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Research article

Investigation of microplastics in community well water in Banda Aceh, Indonesia: a separation technique using polyethersulfone-poloxamer membrane

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Abstract: Microplastics (MPs) pose a substantial challenge to the environment and have life-threatening implications for organisms, including humans. To overcome this challenge, several investigations have been conducted, including adsorption with a specific absorbent, manual and modified sand filtration columns, and ultrafiltration using polymers. However, microplastic removal using these methods remains limited in certain cases; hence, an optimal method is required to separate MPs from water. The aim of this study was to remove MPs from community water wells in Banda Aceh, Indonesia, using a polyether sulfone (PES) membrane modified with poloxamer surfactants and patchouli oil. Membranes were created using the phase inversion method to form an asymmetrical structure with a top-to-bottom pore distribution. Community well water samples were collected from numerous points in Banda Aceh City. This was followed by analysis before and after filtration using a microscope and FTIR spectroscopy to determine the shape and type of MPs. The results revealed fiber- and film-shaped MPs detected in the well water of each community examined in this study. The FTIR analysis demonstrated that MP contamination was dominated by polyethylene and polypropylene plastics, consistent with the trend observed across Asia. Nonetheless, MP contamination could be eliminated by an ultrafiltration process using a membrane. In this study, the removal of MPs using the membrane delivered significant results. Pure PES membranes can eliminate up to 87.5% of MPs from water samples. However, the PES membrane containing poloxamer and patchouli oil delivered 100% rejection.

Keywords: water treatment; microplastics; particle rejection; membrane separation

1. Introduction

One of the most invaluable and vital resources in human life is the availability of clean water of adequate quantity and quality. Consequently, water scarcity has become a pressing global concern. This scarcity of clean water is worsened by the sub-standard quality of raw water due to plastic waste pollution resulting from human activities. Currently, a significant challenge to the global community is the decreasing quality of raw water due to microplastics (MPs) pollution. The issue of MPs has gained considerable attention, considering the crucial role of water in sustaining life and the impact of MPs on the environment. MPs are particles of synthetic polymers with a diameter of less than 5 mm, granular, film, fragment, and foam-shaped, and resistant to biodegradation processes. Certain plastic materials commonly found in waste that can contaminate water bodies include polypropylene, polyethylene, polystyrene, polyvinyl chloride, polycarbonate, polyamide, polyester, and polyethylene terephthalate [1–3].

MPs can be found in water through fragmentation processes, as by-products of the plastic processing industry, and in wastewater discharged into the environment [4,5]. Generally, MPs are classified according to their morphological characteristics, such as size, which significantly affect their survival. MPs can release chemicals rapidly, especially when their surface area is large, as is the case for smaller particles. With decreased particle size, MPs can likely accumulate in humans, potentially causing health problems, such as inflammation, a damaged immune system, toxicity, hormonal imbalance, increased risk of heart disease and infertility, and obesity [6]. Chemicals that are toxic to the environment, such as persistent, bioaccumulative, and toxic substances (PBTs) and persistent organic pollutants (POPs), have the potential to be absorbed by plastics with a substantial impact. Moreover, the health risks associated with MPs depend on the ingested amount and duration in the gut. Recent studies have confirmed that MPs can penetrate the body and cause hormonal imbalance, infertility, obesity, and an increased risk of heart disease [7].

In the past five years, various countries have reported the use of MP-contaminated raw water sources. The results indicate that the distribution of MPs includes contaminated surface water, groundwater, and raw water treated to provide clean water [8–11]. A thorough investigation of MP-contaminated raw water sources was performed by Li and co-workers [12] in China. The authors analyzed 79 sewage sludge flow points from 28 sources of industrial waste treatment plants in 28 provinces. The results confirmed that all sludge samples contained MPs with an average concentration of $22.7 \pm 12.1 \times 10^3$ particles per kg of dry sludge [12]. The results revealed that the MP content in the sludge from industrial effluent treatment significantly contributed to groundwater pollution. Similarly, Fuller and Gautam [13] reported that MP content in the soil of industrial areas in Sydney ranged from 300 to 67,500 mg kg^{-1} [13]. The results of other groundwater pollution studies in China confirmed an average of 317 particles per 500 g (dry weight) of mud.

