CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Studies related to water treatment and the filtering process from the perspective of *Fiqh* and scientific perspectives have not been discussed comprehensively until now. Recent studies only discussed scientific aspects of water treatment but still have no serious discussion on the *Fiqh* perspective, especially for membrane water treatment. Therefore, this study aims to identify and evaluate the membrane water treatment and purification process according to *Fiqh's* perspective. Next, this study suggests Muslims for the Shariah compliance membrane's water treatment and purification process model.

Existing studies also focused more on scientific perspective discussions on water treatment methods from sewage plants or reuse of used water by the application of modern scientific methods such as physical processes, biological processes and complex chemical processes but are seen to treat water without Shariah-compliant guidelines and does not convince the Muslim community. Based on the various factors that distinguish between science and *Fiqh* perspectives, such as halal and haram, health development, environmental factors, physical and spiritual development, a balanced lifestyle and so on, this study is made up to identify and determine whether the sewage treatment process that is used today follows the *Fiqh* or not.

The use of science and technology in water treatment is seen as helping to understand the reality of the world better today. Consequently, this study's final objective is to review the water treatment process that is in line with the current Shariah-compliant purification models in Malaysia that will be highlighted. This finding will break the deadlock that has plagued Muslims over the years and, at the same time, contribute to society today and in the future to resolve the more complex *hukm* related to water purification.

2.2 Halal Industries in Malaysia

The Muslims' confusion regarding the use of recycled water is related to the *hukm* of *halal* and *haram* in Islam. Muslims stress the importance of the permissibility of sources to be consumed because they believe these sources will boost the development of human wellness and behaviour development. While, *haram* sources are prohibited in the al-Quran, al-Sunnah and the consensus of the Muslim jurist (ijmac) that leads to sin and impiety to do so (Nurrulhidayah et al., 2011). Thus, *halal* concepts must first be discussed to enlighten the confusion about using recycled water.

According to the Halal Industry Development Corporation (HDC), Malaysia is the world's halal hub pioneer. Its agencies manage things related to halal matters in all aspects. Several halal agencies have been established in halal matters in Malaysia, including:

1. Department of Islamic Development Malaysia (JAKIM)

   JAKIM’s role is to establish Malaysia Halal logo and implement the Halal Certification System. It also covers the issues of Halal certificates for local and export markets, monitoring and enforcement of halal guidelines

2. Halal Industry Development Corporation (HDC)

The role of HDC is to boost the Halal agenda in terms of standards development, branding enhancement, and commercial and industrial development by focusing on the development of Halal standards, audit and certification and also capacity building for Halal products and services.

3. Department of Islamic States

   These agencies help in monitoring to protect the Halal integrity and issue Halal certificates for domestic markets only

4. Ministry of Domestic Trade, Co-operatives and Consumerism (MDTCC)

   MDTCC provides enforcement and monitoring programs to protect Halal integrity, the Halal logo, and consumer interest. MDTCC aimed to encourage ethical trade practices and to protect consumer interest

5. Ministry of Trade and Industry (MITI)

   MITI formulates strategies and provides incentives to encourage trade and investment in Halal products and services. MITI's focus is not only on promoting Halal products and services but takes a holistic view and has worked with the Ministry of Finance to design and provide incentives and support throughout the manufacturing process. MITI assumes an active role in promoting the Malaysian Halal Standard at the international level to be used as a benchmark for the International Halal Standard

6. Malaysia External Trade Development Corporation (MATRADE)

   MATRADE is the national trade promotion agency under MITI. It undertakes various export promotion activities, including promoting the Halal sector and participating in international trade fairs overseas, organising specialised Halal marketing missions to selected markets, undertaking

advertising and promotion of the Halal sector and disseminating information on market opportunities in the Halal industry to Malaysian companies.

7. Malaysia Productivity Corporation (MPC)

   MPC help in identify potentials in the Halal industry and provides training and consultancy to SMEs and industries to meet Halal standards and requirements.

8. Standard and Industrial Research Institute of Malaysia (SIRIM)

   SIRIM focus on discovering and developing new technologies to enable industries to move up the value chain and aims to expand from simply using technology to solve technical problems to discovering technology that will help industries to reinvent their products and business

9. Department of Standard Malaysia

   It is an agency under the ambit of the Ministry of Science, Technology and Innovation (MOSTI). STANDARDS MALAYSIA play an active role in assisting Malaysia to accelerate the Halal industry by developing the Malaysian Standard on Halal Food (MS 1500) also helps industry leaders develop and promote Malaysia's Halal Standards and continually develop and update Malaysia Halal Standards.

10. Economic Planning Unit (EPU)

    EPU helps formulate the Halal Industry Master plan to strengthen its role and function.

11. SME Corporation Malaysia

    SME Corporation Malaysia provides matching grants to SMEs for Halal product development and product formulation, sample testing, acquisition of machinery and equipment, renovation expenditure for compliance with

certification requirements, and other related costs for compliance with the requirements of Halal certification and promotional activities.

12. Department of Chemistry

    Department of Chemistry is the leader in Halal product analysis and traceability. They specialize in meat speciation/Halal DNA functions, research, and product quality assurance.

Numerous agencies related to halal matters in Malaysia have proven that Malaysia is suitable and relevant as a global Halal hub that can be a reference point internationally. According to Samori et al. (2014), Islam has laid down the general guidelines on halal: first, all materials and ingredients must be halal. Secondly, all the permissible animals to be eaten in Islam should be slaughtered according to Islamic rites and ethics of slaughtering, must be performed by a mentally sound Muslim, using a sharp cutting tool and last but not least, thirdly, the halal and non-halal ingredients must not be combined, or come into contact with haram materials such as pig, swine, the dog either during storage, transport, cooking, and serving (Nawai et al., 2007). All these three guidelines must be considered to ensure the *hukm* of halal and haram of consumers products for Muslims.

