferrous ions produced at the anode (Eq. (1)) react with free cyanide (Eq. (2)) [43] forming hexacyanoferrate which subsequently also can react with other ferrous ions producing insoluble prussian blue (Eq. (3)) [44].

$$4Fe_{(s)} \rightarrow 4Fe^{2+}_{(aq)} + 8e^{-} \quad (1)$$

$$Fe^{2+} + 6CN^- \rightarrow Fe(CN)_6^{3-} \quad (2)$$

$$4Fe^{2+} + 3Fe(CN)_6^{3-} \rightarrow Fe_4[Fe(CN)_6]_3 \quad (3)$$

The percentage of cyanide removal from wastewater in which iron is employed as electrodes varies depending on the duration and current density used. A study by Abdulla et al. [45] reports 71% removal of cyanide, Elawwad and Hamdy [46] presents higher removal up to 99.2%, while Mamelkina et al. [47] report 60% removal of cyanide.

3.1.5 Manganese

Manganese affects human health in both positive and negative ways. Manganese is one of the essential metals needed for numerous biochemical processes in human's body, such as to develop of strong bone, coagulation, healthy immune system and reproduction [48]. On the other hand, even though rarely encountered, manganese can also harm humans when consumed in a very high concentration [49]. Some symptoms experienced by those intoxicated by manganese are depression, hearing problems, tremors, irritability, and headache [49].

To avoid such problems, manganese levels in water used for hygiene purposes must comply with the health standard. The standard set by the Ministry of Health is 0.5 mg/L. This means the level of manganese in the ablution wastewater treated using the EC which is ≤ 0.010 mg/L has met the standard.

Several studies using iron as electrodes have proven that the EC removes manganese quite significantly from water with percentages starting from 50% [50], 85.5% [51] and up to 99% [52]. These are affected by the duration of the treatment and voltage applied [53].

Manganese elimination mechanism from water using EC is similar with those of other metals, including fluorine, cyanide, and iron. Metal cations formed at the anode will destabilize colloidal particles in the water, including manganese particles, forming flocks that are easier to separate using flotation and or sedimentation [26].

3.1.6 Nitrite (NO2) and Nitrate (NO3)

Both nitrite and nitrate concentrations observed in the treated wastewater are below the standard the Ministry of Health set. The nitrite level in the treated wastewater is < 0.003 mg/L, while the standard is 1 mg/L. The nitrate level is somewhat higher than that of nitrite, 1,31 mg/L. However, the value still meets the standard required for hygiene purposes to contain a maximum of 10 mg/L of nitrate. Controlling the level of nitrite and nitrate in water is vital since high levels of the compounds are detrimental to human health, especially to infants [54, 55].

Several studies have reported the EC can be used to decrease nitrate concentration. Malakootian et al. [56, 57] report 89.7% and 43-59% removal of nitrate, respectively. This happens because an oxidation reaction occurring at the anode produces cation metals that can eliminate nitrate from water [58]. In addition, hydroxides produced by the electrodes also adsorbed nitrate which in turn increases the removal percentage of nitrate from water [36]. On the other hand, nitrite is often found as by-products during nitrate removal treatment [59]. However, Nazlabadi et al. [60] report that both compounds can be eliminated using the EC.

3.1.7 Hardness and detergent

The hardness level of the processed wastewater is 116 mg/L. Meanwhile, the standard is 500 mg/L. The detergent level in the treated wastewater is 0.007 mg/L and the standard is 0.05 mg/L. This means that the level of hardness and detergent in the treated wastewater meet the requirements set by the Ministry of Health.

Hardness in the wastewater which is caused mainly by calcium and magnesium cations [61] could also be decreased using the EC. However, the result is affected by the pH of the solution, current density, and EC duration [62]. Nonetheless, the result is still relatively high. Santhusan et al. [61, 63] reported that hardness removal of 84%, 95.6% and 80.6%, respectively. Other studies on detergent removal present similar results, in which the EC is proven to minimize the concentration of detergent in water [64, 65].

3.1.8 Pesticide

The results of pesticide examination on the treated ablution wastewater using Thin Layer Chromatography (TLC) analysis method are shown in Table 2.