The issue of limited access to clean water is also a significant challenge throughout Indonesia, including in Banda Aceh City on the western edge of Sumatra. Notwithstanding the efforts of the state company PDAM, clean water production has failed to meet Banda Aceh's increasing demand. Accordingly, several urban communities depend on shallow dug-through water to meet their daily water requirements, such as washing, bathing, cooking, and drinking. The direct use of well water that has not experienced treatment processes poses a considerable risk to human health because of the inability to meet clean water quality standards in terms of physical, chemical, and biological properties [14].

Currently, there are indications of water stream pollution caused by plastic waste in the coastal waters of Banda Aceh and Aceh Besar [15,16]. Over time, the accretion and deterioration of plastic waste can generate microplastic pollutants that contaminate groundwater, posing health hazards to humans and other living organisms. Given that numerous Banda Aceh residents continue to rely on well water for their household's clean water needs, it is imperative to assess the suitability of well water, particularly regarding contamination by microplastic particles. Therefore, this study aimed to investigate the distribution of MPs in shallow groundwater within the area surrounding Banda Aceh, particularly focusing on communities using well water for washing, bathing, and cooking. Moreover, this study devised a membrane-based method for separating microplastic particles from well water samples.

The MP removal process was performed using several methods, including manual filtration, which produced suboptimal results [17]. Conventional methods such as adsorption have low selectivity for microplastics, whereas coagulation, flocculation, and sedimentation generally use high concentrations of chemicals to achieve the best performance, which can have adverse health effects. Bioremediation is also commonly used to remove MPs in water; however, this process is time-consuming and has low removal efficiency [18]. Furthermore, the filtration process involves using filter paper with pores between 20 and 25 μm, allowing the filtration of MPs of sizes up to several dozen microns. However, such large pore sizes are ineffective for capturing MPs in the range of a few microns or nanometers. Although micro (0.1–1 μm), ultra (2–100 nm), and nanofiltration (~2 nm) methods have promising applications for filtering micro- and nanoplastics, they also have certain limitations. These include slow filtration and pore blockage due to small pore sizes, the need for high pressure during filtration, which increases the cost and energy consumption, and regeneration requiring high-pressure recoil technology, which consequently complicates the recovery process [19].

Membrane technology has been introduced as a promising alternative for water treatment [20], wastewater treatment [21], and removal of microplastics from water samples owing to its high removal efficiency, simple operation, continuous separation, simultaneous separation of MPs from water, and adjustable membrane properties [22]. Pizzichetti et al. reported that using commercial membranes, such as polycarbonate (PC), cellulose acetate (CA), and polytetrafluoroethylene (PTFE), can effectively remove MPs, but particles in the range of 20–300 μm pass through membrane pores and accumulate inside the permeate tank [23,24]. In addition, membrane separation is commonly used in water treatment processes to minimize the presence of micropollutants because of its low energy consumption; however, energy consumption is strongly influenced by impurities, flow rate, pressure, and impurity concentration. Therefore, adjustments are needed to modify the characteristics and properties of the membrane by adding hydrophilic additives [25] to achieve efficient MP removal by membranes [1]. In this study, a polymeric blend membrane was proposed as a separation technique for MPs from water samples. Four types of modified polyethersulfone membranes with different concentrations of additives were set on the cross-flow filtration module. The removal efficiency of microplastic particles by membrane type is comprehensively discussed.

2. Methodology

2.1. Study area

This study was conducted in Banda Aceh City, Aceh Province, Indonesia, which is situated on the westernmost point of Sumatra Island, Indonesia, as shown in Figure 1. In this study, a total of four water sampling points across four districts were selected: Meuraxa, Kuta Alam, Kuta Raja, and Syiah Kuala. These districts represent densely populated coastal areas. Their coordinates were measured by a global positioning system (GPS). An overview of the sampling points is presented in Figure 1, and data are described in Table 1.