JAKIM also introduced the Malaysian Halal Certification Procedure Manual (Domestic) 2020, Malaysian Halal Management System 2020 and Malaysian Standard 2019 to strengthen coordination between halal certification and halal products and services in Malaysia. There are several standards issued under the nine schemes for Malaysian Halal Certification as follows (Manual Procedure of Malaysia Halal Certification (Domestic), 2020):

i. Food and Drink Products

Food and drink products and beverages are made or produced for human use.

ii. Food Premises

Food premise means any building or structure, permanent or not, for preparation, serving and selling food, such as a restaurant, cafeteria, bakery shop, food court, fast food restaurant, cake and pastry shop, franchise restaurant, kiosk, canteen, hotel kitchen and other.

iii. Consumable Materials/ Products

Consumable materials mean consumer goods or products excluding food and drink.

iv. Cosmetics Products

Cosmetics means material and preparations for contact with various outer layers of the body (epidermis, hair, nail, lips, and external sexual organ) or on teeth and mucus channels in the mouth. The sole objective is to clean, perfume, change the appearance, improve body odour, and protect or preserve them in good condition. It is also included personal care products.

v. Slaughterhouse

A slaughterhouse is a place or premise for the slaughtering and processing of animals on a commercial basis.

vi. Pharmaceutical Products

Pharmaceutical refers to finished dosage products, including prescribed and non-prescribed medicinal products for human usage (biopharmaceutical, radiopharmaceutical, traditional medicine, dietary supplement and researched medicine) that have been registered with the Drug Control Authority under the Ministry of Health Malaysia.

vii. Logistics Services

Logistic means services for transportation of goods and cargo chain services or warehousing and related activities or retailing related to managing and handling food, beverages and goods.

viii. Medical Devices Products

Medical devices are any healthcare product used to diagnose, prevent, monitor or treat illness or handicap but excluding drugs (Johari & Khairunnisa, 2019).

ix. OEM (Original Equipment Manufacturer)

OEM (Original Equipment Manufacturer) Company OEM Company is the manufacturer which offers manufacturing services to other companies on a contract basis (Manual Procedure for Malaysia Halal Certification (Third Revision, 2014)

These nine schemes have guidelines to be referred to for managing halal matters. The standards are as follows (JAKIM, 2020):

Table 2.1: Halal Standards in Malaysia

Schemes	Main Standards
Food/beverage	MS 1500: 2019 Halal Food- General Requirements (Third Revision)
Food Premise	MS 1500: 2019 Halal Food- General Requirements (Third Revision)
Consumers Goods	MS 2200-2:2013 Islamic Consumer Goods-Part 2: Usage of Animal Bone, Skin and Hair-General Guidelines MS 2565:2014 Halal Packaging-General Guidelines MS 2594:2015 Halal Chemicals For Use In Potable Water Treatment-General Guidelines
Cosmetics and Personal Care	MS 2634: 2019 Halal Cosmetics- General Requirements (First Revision)
Slaughterhouse	MS 1500: 2019 Halal Food- General Requirements (Third Revision) MS 1500:2009 Halal Food-Production, Preparation, Handling and Storage-General Guidelines (Second Revision)

Pharmaceutical Industry	MS 2424: 2019 Halal Pharmaceuticals- General Requirements (First Revision)
Logistics	MS 2400-1: 2019 Halal Supply Chain Management System – Part 1: Transportation- General Requirements (First Revision) MS 2400-2: 2019 Halal Supply Chain Management System – Part 2: Warehousing- General Requirements (First Revision) MS 2400-3: 2019 Halal Supply Chain Management System – Part 3: Retailing- General Requirements (First Revision)
Medical Devices	MS 2636: 2019 Halal Medical Device – General Requirements
OEM (Original Equipment Manufacturer)	-

Source: Manual Procedure of Malaysia Halal Certification (Domestic), 2020

These primary halal standards and guidelines are different following the schemes and also adopt some other regulations and laws that include (Siddique; et al., 2021):

1. Guidelines for Halal Assurance Management System of Malaysia Halal Certification
2. Malaysia Protocol for the Halal Meat and Poultry Production
3. Guidelines for Islamic Cleansing
4. Guidelines for Control of Cosmetic Products in Malaysia
5. Guidelines on Cosmetic Good Manufacturing Practice
6. Pharmaceutical Inspection Cooperation Scheme (PIC/S): Guide to Good Manufacturing Practices for Medicinal Products
7. The procedure of issuance of Islamic slaughtering Authorization by State Islamic Religious Departments
8. Malaysia Food Act 1983
9. Food Regulation 1985
10. Animal Act 1953 (Reviewed 2006)
11. Standards of Malaysia Act 1996 (Act 549)
12. Trade Description Act (Revision 2011)

13. Decisions of the Muzakarah Committee of the National Council for Islamic Religious Affairs of Malaysia (*JK Muzakarah Majlis Kebangsaan Bagi Hal Ehwal Ugama Islam Malaysia*) decreed by the states
14. Other related guidelines and regulations

These standards and guidelines are interrelated to each other to be referred to as there are supported and completed each other. Under the membrane water treatment, the related standards are MS 2594: 2015 Halal Chemical for Use in Potable Water Treatment- General Guidelines and MS 2200-2:2013 Islamic Consumer Goods-Part 2: Usage of Animal Bone, Skin and Hair-General Guidelines. The MS 2594: 2015 specifies requirements for Halal chemicals used in potable water treatment. Processed chemicals used in treating raw water during potable water production fulfil the requirements that align with the Shariah law and the relevant regulations or laws in force in Malaysia (Mohd Imran & Abid, 2016).

MS 2200-2: 2013, which discussed the Islamic Consumer Goods-Part 2: Usage of Animal Bone, Skin and Hair-General Guidelines also related to this research. Both standards specify requirements for halal materials, especially for the filter's material sources and the chemical material used in potable water treatment. Processed chemicals used in treating the raw water during potable water production fulfil the requirements that align with the Shariah law and the relevant regulations or laws enforced in Malaysia. So, this membrane water filter is categorised and monitored under the scheme of consumable materials as the membrane water filter is used to filter the water consumed by consumers.

2.3 The Concept of Water

Water is a blessing God has bestowed on humans and is an essential element in human life (Mohd Mahyeddin, 2016). Water or H2O forms are the basis of all bodily fluids, including blood, spinal fluid, saliva and joint lubricant. Water is a crucial concern for planet earth and its inhabitants as it makes up two-thirds of human body weight, regulates body temperature, maintains health, personal cleanliness and general hygiene and is indispensable in agriculture and industry. Humans would die within a few days without an adequate supply of water. So, Islam takes the issue of water and its conservation very seriously.