Table 2. Characteristic of pesticides of the treated ablution wastewater by Thin Layer Chromatography (TLC)

Parameter	Result	Analysis Method
A. Organochlorine group		
Engine	Negative	TLC
Dieldrin	Negative	TLC
DDT	Negative	TLC
Endosulfan	Negative	TLC
Lindane	Negative	TLC
B. Organophosphate group		
Malathion	Negative	TLC
Diazinon	Negative	TLC
Fenthion	Negative	TLC
Fenitrothion	Negative	TLC
Monocrotophos	Negative	TLC
C. Karma group		
Carbaryl	Negative	TLC
Carbofuran	Negative	TLC
BPMC	Negative	TLC
Aldicarb	Negative	TLC

The analysis results using TLC showed that the treated wastewater is free from organochlorines, organophosphates, and karma groups of pesticides. TLC is one of the methods commonly used to identify pesticide residues [66]. This method is widely used because it is considered to have good selectivity and efficiency compared to other but more expensive methods [67]. This method is proven to have succeeded in identifying various types of food and beverage products, both in the form of raw materials and in the form of final products and materials originating from the environment or the wild [68]. These results are in line with research by Abdel-Gawad et al. [69], which reports that the use of EC can remove pesticides up to 98-99% using iron electrodes with the initial pH of 6-7 and 10 minutes of electrolysis time. Another study conducted by Ghalwa, Nasser, and Farhat explains that the use of the EC is able to remove abamectin pesticide up to 94%.

3.2 Final result of biological/microbiological parameters

The biological parameter is one of the parameters required by the Ministry of Health Regulations no. 32/2017. Biological parameters tested in this study are E. Coli and Coliform. The results of the biological analysis (E. Coli and Coliform) on several samples of the treated ablution wastewater can be seen in Table 3, while the picture of the result can be seen in Figure 1.

Table 3. Results of microbiological analysis of the treated ablution wastewater

Sample	Results	
	E. Coli (CFU/mL)	**Coliform (CFU/mL)**
Ablution Source Water	8	8
Ablution Wastewater	UBUD	UBUD
Electrocoagulation Treated Water	UBUD	UBUD
Electrocoagulation Treated Water with Addition of Chlorine	0	0

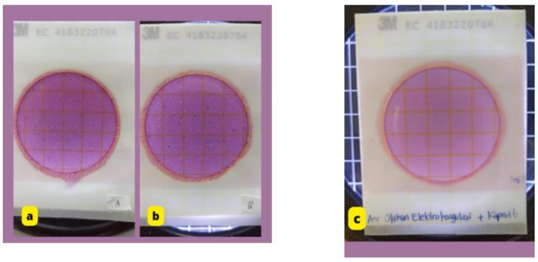

Figure 1. Bacterial test results of water samples

The explanation of each parameter is as follow:

3.2.1 Ablution water bacteria test results

The source of the ablution water used in this study was from Imam Bukhori Mosque of UIN Raden Mas Said Surakarta. The source of the ablution water comes from wells around the mosque. The results of E. Coli and Coliform microbiological analysis are 8 CFU/mL for each parameter. The maximum standard of E. Coli in water for sanitation hygiene purposes according to the standard set by the Ministry of Health No. 32/2017 is 0 CFU/mL, while the maximum standard for Coliform is 50 CFU/mL. This means the level of E. Coli does not meet the standard. This is probably due to contamination from the surrounding environment.

The results of this study are in accordance with that of Restina et al. that report 1 out of 12 water samples from dug wells positively contains E. Coli (8.3%). A similar result is also reported by Korniasih and Sumarya [70] revealing 15,6 and 9,8 MPN/100 mL of E. Coli and Coliform level detected from water samples of drilled wells. According to Chandra [71] dug wells are easily contaminated by microbes. This is because dug wells are relatively close to the ground surface. As a result, they are easier to be contaminated by human, animal or household waste [72]. Aramana et al. [73] added that dug wells contaminated by human waste might contain E. Coli.

3.2.2 Ablution wastewater and the treated ablution waste water

The results analysis of Coliform and E. Coli in the ablution wastewater is TNTC (Too Numerous To Count) for E. Coli and Coliform. This indicates the occurrence of contamination in the ablution water. Contamination may come from parts of the human body that are cleaned during the ablution ritual and also from the sewers where the ablution wastewater is collected before being sampled. The results of the research by Widyaningsih et al. [74] show that Coliforms are abundant in river estuaries, such as the Wiso River Estuary.

The treated ablution wastewater using the EC also showed similar results for Coliform and E. Coli. Both parameters were identified as TNTC. This shows that the EC method alone cannot remove microbes, especially E. Coli and Coliform. This is different from the studies conducted by Boudjema et al. [75-77] which shows the EC can remove bacteria such as E. coli by forming of an in-situ coagulant, which then flocculates with the bacteria and can be filtered from the solution. This difference is probably due to the large number of E. Coli and Coliform in both samples. Consequently, the level of both microbes stays the same, TNTC, before and after the EC treatment. Another reason is that the coagulant formed during EC is not well separated causing the microbes to continue contaminating the treated wastewater.