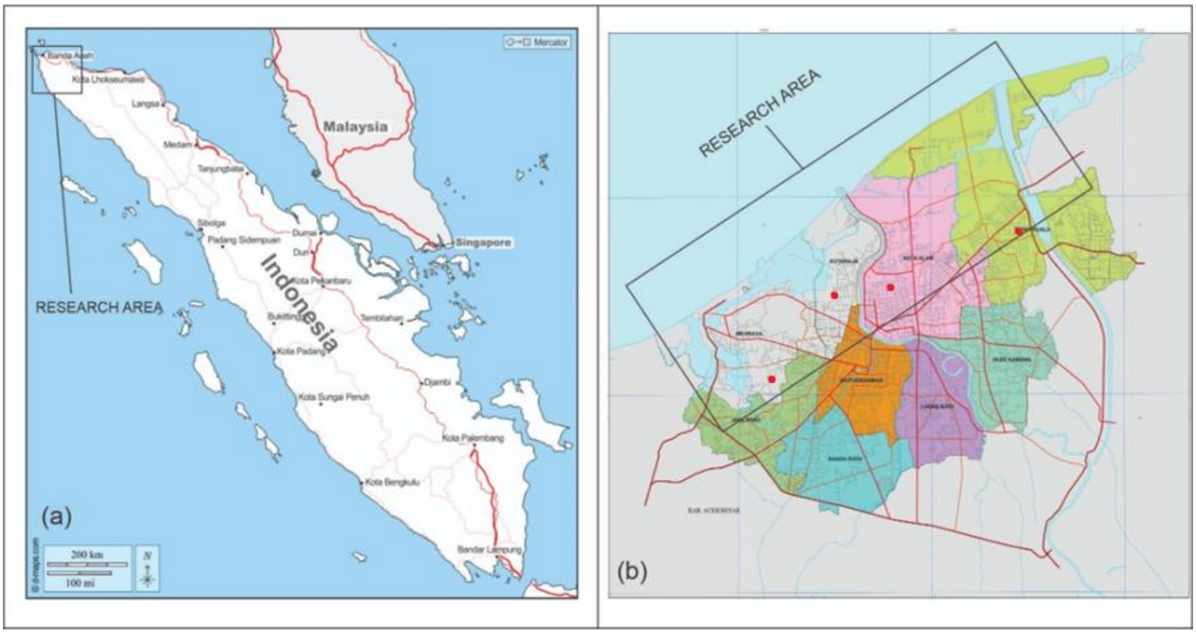


Figure 1. Map of the locations of well water sampling points in Banda Aceh City.

Table 1. Sampling code and location.

Sample code	District	Latitude	Longitude
1	Meuraxa	5°33'51.02"U	95°18'7.66"T
2	Kuta Alam	5°33'47.61"U	95°19'43.49"T
3	Kuta Raja	5°34'39.11"U	95°19'11.67"T
4	Syiah Kuala	5°35'48.53"U	95°20'46.53"T

2.2. Sampling method

Water sampling was conducted at four locations using a horizontal water sampler while adhering to the Indonesian National Standard (SNI 6989.58: 2008). Samples were taken at a depth of 20 cm below the water surface to avoid surface microlayers and 20 cm above the bottom of the well, with careful consideration to avoid sediment deposits. Subsequently, 1 L of water was collected in a sample container and forwarded to the laboratory for analysis to determine the type and number of MPs.

2.3. Sample treatment

Before analyzing the MP content, water samples were treated as previously described with slight modifications [26,27]. Water samples were oxidized with hydrogen peroxide (H_2O_2, 30%) and ferrous sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$) to remove organic compounds present in the water sample. 20 mL each of H_2O_2 and $FeSO_4 \cdot 7H_2O$ were added to 100 mL of water sample. The solution mixture was heated on a hotplate for approximately 30 min. The solution was then left to stand at room temperature for 1 h until the sediment completely settled at the bottom of the glass beaker. Subsequently, water and sediment were separated using a vacuum filtration system with a 3-branch glass funnel equipped with a 0.2 µm membrane filter. The membrane filter was placed in a Petri dish wrapped in aluminum foil and placed in a desiccator for 24 h.

2.4. Quality control/quality assurance (QC/QA)

Quality control and quality assurance are crucial aspects of microplastic analysis research. The goal is to ensure that MP data are genuinely accurate and free from contamination by MP particles originating from the surrounding research environment [28,29]. All steps involved in sampling, processing, and analyzing the samples adhered to quality control/quality assurance (QC/QA) protocols. Cotton clothing and gloves were used to prevent potential fiber contamination from the surrounding air.