There is much evidence in the Qur'an and the hadith that mention the importance of water management and conservation. The Quranic evidence has mentioned water 63 times in the Qur'an (Abdul Baqi, 1987) and almost reached 1% of the Quranic verses (Ahmad Zaharuddin, 2004).

﴿أَوَلَمۡ يَرَ ٱلَّذِينَ كَفَرُوٓاْ أَنَّ ٱلسَّمَٰوَٰتِ وَٱلۡأَرۡضَ كَانَتَا رَتۡقٗا فَفَتَقۡنَٰهُمَاۖ وَجَعَلۡنَا مِنَ ٱلۡمَآءِ كُلَّ شَيۡءٍ حَيٍّۖ أَفَلَا يُؤۡمِنُونَ﴾

Which means, "Do not the Unbelievers see That the heavens and the earth Were joined together (as one Unit of Creation), before We clove them asunder ? We made from water Every living thing. Will they Not then believe?".

(Al-Quran. Al-Anbiya' 21:30)

This *ayat* refers to water as the substance that sustains life and the key agent for purification. Muslims believe that water is a gift from Allah and proof of Allah's existence, greatness and uniqueness. Allah calls on us to contemplate the rain, the

rivers and the salty and sweet water, and He calls on us to recognise water as a sign of His gift. Next, Allah also provides us with the water we need as the following ayat:

﴿ أَمَّنْ خَلَقَ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضَ وَأَنزَلَ لَكُم مِّنَ ٱلسَّمَآءِ مَآءً فَأَنۢبَتْنَا بِهِۦ حَدَآئِقَ ذَاتَ بَهْجَةٍ مَّا كَانَ لَكُمْ أَن تُنۢبِتُوا۟ شَجَرَهَآ ۗ أَءِلَٰهٌ مَّعَ ٱللَّهِ ۚ بَلْ هُمْ قَوْمٌ يَعْدِلُونَ ﴾

Which means, “Or, who has created The heavens and the earth, And who sends you down Rain from the sky ? Yea, with it We cause To grow well-planted orchards Full of beauty and delight : It is not in your power To cause the growth Of the trees in them. (Can there be Another) god besides God ? Nay, they are a people Who swerve from justice”.

(al-Quran. Al-Naml 27:60)

Meanwhile, the hadith of the Prophet Muhammad saw, if referred to in the book of Sahih Bukhari, starts from hadith 541 until hadith 569, discusses water management and amounts to almost 28 *hadith* and are all authentic (sahih) hadith (Ahmad Zaharuddin, 2004). Thus, we can see the importance of water management is highly emphasized in Islam. Water management has long been featured since the time of the Prophet Muhammad saw in 1420 years ago, and this continues and is also a law that has been enforced from ancient until now.

The evidence can be seen in a provision of the first Islamic Civil Law Code in the Turkish Ottoman era, namely *Majallah al-Ahkām al’Adliyyah,* which provides the aspects of rights to water and the ownership and sharing of water reserves (Mokhtar et al., 2015). Islam demands its believers to use water wisely and frugally, so it is also necessary to avoid excessive use in worship. This can be seen from the action the

Prophet Muhammad saw in using water during ablution. Meaning: Prophet Muhammad usually bathed using one *sa'* to five *muds* of water and performed ablution with only one *mud* of water. Even in carrying out religious demands such as performing ablutions and purifying the large and small hadath, Muslims are obliged to save water even when using flowing river water, and they also need to be frugal. In addition, the King of Sri Lanka in the 12th century, the Parakrama Bahu the Great, also established a superior level of water management by holding to the principle (De Casparis, 1975):

'Don't let even a drop of rainwater flow into the sea without benefiting human beings.'

This principle means that humans can make the best use of water resources without being wasted. Water is an element that is included in one of the earth's natural ecosystems, namely the hydrosphere. The hydrosphere is one of the most critical environmental components of the earth's natural ecosystem apart from the atmosphere, lithosphere and biosphere (Meerangani, 2018). These four major components of the environment need to be cared for and given attention by human beings and always be at a point of equilibrium. If not balanced, the welfare of beings on earth will be affected by various natural disasters. The hydrosphere is a natural component involving water elements on the earth's surface, air, and soil. About 97% of the earth's water resources are seawater and cannot be used for domestic purposes, and only 3% of water resources can be used for domestic purposes consisting of ice, groundwater, river water and well water. This water source is used for agricultural, industrial, commercial, and public

use (Yosfadri & Hashim, 2019). There is a variety of use for water, as mentioned in the Al-Quran:

﴿ وَأَنزَلۡنَا مِنَ ٱلسَّمَآءِ مَآءَۢ بِقَدَرٖ فَأَسۡكَنَّٰهُ فِي ٱلۡأَرۡضِۖ وَإِنَّا عَلَىٰ ذَهَابِۭ بِهِۦ لَقَٰدِرُونَ ﴾

Which means, "**A**nd We send down water From the sky according to (Due) measure, and We cause it To soak in the soil ; And We certainly are able To drain it off (with ease)".

(Al-Quran. Al-Mu'minun. 23:18)

This water source has many uses and importance in human life, so it is recorded about water use in the Quran.

Table 2.2: The Use of Water in the Perspective of the Quran

Uses of Water	Surah
Human and animal drinks Fertilizing the Plants	Al-Nahl (16:10) Al-Wāqi'ah (56: 17-21)
Physical and Spiritual Cleansing Agent (use for Islamic remedy and religious purposes)	Al-Muddathir (74: 4) Al-Anfāl (9:11)
Fertilizing nature, greening the landscape and balancing the ecosystem	Al-Nahl (16:65) Al-Rum (30:24) Al-Hajj (22:63)
Sources of livelihood through economic activities (agriculture, plantations and fisheries)	Al-Baqarah (2:22) Al-Jāthiyah (45:12) Al-Mā'idah (5:96)
International and local communication medium	Al-Luqmān (31:31)
Development of science	Al-Mulk (67:30)

Source: Mokhtar et al. (2015)

The Quranic verses prove that water resource is vital and will affect human life if not appropriately managed. Proper and effective water management is critical because it will affect water quality. As water is essential, humans recognize water by celebrating world water day every 22nd March every year since 1993 to appreciate and

raise awareness that 2.2 billion people are living without access to safe water and how action is being taken to tackle the global water crisis. This is to support the achievement of Sustainable Development Goal 6: Water and Sanitation for all by 2030 (United Nations, 2021).