3.2.3 Electrocoagulation treated water with the addition of chlorine

The treated wastewater which contained a high concentration of E. Coli and Coliform, namely TNTC, was further treated by adding chlorine with a concentration of 20 g/1000 L. According to Supriyadi et al. [78] chlorine can eliminate E. Coli and Coliform bacteria from river water so the water can comply with applicable standards.

The results showed a significant decrease of E. Coli and Coliform from TNTC to undetectable. The results of this study are in line with studies conducted by Habibi et al. [79] which shows a decrease of E. Coli and Coliform from 2.3 x105 cfu/100 ml to <1 cfu/100 ml for E. Coli and from 2.3 x105 cfu/100 ml to undetectable for Coliform. Mulyati et al. [80] also uses chlorine to reduce Coliform in treated wastewater. The study of Mulyati et al. [80] indicates that the use of 200 g of chlorine tablets could effectively reduce Coliform up to 98.55%.

3.3 Demographics of respondents

The social perception study of the treated ablution wastewater was conducted at the Imam Bukhori Mosque in Sukoharjo, owned by UIN Raden Mas Said Surakarta and the Great Mosque of Surakarta (Masjid Agung Surakarta). The study was conducted using the Focus Group Discussion approach to assess the pilgrims' perception on reusing the treated wastewater for ablution. Four worshipers and one administrator from each mosque participated and made up a total of 10 respondents.

Table 4 shows the demographic data of the respondents involved in the FGD. The distribution of respondents is separated by gender, age group, and level of education.

The age profile of 10 respondents in this study comprised 60% (n=6) males and 40% (n=4) females. Although data collection was carried out on the gender variance of the respondents, several previous studies found no effect of gender on the perception of wastewater treatment [81, 82].

Regarding the age group of respondents, the age of FGD respondents varied from the age of 25 years to above 50 years. 10% were aged >50 years old, 30% were aged between 45-49 years old, 50% were aged between 30-44 years old, and 10% were aged between 25-29 years old (Table 4). The age group profile of respondents has been studied to correlate with the perception of treated water in that age group [83-87]. Several studies have stated that the relatively younger age group is more receptive to wastewater treatment than older respondents

[87, 88]. However, there are also previous studies that state that the perception of treated water from waste is not related to the respondent's age [81, 89].

Table 4. Demographic profile of respondents based on gender, age group, and level of education

Demographic Characteristic		N	Distribution %
Gender	Male	6	60
	Female	4	40
Age Group	25-29	1	10
	30-44	5	50
	45-49	3	30
	>50	1	10
Level of Education	Elementary School	0	0
	Junior High School	0	0
	Senior High School	2	20
	Diploma	1	10
	Bachelor	2	20
	Master or Above Graduate Degree	5	50

The level of education attained in this survey is another demographic profile; 20% of respondents have completed high school; 10% have completed their diplomas; 20% have completed their undergraduate degrees; and the remaining 50% have completed their master's degrees. According to earlier research, the decision to accept wastewater treatment is largely influenced by the respondent's education level [89-92].

3.4 Perception of the ablution wastewater treatment

FGD that was conducted at two different mosques in Solo resulted in different opinions among respondents regarding their perceptions of reusing the treated ablution wastewater. The discussion was started by asking the respondents about the source of water used for ablution at the two mosques. It was found that both mosques use water sources from wells that are pumped and stored in water reservoirs for praying activities. Furthermore, it was asked about the need for clean water in each mosque per month; mosque 1 (Imam Bukhari Mosque, UIN Raden Mas Said Surakarta) requires 4500L of water per month, while mosque 2 (Surakarta Great Mosque) requires much more water, about 1.5 million liters per month. This huge amount of water is needed since the second mosque is located in the center of Solo and is used by approximately 7,000 worshipers per month. However, with such a great demand for clean water, there are still no significant obstacles to the procurement of clean water sources, especially for wudu. The only hindrance faced by the mosque 2 administrators is the quality of clean water that does not meet the standards, namely, water that smells of iron.

The next discussion addressed the respondents' knowledge of wastewater treatment and reuse. The question asked was, "Have you ever thought of recycling or reusing the ablution water that has been used?" The answers between mosque 1 and mosque 2 respondents were much different. Respondent 1 has not, because the water is abundant, so there is no more treatment related to the wastewater produced by the mosque. Other respondents in mosque 1 have also not considered treating wastewater and tend to agree with respondent 1. Whereas at mosque 2, most respondents have thought about treating the mosque wastewater.

Respondent 6 said, "I have thought about treating the wastewater that has been used. Our mosque even has a pilot plan for treating wastewater generated by the mosque."