Sampling: The horizontal water sampler was constructed from stainless steel. This ensures that water samples are collected without touching human hands or any plastic materials. After collection, the water sample was stored in glass bottles sealed with aluminum caps.

Treatment: All containers used during the oxidation process were glassware, specifically beakers, measuring cylinders, Erlenmeyer flasks, and Petri dishes. Prior to use, each piece of equipment was washed with distilled water and then dried upside down in an oven. Once dry, the equipment was stored after being sealed with aluminum foil.

Analyzing: The surface of the sample channel on the microscope and the FTIR spectra were rinsed three times with distilled water and wiped before examination. Blank analysis (distilled water) was performed to ensure that the samples were not contaminated by laboratory equipment.

2.5. Analysis of MPs

MP content in well water samples was observed using a light binocular microscope with magnification adjusted to the object and then visually identified. Digital images were recorded, and the number of MPs was calculated manually. The parameter obtained for abundance level was the number of particles per liter. The MP concentration was calculated using Eq 1 [30].

$$\text{Concentration} = \frac{\text{The counted number of MPs particles (particle)}}{\text{Volume of Sample (mL)}} \quad (1)$$

The types of MPs present in the well water samples were analyzed using the polymer functional group method and were detected using Fourier-transform infrared spectroscopy (FTIR). The infrared (IR) spectra of each of the water samples were recorded at a wavenumber of 500–4000 cm^{-1} and at a resolution of 2 cm^{-1} [30]. The types of MPs present in the water samples were identified by studying the recorded IR spectra and referring to standard functional polymer groups. The FTIR analysis procedure was described elsewhere in our previous study [21].

2.6. MP ultrafiltration process

Four types of flat sheet membranes were fabricated as described in detail in previous works [31]. The membranes were fabricated using polyether sulfone (PES), poloxamer (P188), patchouli oil (PO), and N-methyl pyrrolidone (NMP). The details of the membrane and its composition are given in Table 2. Cross-flow filtration was performed to separate MPs from the water samples. The procedure was described in our previous study [32]. The water samples were passed through a membrane module via cross-flow filtration using a membrane layer at an operating pressure of 1 bar [33]. The permeate was collected after ultrafiltration for 30 min. MP content in well water before and after filtration was measured using a light binocular microscope. The rejection coefficient of the MP particles by the membrane was calculated using Equation 2.

$$R_m = \left(1 - \frac{C_p}{C_f}\right) \times 100\% \quad (2)$$

Here, R_m = MPs rejection percentage (%), C_p = concentration of MPs in the feed (MPs/L), and C_f = concentration of MPs in the permeate (MPs/L) [34]. The transmembrane pressure was set to 1.0 bar for all filtration experiments.

Table 2. Membrane composition.

Membrane code	Material (wt%) PES	P-188	PO	NMP	Characteristic Porosity (%)	Water contact angle (°)	Water flux ($L/m^2.h$)
MPO_0	16	0	0	84	53.8	70.4	25.3
MPO_1	16	3	1	80	64.5	52.7	83.2
MPO_3	16	3	3	78	69.9	46.0	90.7
MPO_7	16	3	7	74	73.2	39.7	151.9

3. Results and discussion

3.1. MPs in well water

The abundance and contamination of MPs in well water were examined qualitatively and quantitatively. Qualitative analysis confirmed the presence of MPs in each community well water sample, as evidenced by an abundance test using a binocular light microscope. Observations were made using different microscope magnifications depending on the object, as exhibited in Table 3.

Table 3. Number and size of MP particles in water at each sampling point.