Table 2.3: The Theme for Word Water Day

Years	Theme
2015	Water & Sustainable Development (Air & Pembangunan Mapan)
2016	Water & Jobs (Air & Pekerjaan)
2017	Wastewater (Air Sisa)
2018	Nature-Based Solution For Water (Penyelesaian Berasaskan Semulajadi Untuk Air)
2019	Leaving No One Behind
2020	Water and Climate Change
2021	Valuing Water
2022	Groundwater - Making The Invisible Visible

Source: Researcher (2022)

Source: https://www.worldwaterday.org/

Figure 2.1: The Occasion of World Water Day on 22 March Every Year

Water is the most important source and foundation of life's growth. The considerable role of water in this world is undeniable. According to the United States Geological Survey (USGS) (2010), the earth's total water content is almost 326 million

cubic meters. Theoretically, as much as 72% of the earth's surface is covered by water, but 97% of the water is saltwater and is not suitable for conservation. 70% of the drinkable water is ice-like, while less than 1% of the world's drinking water can be utilized directly.

The excess of water resources is not a problem for the world's population, but what becomes a problem is when several countries in the world are having trouble getting clean water sources that the population can use. Therefore, the best and most effective method for water conservation must be implemented in managing water resources because water is an important element that can maintain the quality of human life to always be in harmony and comfort. One of the initiatives in managing and conserving water resources is through water treatment and reuse, is a necessity today (Konda Reddy et al., 2017). Consequently, there has been an idea of reusing water by applying the purification method, termed *Fiqh* as *tathīr al-mā'*. However, this purification water method raises doubts among Muslims as this method applies treated water or sewage water, purified as a clean and pure water substance in the *zahir* view.

2.4 Water Treatment & Purification Process History

Water is an essential spiritual and physical element in daily human life and, by its innate nature, is cold and moist, which can reduce heat and clean the body. Humans have made many efforts to pursue and maintain the cleanliness and freshness of water to be consumed. Purifying water is not a new method for obtaining clean water sources; it has been done since ancient times and will continue until the end of time. Islam also required Muslims to use clean and pure water for religious purposes. So, when the water is contaminated with *najāsah* (*mutanajjis* water), *fuqahā'* almost agreed that *mutanajjis* water could become pure when having the purification process.

The methods of water purification from *Fiqh* perspective can be simplified as as below:

Table 2.4: The Purification of *Mutanajjis* Water in *Fiqh*

Madhhab	**Methods**	**Quantity (2 *qullah*)**
Hanafi	*Ṭarīqah Mukatsarah* Addition of *muṭlaq* water *Ṭarīqah Nazh* Removal of *najāsah* and disposal of water	not required
Maliki	*Ṭarīqah Mukatsarah* Addition of *muṭlaq* water *Ṭarīqah Nazh* Removal of *najāsah* and disposal of water Addition of substances that can eliminate *najāsah*	not required
Syafie	*Ṭarīqah Mukatsarah* Addition of *muṭlaq* water *Ṭarīqah Nazh* Removal of *najāsah* and disposal of water *Taghyīr* Natural change	required
Hanbali	*Ṭarīqah Mukatsarah* Addition of *muṭlaq* water or mutanajjis water *Ṭarīqah Nazh* Removal of *najāsah* and disposal of water *Taghyīr* Natural change	required

Source: adapted from (Salleh et al., 2021)

While the purification of water from a scientific perspective also started with the variety of methods suggested to produce clean water. In a book published in 1948 by the American Water Works Association titled *"The Quest for Pure Water: The History of Water Purification from the Earliest Records to the Twentieth Century"*, the authors speculate that the pursuit of purifying drinking water begins in prehistoric times.

However, the earliest documentation on water treatment methods has been found in Sanskrit and an inscription in ancient Egyptian tombs. Many water treatment methods are mentioned in Sanskrit medical books known as Sus'ruta Samhita, which began in about 2000 BC (M. N. Baker & Michael, 1948). The methods mentioned were boiling water, water heating under the sun, dipping the heated iron into water, filtration through gravel and sand, Nirmali seed (Potatorum Strychnos) and a stone called Gomedaka. While on the walls of the tombs of Egyptian kings such as Amenophis II and Rameses II, who reigned in the 15th and 13th centuries, it was said that carvings or apparatus pictures were used for water purification (M. N. Baker & Michael, 1948).

Subsequently, in the 9th and 8th centuries, the development of water purification methods with the creation of more systematic technologies by the Romans and Greeks, such as Hippocrates, Diophanes and Paxamus and also the leading Islamic chemist in the 8th century, Jabir Ibn Hayyan or better known as Geber in the western world that suggested the use of the siphons axis as a method of purification of water. Exploring the progress of civilization, a more modern method in this water purification process was officially inaugurated in 1804 when Paisley town in Scotland introduced the world's first water purification plant. The plant uses gravel and concentric sand filter to treat water, and then the treated water is distributed to residents using horses and strollers.

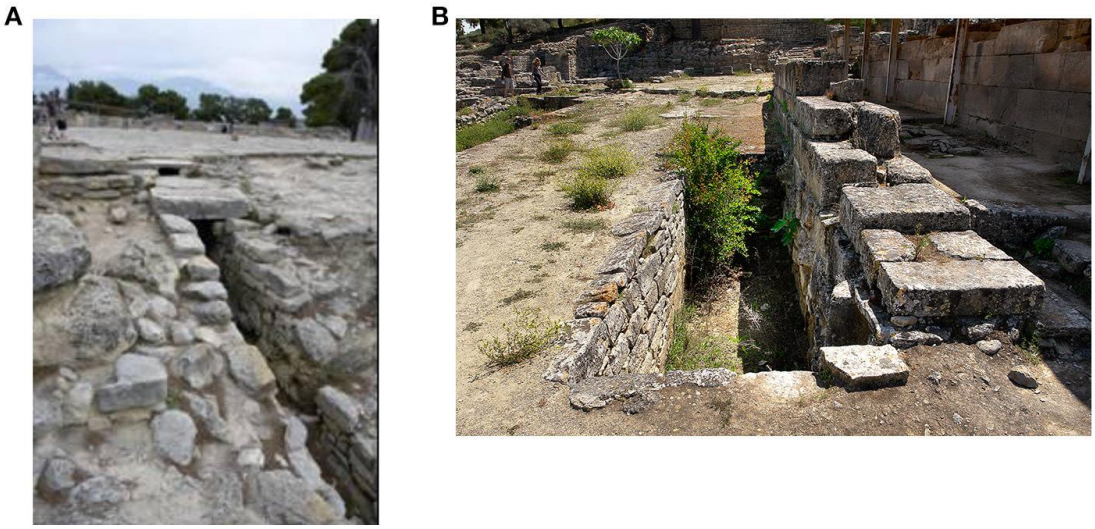
Water technology was developed years ago and has continually evolved for many purposes, including potable reuse. In addition, water reuse started more than 200,000 years ago during prehistoric times and until today's modern century. The evolution of water reuse technology can be explained below:

2.4.1 Prehistoric Time (ca. 3200 – 1000 BC)

Homo sapiens (modern human) was the human that lived on this earth, and they survived as hunter-gatherer (Vuorinen et al., 2007). The first human communities were scattered over the wide area on earth, and waste was decomposed using natural cycles by land (Lofrano & Brown, 2010). Early communities' nomadic lifestyle caused limited disposal problems because they moved when existing conditions became unlivable (Angelakis et al., 2018).

2.4.2 Historical Time (ca. 1000 BC – 330 AD)

The human communities during this period were the established permanent settlements, and the disposal of human excreta was managed either on the ground surface or in holes dug in the ground covered after use. Next, the evolution of collection systems for both wastewater and also stormwater. The first indication of the utilization of wastewater for irrigation and fertilization of agricultural land was in Bronze Age civilizations when humans developed advanced sewerage systems to dispose of wastewater to rivers, sea and agricultural land for irrigation and fertilization purposes (Angelakis et al., 2018).

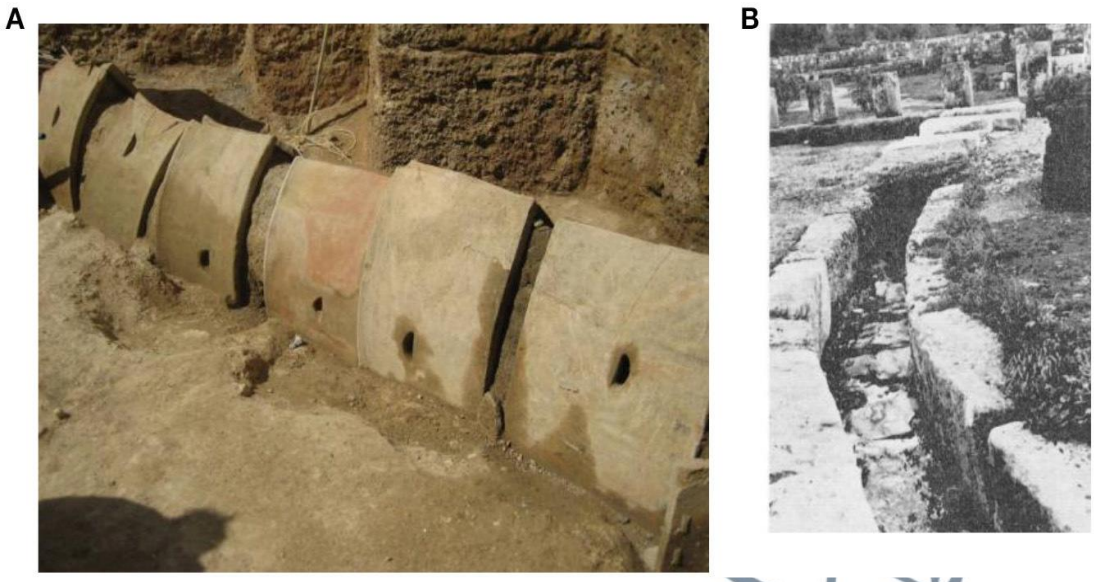


(A): Water and Wastewater Conveyance Facilities to Transport Water to Farmland
(B): Water Storage for Land Application Purposes

Source: Angelakis et al. (2018)

Figure 2.2: The Facilities of Wastewater Management in Ancient Times

Next, the advanced sewerage and drainage system that every house was connected to the main sewer to ensure proper waste removal. The inspection holes were provided to ensure the system functioned and was appropriately maintained. The wastewater collection systems evolved as the permanent settlements developed based on the observation of flowing water. The first wastewater collection facilities were open channels, then evolved into channels covered with flat stones and closed conduits or tubes.



Source: Angelakis et al. (2018)

Figure 2.3: Sewers and Drains Used to Collect and Convey Wastewater to Central Sewer

2.4.3 Early and Mid-modern Times (ca. 1400 – 1900 AD)

This period shows that sanitation practices emerged as the great epidemics in several world regions, which led to the development of effluent disposal and reuse practices. Engineered land application systems evolved, and faeces and urine separation were practised. Next, intensive treatment methods were used before discharging the treated effluent to land and freshwater bodies by using various methods like large septic tanks, contact beds, trickling filters, and intermittent sand filters (Angelakis et al., 2018).

2.4.4 Contemporary Times (1900 AD – present)

The advent of the twentieth century brought developed technological and scientific innovations in implementing wastewater treatment plants. During these centuries, water has been reused for various areas when the water has been appropriately treated and improved effluent water quality beyond agricultural and

landscape irrigation to recreational and environmental use, industrial reuse, groundwater recharge and potable reuse (Angelakis et al., 2018).

Various water treatment methods and the process has developed nowadays, like screening, filtration, microfiltration, ultrafiltration, crystallization, sedimentation, gravity separation, flotation, precipitation, coagulation, oxidation, solvent extraction, evaporation, distillation, reverse osmosis, ion exchange, electro dialysis, electrolysis, adsorption, setting-out, centrifugal and membrane separation, fluidization, neutralization and remineralization, reduction and oxidation and so on (Imran Ali, 2012). These water treatment methods can be combined depending on the types of contaminated water and prospective purposes (Stackelberg et al., 2004).