"I once thought of treating the wastewater from the mosque so that the water is suitable to be reused, but I cannot because it is not my expertise." Respondent 7 said.

"I have also had thoughts of reprocessing the mosque's wastewater, especially the water that comes from the foot-washing pool located right at the front of the mosque. The water is often wasted, but at least the water can be reprocessed and reused." Respondent 9 shared.

Respondents' perceptions of wastewater reprocessing demonstrate their awareness of and care for the wastewater produced by the mosques they oversee. After finding out the respondents' experiences and perceptions towards wastewater retreatment, the discussion continued with the respondents' knowledge regarding one of the wastewater treatment methods, namely electrocoagulation. "Have you ever heard of the term electrocoagulation in wastewater treatment?" The answers from all respondents stated that they had never heard of water treatment using the mentioned method. This might be due to the fact that the electrocoagulation method is still not widely used in Indonesia to treat wastewater, which makes the technology less popular there.

The researcher then played a video to introduce the electrocoagulation method as a liquid waste processor that can produce clean and reusable water. After the video had finished playing, the conversation went on to explore each respondent's opinions and replies. "How do you respond as a person if you know that the ablution water is taken from water that has been treated with electrocoagulation, provided that the water has met the requirements to treat the wastewater according to Indonesian Ulema Council (MUI)?". The answers to the question varied among respondents, with some agreeing and others disagreeing. Respondents who gave a positive response to the use of the EC method as a method of treating ablution wastewater were six people, with the reason that if the MUI had declared the water halal and holy, then they would use it. While four other respondents responded negatively to the use of the EC method to treat the ablution wastewater, their statements are as follows:

"I don't think it's necessary to treat the ablution wastewater, it would be better to treat the existing water because the quality of water that comes from wells is poor," respondent 10 said.

"Emmm, I feel that there is still no need to treat the water again; if I know that the water comes from the ablution wastewater, I don't want to use it, but if I don't know, then I will use it." respondent 3 shared.

"I also feel that it is unnecessary to use the treated wastewater for ablution," respondent 4 said.

"Because I have never experienced water scarcity and there is still plenty of water in our mosque, I don't want to use the treated wastewater." respondent 5 commented.

Due to the fact that water scarcity is not the most popular issue discussed in the region, many respondents need to be made aware of the importance of treating wastewater. Rahayu et al. [93] report that groundwater wells in the Solo area have been experiencing a drastic decrease of 1.5-4 m resulting in the area where the wells are labeled as damaged zones. This has forced the networked-water companies to cease their operating wells across the city. Respondents from mosques where water is readily available without the need to purchase water are sometimes hesitant to use the cleaned ablution wastewater. The cleanliness of the water is another factor in respondents' unwillingness to use the treated ablution wastewater. The respondent is aware of and has been informed by the researcher that the water produced during the treatment of the ablution wastewater using the continuous EC method complies with the requirements for clean water set by the Ministry of Health Regulation No. 32 (MENKES, 2017). However, there is no limit set for virus level in the water. The regulation only covers physical, chemical, and microbiological safety limits. As a result, respondents expressed concern regarding the safety of the processed ablution wastewater during the ongoing COVID-19 outbreak. Pinon and Vialette [94] said that the condition of the virus in the water depends on the presence or absence of an increase in temperature, the concentration of bacteriophages in the water, and the presence or absence of the addition of disinfectant substances in the water. In this study, chlorine, a disinfectant, was added to the treated wastewater to disinfect water from all types of bacteria and viruses. However, in this study, no data on virus contamination was obtained from the processed wastewater. For this reason, further research on viruses is needed to observe the safety of the treated ablution wastewater. Analyzing virus contamination in the processed ablution water can be done using a method that is currently widely used, namely quantitative polymerase chain reaction (qPCR) [95].

4. CONCLUSIONS

This research concludes that the ablution wastewater can be treated using the continuous EC method to produce sanitary hygiene water that satisfies the requirements of the Ministry of Health Regulation No. 32/2017 on Water Quality Standard for Sanitary Hygiene Purposes. Referring to the decision of the Indonesian Ulema Council, the researcher informed the respondents that the water quality had fulfilled the required standards and that the treated water can be used legally for ablution. Over half of the respondents agreed to utilize the treated ablution wastewater, while the rest declined to use the water for ablution and other purifying activities. They argue that respondents do not require wastewater treatment at this time since there is still an abundance of clean water and respondents are concerned about the safety of their drinking water contaminated by viruses. For this reason, further research is needed on the safety of the processed ablution wastewater with continuous electrocoagulation in terms of the virus content in the treated water. Determining virus contamination in the processed ablution water can be done using a method that is currently widely used, namely quantitative polymerase chain reaction (qPCR).

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