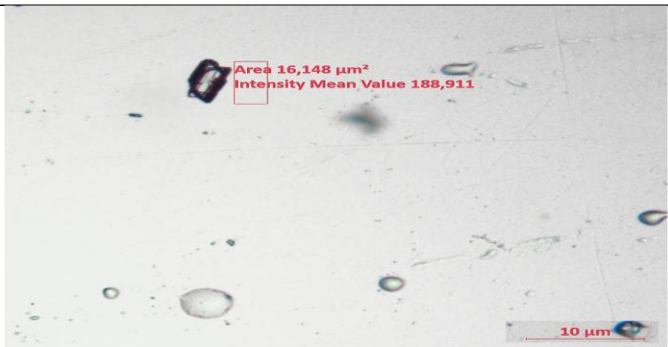
No	Sampling point	Particle/mL	Average size (µm)
1	Syiah Kuala	70	0.94–536
2	Kuta Alam	23	1.02–804
3	Kuta Raja	22	1.74–414
4	Meuraxa	15	2.77–1223

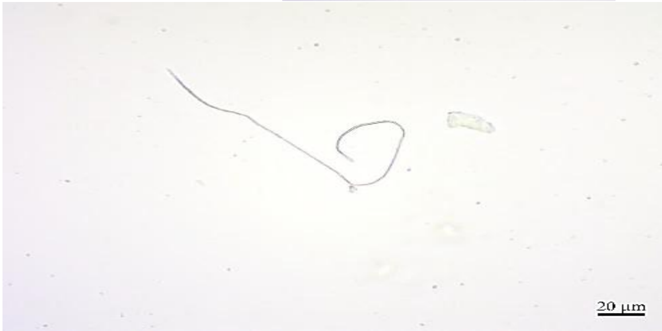
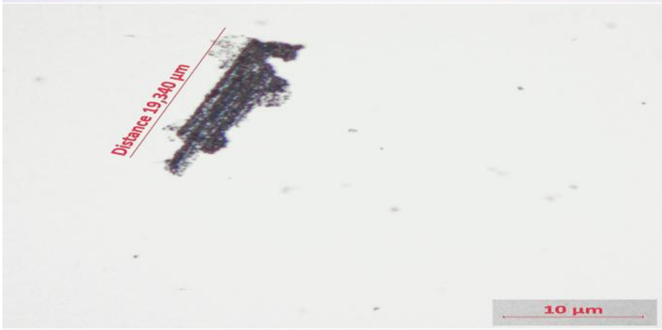
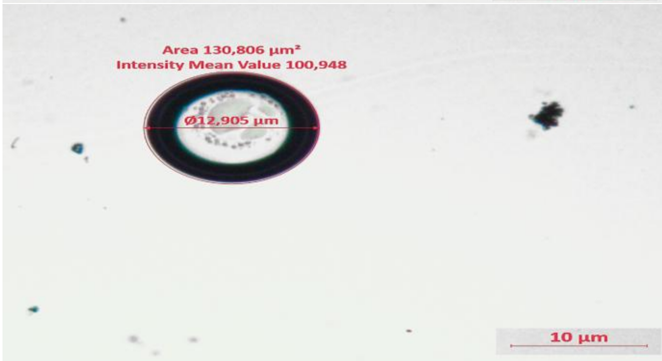
MP particles varying in number and size were identified in all water samples. Based on Table 3, the MP data for each sample demonstrated that Syiah Kuala contained the highest amount of particles (70 particles/mL). This was attributed to the presence of numerous MPs carried by currents from the sea and the population density level. In particular, community activities and population density have a considerable influence on MP pollution because the level of plastic waste tends to be greater in densely populated areas.