2.5 Previous Study on Water Treatment & Purification

For the general public, when called "treated water", it is automatically in the image of their mind the sewage water contained in the sewage tank behind the house is processed into clean water. The dogma of this kind of thinking is a limiting factor in our society because of their limited scope of thought and resistance to exploring knowledge. But in fact, the understanding of treated water is more broadly defined, and the debate about it is still open to the public, arguing and throwing ideas. Hence, this study is a critical element that will open the door to the discussion on "water purification" from the perspective of *Fiqh* and science. It will also clear the confusion and respond to the community's concerns about the *hukm* and its problems.

Looking at the writings and studies done by previous scholars, the researcher found that most of the resulting results were more likely to be scientific studies that discussed chemistry methods and water physics laws which were adapted to the study's title to allow contaminated water to be treated and recycled into clean water to be

conserved by life in the world. In other words, all the methods created by these scholars allow contaminated water to be treated in any way, even to eliminate the substances in the water. For example, the paper entitled "Solar Photocatalytic Process for The Purification of Water: State of Development and Barriers to Commercialization", published by Elsevier in 1996, explained that over two decades of research is to illustrate the best method of commercialization in treating contaminated water using the 'Photocatalytic' process (light as a catalyst). This study aims to make the sun a source of light that will contribute to the smooth running of this water treatment process.

Many other studies have been regarding the reused water process. A study on "Solar Photocatalytic Process for The Purification of Water: State of Development and Barriers to Commercialization" (1996) explains the best method of commercialization in treating contaminated water using the 'Photocatalytic' process (light as a catalyst) and the other study is about the introduction of treated clean water (Wastewater and Water Treatment). Next, "Sewage Treatment in Hot Climates" by Duncan (1994) reviews the process and implementation used to treat wastewater and clean water.

While in other writing, for example, in an article published by the United States Environmental Protection Agency (EPA) titled "Wastewater and Water Treatment", this article deals with more general types of water. Explanation of the types of water divided into three, namely drinking water, distilled water and purified water, can provide an overview for any readers on the introduction of treated clean water. This article also briefly discusses the types of water purification processes commonly used by industries, such as distillation, deionization, reverse osmosis, and carbon filtration. Consequently, this article can help the researcher get a clear picture of the general introduction of water types and the water treatment methods that are commonly used.

Researchers also refer to the book written by (Duncan, 1994), published by John Wiley & Sons. Ltd with the title "Sewage Treatment in Hot Climates", in which the author describes the process and implementation used in treating wastewater and clean water through 14 illustrated topics in this book. It also reveals the standard methods used by hot climate states in water treatment and thus provides an introduction to wastewater and how to treat it. Chapter 2 in this book also describes the basic types of microbiology commonly found in contaminated and treated water and the importance of these microbes. This book can help us understand the water treatment method.

In addition, in the Science and Technology Encyclopedia, the book Chemistry 5th Volume, published by Dewan Bahasa & Pustaka, defined water from a chemist's perspective and explained that the cause of the water odour is due to refractory organic compounds such as aromatic hydrocarbon compounds and halogenated hydrocarbons; both compounds are organic compounds that are not easy to undergo degradation or decomposition process.

Based on the previous studies, it can be concluded that most writers who tend to the science field maintain the status quo opinion, which is the usual water purification method, without regard to its validity for Muslims. There is no detailed study of whether the specific method used for water purification today follows the *Fiqh* method or not and no study on how far the purification method meets the reality of the Muslim community.

However, several past studies in Islamic or scientific perspectives relating to water, such as by Md Yunus & Abdul Manan (2004), regarding the status of using NEWater as drinking water and for domestic use. The treated water can be used for ritual purposes such as *gḥūṣl* and *wuḍū',* ānḍ the study pointed out that *hukm* of using

NEWater is *ḥārūṣ* because this water is pure and can be purified (*muṭlaq* water). Another study on water treatment from ablution usage is to be treated and reused for domestic use after the treatment process (Misbahul Muneer et al., 2014). The *Thurath Fiqh* book also served about the water and focuses on water treatment and purification from the *Fiqh* perspective in *Mawsu'ah Ahkām Ṭahārat Al-Najāsah 'Ayanuha wa Bayān Kayfiyyah Tathīruha wa Al-Ṭahārah Minha*, by Umar Dibyan (2005).

This study attempts to see the 'symbiosis' between these two branches of knowledge (science and *Fiqh*) and tries to translate the researcher by specifying the methods discussed by previous and today scholars of *Fiqh* . Among the *Fiqh* books that can be used as references to this issue are the book *Mausū'ah Ahkām Ṭahārat Al-Najāsah 'Ayanuha wa Bayān Kayfiyyah Tathīriha wa Al-Ṭahārah Minha* by Umar Dibyan (2005). The author describes the *Fiqh*i method of how the water contained in the *najāsah* can be cleaned. The author states that if the water containing *najāsah* is to be purified, it can be used by adding the soil to it and through several other processes. Making the dirty water 'halal' used also requires its method. If water is rated less than two *qullah*, it can purify by adding more water until it reaches or exceeds the rate of two *qullah*. This method is also mentioned in the book *Al-Muhadhdhab* by Al-Shiraziyy (1996). The same view is also quoted in *Al-Mu'tamad fi al-Fiqh Al-Syafi'iyy* by Al-Zuhailiyy (2013) in the *ṭahārah* chapter. This method is known as *mu'alajah* method.