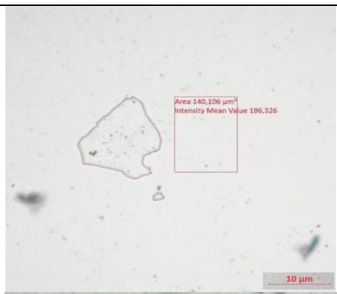
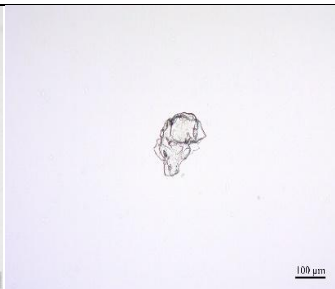
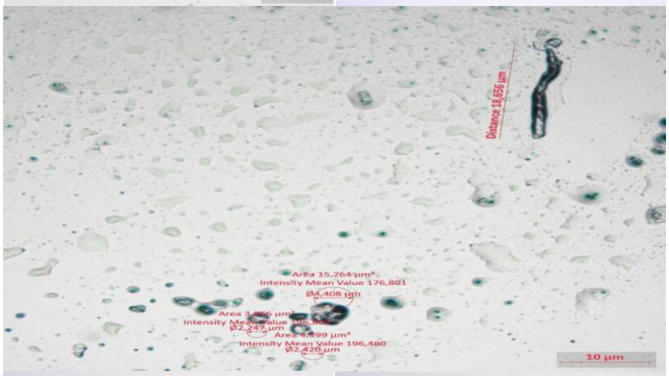
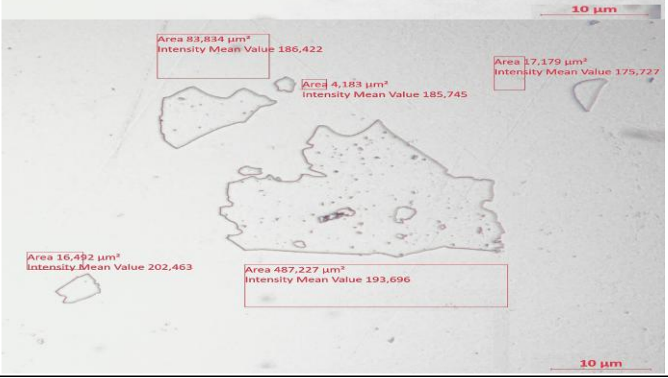
3.2. MP shape in well water

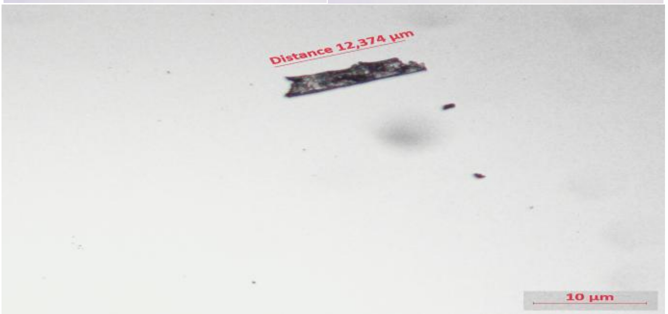
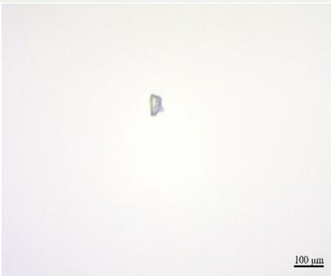
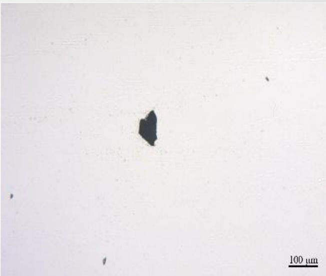
MPs come in various shapes and display physical characteristics that help determine the type of plastic present in the well water samples, as shown in Table 4. A previous study has shown that the origin and entry path of MPs play a significant role in shaping their form. MP fragments are primarily derived from anthropogenic sources, such as household waste, whereas film-shaped MPs, with flexible and thin physical characteristics, originate from degraded pieces of single-use plastic bags. [24]. Additionally, fiber-shaped MPs are derived from rope fibers and are typically extremely small. These include synthetic fabrics released by washing, fishing nets, industrial raw materials, household appliances, and weathering plastic products. This phenomenon is common in residential areas, as observed at the sampling points. Coastal residential areas in Banda Aceh have a significant potential to generate plastic waste, particularly in the form of bags and food or beverage packaging [15,16].

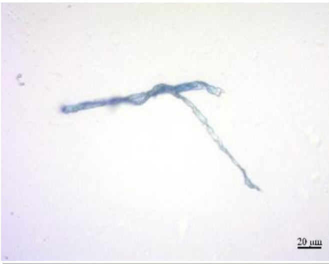
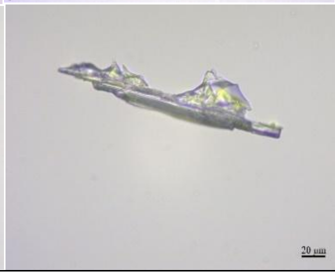
Table 4. MP shapes in water at each sampling point.