The Fiqh books discussed the hukm of used treatment water and how the used water to be purified in the *Fiqh Ibādah* focused on *ṭahārah najāsah's* title. *Ṭahārah* is a concept of purity, sanitation or hygiene that is clean from the *najāsah ḥaqīqiyy*, is impurity (*khabath*) or *najāsah ḥukmiyy* (*hadath*) (Wahbah, 1985a). *Ṭahārah ḥaqīqiyy* purifies the body, clothes and the environment from impurities or *najāsah* that can be

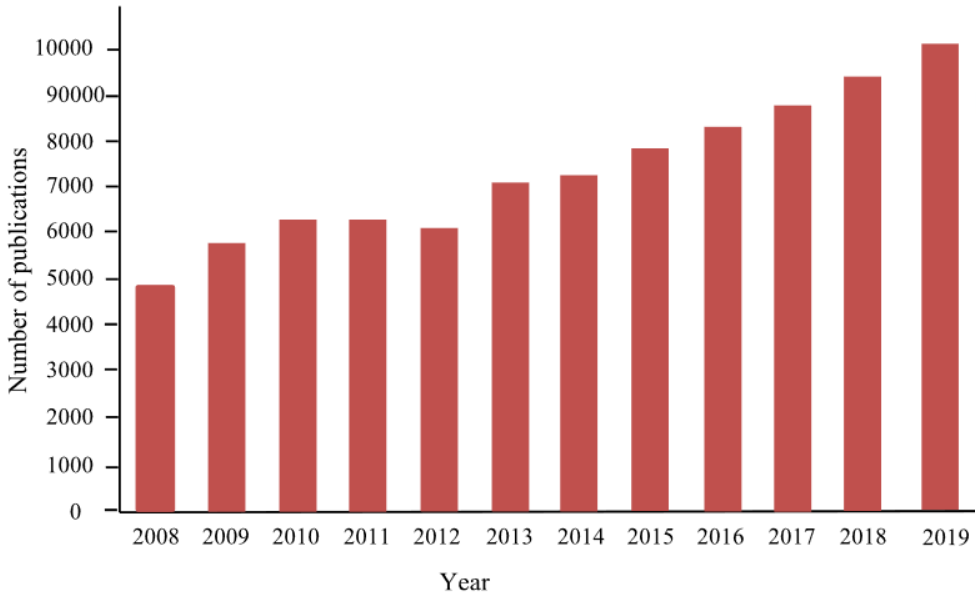
seen, like urine, stool, blood and wine. *Ṭahārah ḥukmiyy* is purified from the uncleanliness that cannot be seen, like breaking of ablution (*wuḍū'*) or ghusl (bath). The *Fiqh*i methods related to this water treatment is *maṣālih mursalah* and *ḍarūrah* (Al-Zuhailiyy, 1985).

Next, the fatwa issued by the website of the Islamic Affairs and Waqf Affairs Department of the United Arab Emirates (UAE) mentioned in fatwa number 1191, dated 18th June 2008, that the water of the *mutanajjis* becomes purified with the abundant water poured upon it until its the impurities has disappeared. If the water is in substantial amounts, but there are a few *najis* in it, so it does not change the condition of the water, then it remains pure (General Authority of Islamic Affairs & Endowment, 2008). This statement is seen as more public and, like most of the opinions of the other school scholars.

Then, in a forum, Naifal Juraydan explicitly mentioned the views of the four major schools about water and their understanding of it and also explained in depth the type of water in the *madhhab* of Syafie, which is divided into four parts; the first is pure and purified water (*muṭlaq* water). Secondly, pure water can be used only in an emergency or due to lack of water because if the water is too hot (*musyammas*) or too cold, or the water is found in the area where Lut and Tsamud are punished. The third is the *mustaᶜmal* water and the fourth is the water of the *mutanajjis*. This division of water is explained by its definition in detail by referring to the books such as *Kitab Badā'i as-Ṣanā'i*'(Al-Kasāniyy, 1998), *Al-Muhadhdhab* (Al-Shiraziyy, 1996) and *Al-Majmū'* (Al-Nawāwiyy, 2009). The writer also explains the stages of wastewater treatment, which is synchronized with the Fiqh method and encloses the fatwa issued by the Council of the Great Kingdom of Saudi Arabia, which requires chemical wastewater treatment.

The fatwa issued by the Council of Muslim Constitution of the Muslim World following the 1398H shariah in the city of Taif in the 13th Council of the Senior Council of the year also mentioned the necessity of using the treated wastewater because it has removed the *najis* inside it after undergoing purification processes and then removes the smell, colour and taste of the faeces (Scholars, 1978). The fatwa was issued after a careful study by scientists and scholars to solve the problem of lack of clean water in several countries due to excessive pollution and other factors. If examined more closely, it can be seen here the study of these two branches of knowledge moves together but correlates with each other.

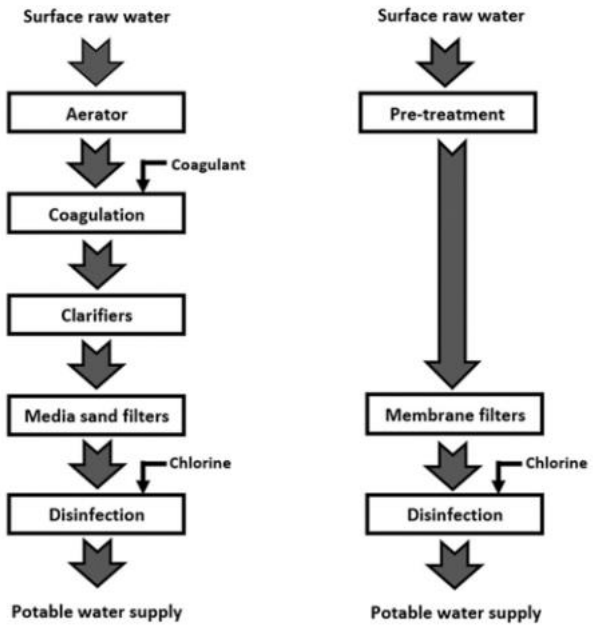
So, one of the recent water treatment and purification technologies is membrane technology. When focusing on the use of membrane technology as the recent technology for water treatment, many researchers acknowledge the advantages and effectiveness of using this technology (Zirehpour & Ahmad, 2016). The literature about this membrane technology increased over the years showing that this technology is adaptable and being developed over time.



Source: (Issaoui et al., 2022a)

Figure 2.4: Publication Numbers of The Membrane Literature Among The Researcher Between 2008 and 2019

The idea of membrane dates back to 1748, when J Abbe Nollet, a French Cleric, first discovered the phenomenon of osmosis, a well-observed natural process of transporting water in plants from roots to leaves (Nath et al., 2022). A membrane is a thin semi-permeable barrier which separates two phases and restricts the transport of various chemicals in a selective manner (Nath et al., 2022). A membrane is defined as a permselective barrier between two homogeneous phases. For many processes in wastewater treatment, the membrane rejects the pollutants, which may be suspended or dissolved, and allows the "purified" water through it (Zirehpour & Ahmad, 2016). Next, Othman et al., (2022) compared the function and effectiveness of conventional and membrane-based water treatment systems that shorten the phases of the treatment.