No.	Sampling point	MPs	Shape
1.	Syiah Kuala		*Fragment*

No.	Sampling point	MPs	Shape
		 	*Fiber*
		 	*Colorful fiber*
			*Transparent fiber*
			*Film*
			*Granule*

No.	Sampling point	MPs	Shape
2.	Kuta Alam	 	*Fragment*
			*Fiber and granule*
		 	*Colorful fiber*
			*Fiber*
3.	Kuta Raja		*Fragment*

No.	Sampling point	MPs	Shape
		 	*Fiber*
		 	*Transparent and colorful fiber*
			*Film*
4.	Meuraxa	 	*Fragment*
			*Film*

No.	Sampling point	MPs	Shape
			*Fiber*
		 	*Colorful fiber*
		 	*Transparent fiber*

In this study, the shape of the MPs found in each of the four samples collected from community well water was dominated by colorful fibers and fragments, followed by transparent fiber, fiber, and film, as shown in Table 4. These results are consistent with those reported in a previous study [35]. Microplastic particles (MPs) have highly variable morphologies and are described as fiber (thread-like), fragments (broken), granules (round), and films (sheet-like). Identifying the morphological types of MPs is crucial for identifying the origin of microplastics so that the problem can be addressed. For instance, fiber MPs can come from textiles and ropes, whereas fragments or films can come from plastic bags or bottles [36]. In addition, knowing the type of microplastics will also facilitate their removal from water, especially through the use of membrane technology to separate MPs. The concept of membrane separation is based on pore size; thus, the particle size of microplastics significantly affects the fouling of the membrane. MPs with particle sizes larger than the pore size tend to clog the pores on the membrane surface and form a cake layer, while MPs with smaller sizes can block the pores inside the membrane, which cannot be recovered [37].

In this case, fiber, film, and fragment types of MPs easily cover the membrane pore surface due to their large particle dimensions. Although fiber MPs have a very small width (x-dimension), their length (y-dimension) can surpass that of films or fragments because of their elongated shape. Fragment and granular types present the greatest challenge for separating MPs using membranes, as their small and irregular sizes can cause blockages in membrane pores, affecting filtration performance (decrease in flux and rejection). As shown in Table 7, fragment-type MPs dominate the MPs found after the filtration process.

3.3. *Types of MPs discovered in well water*

The MPs in the well water samples were reviewed by qualitative analysis using FTIR spectroscopy to determine the functional groups in the compounds or materials. The IR spectra of the well water samples were studied using various standard polymer spectra for polymer types (Figure 2).

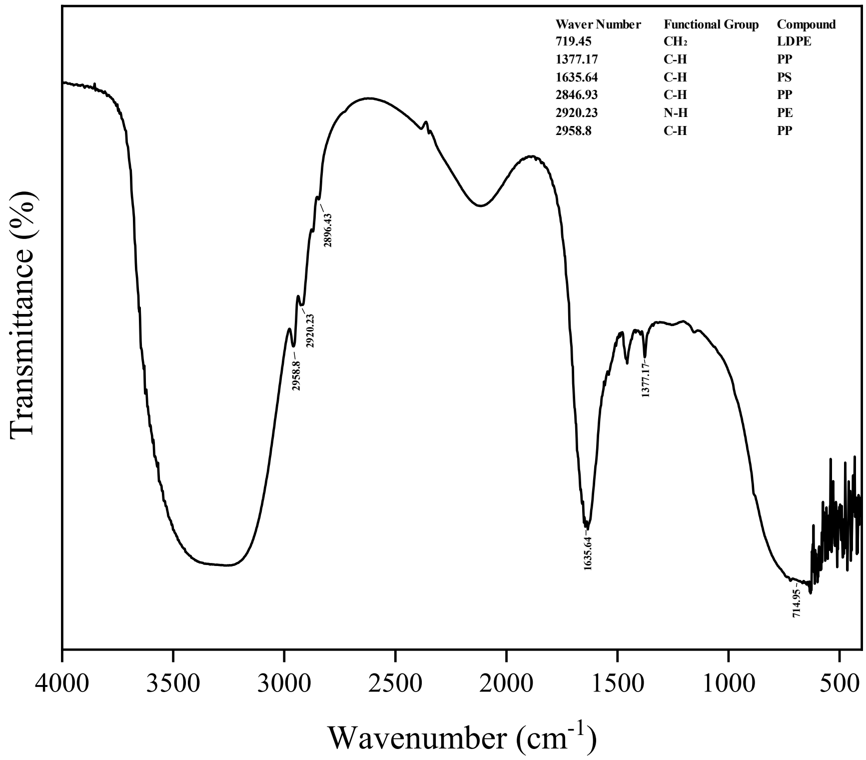


Figure 2. FTIR images of community well water samples containing MPs.