(Source: Othman et al., 2022)

Figure 2.5: Comparison Between Conventional And Membrane Water Treatment Systems

It is also mentioned that the water is divided into four raw water sources: groundwater, surface water, seawater and rainwater, which can be used for drinking and potable water supply. All these water sources might contain various pollutants, and suitable treatment is needed to remove disease-causing agents in water. For example, groundwater commonly had minimal suspended solids, organics matters, and other potential foulants compared to surface water. Therefore, most of the membrane system configurations can be utilized for groundwater. While surface water typically has higher suspended solids, dissolved organics, and microorganisms that require further treatment and filtration. Seawater might contain high salinity, where the total dissolved solids (TDS) is around 35,000 ppm, and it is vital to treat seawater and convert it into potable quality water. Rainwater is considered a high-quality water source, but it might

be acidic due to air contamination. It could be exposed to zinc due to the rainwater collection system commonly collected through zinc roofing (Othman et al., 2022).

Two compounds exist in water which is organic and inorganic compound. Natural Organic Matter (NOM) is a complex material discovered in groundwater and surface waters. While it is not toxic, the presence of NOM can decrease the quality of the potable water by modifying its colour, odour and taste. Inorganic compounds such as heavy metals and pollutants such as iron, mercury, arsenic, chromium, copper and lead might be present in the water source due to industrialization and urbanization (Othman et al., 2022). Also, there are advantages and disadvantages of membrane technologies for water treatment, and it suggests using pre-treatment and post-treatment for the membrane process to reduce membrane fouling.

The membrane process has been widely used in many fields, such as in the manufacturing industry, and it is considered to be one of the most cost-effective water treatments available and saves water resources because of the good treatment effect, it can be recycled and used to produce considerable economic, social and environmental benefits, especially in wastewater treatment (Issaoui et al., 2022a). The function of this membrane technology in the water industry is to improve the water quality for use, reuse or discharge to the environment, especially for wastewater treatment (Issaoui et al., 2022a).There are four types of membranes, namely ultrafiltration, microfiltration, reverse osmosis and nanofiltration (Issaoui et al., 2022b). All these types are allowed different solutions and porousness to their layer or membrane surface.

Various applications and utilization of membrane technology can be seen from the various usage in industries such as food industries (like fish, dairy, meat, vegetables and beverage processing industries which produced wastewater commonly containing high organic loads), pulp and paper industries, textile industry, laundry

industries, landfill leachate and so on (Zirehpour & Ahmad, 2016). All these industries produce chemical waste that flows through wastewater to the environment. Types of membranes are used to filter different solutions. For example, an ultrafiltration (UF) membrane is applied to remove suspended solids and microorganisms from the brackish water (Nath et al., 2022). Reverse Osmosis (RO) systems have become ubiquitous in many applications, including households, hospitals, refineries, power plants, pulp and paper industries, semiconductor manufacturing facilities, manned spacecraft, etc. RO is used as a concentration step at various stages of processing in the dairy, food, pharmaceuticals and galvanic industries and could effectively remove most salts to the desired extent (Nath et al., 2022).

Nanofiltration (NF) finds its application in removing dyes, salts, and dye intermediates from wastewater generated by textile, leather, pulp and paper industries. It is also used in the recovery of bleaching solutions, separation of heavy metals from acid solutions, antibiotics from pharmaceutical waste, removal of natural organic matter, degreasing agents, phosphate, sulphate nitrate and fluoride from a large number of wastewater streams. NF finds its application in removing dyes, salts, and dye intermediates from wastewater generated by textile, leather, pulp and paper industries. It is also used in the recovery of bleaching solutions, separation of heavy metals from acid solutions, antibiotics from pharmaceutical waste, removal of natural organic matter, degreasing agents, phosphate, sulphate nitrate and fluoride from a large number of wastewater streams. The application includes cell harvesting from the fermentation broth, fractionation of milk proteins, production of high-value whey protein concentrates as well as whey protein isolate, the concentration of vegetable and plant proteins such as soy, canola and oat, corn syrup clarification, clarification of fruit juice and so on (Nath et al., 2022).

Recent trends of membrane application in wastewater treatment processes indicate that instead of using one stand-alone membrane unit, a combination of two or more membrane processes or even the integration of a membrane and non-membrane process proves more effective in achieving the objectives of wastewater reclamation. UF and MF are gradually becoming suitable candidates for process intensification in the integrated pre-treatment of water and wastewater. A combination of coagulation/UF can also be considered for surface waters containing relatively high levels of organics. UF can act as a pre-treatment of RO unit to produce ultrapure water (Nath et al., 2022).

Issaoui et al., (2022) discussed the view of membrane technology in wastewater treatment and also the challenges and issues that come out from this application which are membrane fouling, low permeability and short lifetime, developing the separation between solutes, insufficient rejection of pollutants and the need for new and improved modelling and simulation tools. All these issues lead to an increase the operating and energy cost. The suggestion and future prospect to increase the effectiveness of membrane technology also highlighted; the development of new membrane materials and processes, focusing on sustainability and circular economy concepts in suggesting environmentally friendly chemical agents for cleaning the membranes.

Reusing or recycling ablution water can also be a strategy for water conservation, especially for Muslims, as ablution is a compulsory part of Islam. Many researchers have studied the use of reusing ablution water for various purposes. For example (al-Mamun et al., 2013) found that used ablution water is not polluted much and can be easily recycled and reused for general cleaning and landscape works after sand filtration. This is what he suggested for IIUM Masjid to reuse potential ablution

water to conserve the water. While Rahman et al., (2016) mention that A Muslim approximately utilizes 25 litres of water for five daily prayers and suggested to reuse ablution water for ablution purposes instead of for plant irrigation and toilet flushing by using conventional water treatment focusing on ultraviolet light to disinfect microorganisms. This sustainable device, called ReWudhuk, is purposely designed to treat *musta'mal* water from ablution to use in the mosque.

While Suratkon et al., (2014) suggested Smartwudhu' for recycling the ablution water. This model also uses conventional water treatment systems focusing on chlorination, filtration unit, and sedimentation. Though, most past studies on recycling ablution water suggest that conventional water treatment for treating ablution can be reused for various purposes.