The results were analyzed for functional groups using a standard polymer spectrum. Interpretation of the FTIR spectra shown in Figure 2 is presented in Table 5. Based on Table 5, the results of the FTIR analysis of well water samples exhibited bonds that were close to the standard wavelengths for polymer types of polypropylene (PP), polyethylene (PE), polyethylene glycol (PEG), polystyrene (PS), and low-density polyethylene (LDPE) [38]. Polyethylene is a polymer sourced from plastic bags and packaging commonly found in water [39].

Table 5. Various types of MPs obtained from water samples based on the explanation of the IR spectra.

No.	Sample	Wavenumber	Bonding	Plastic types
1.	Syiah Kuala	2958.8	C-H	PP
		2920.2	N-H	PE
		2846.9	C-H	PE
		1635.6	C-H	PS
		1377.2	C-H	PP
		719.4	CH_2	LDPE
2.	Kuta Alam	3252.0	O-H	LDPE
		2966.5	C-H	PE
		1635.6	C-H	PS
		1462.0	C-H	PP
		1396.5	O-H	LDPE
		1377.2	C-H	PP
		719.4	CH_2	LDPE
3.	Kuta Raja	2345.4	C-H	PE
		2112.0	C-H	PE
		1635.6	C-H	PS
		1462.0	C-H	PP
		1396.5	O-H	LDPE
		1377.2	C-H	PP
		1342.5	C-O	PEG
		719.4	C-H	LDPE
4.	Meuraxa	1635.6	H-C-H	PEG
		1462.0	C-H	PP
		1396.5	O-H	LDPE
		1377.2	C-H	PP
		717.5	Benzene derivative	PS

The peaks obtained at wavenumber 1462 cm^{-1} and 1377 cm^{-1}, in addition to 2920 cm^{-1} and 2846 cm^{-1}, represent the functional groups of PE and PP [4]. In shallow groundwater, MP contamination can originate from the sanitary conditions of a community that undertakes activities such as bathing and washing, which can affect the abundance of MPs. This is because washing activities can produce fibers from clothes, or the incorrect disposal of detergents and plastic waste. The results indicate that all well water samples tested were contaminated with MPs. The samples from Kuta Raja had the highest level of contamination.

3.4. MP analysis after filtration

Membrane performance was examined by filtering well water contaminated with MPs. Based on the results presented in Table 6, it can be noted that the four membranes exhibit good MP rejection performance, with a rejection percentage of 82%–100%. Microplastics in community well water in Syiah Kuala and Kutaraja were eliminated. This occurred because such microplastics were larger in size than the membrane pores; hence, they could be completely removed [40]. Unfortunately, traces of

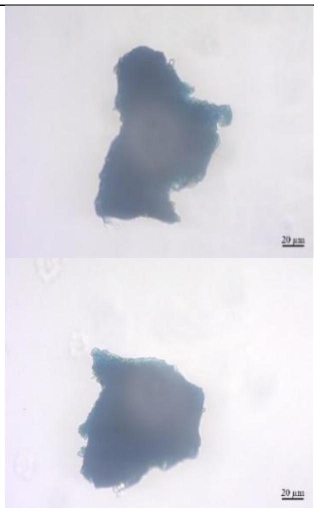
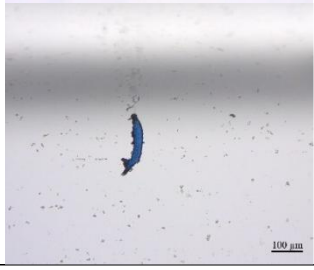
MP residues were still observed in community well water samples after the filtration process, specifically in Kuta Alam, where 2 particles/mL were detected ranging in size from 118 to 143 mm. The community well water sample obtained from Meuraxa contained small MPs (1 particle/mL) measuring 195 µm in size.

Table 6. MP particle rejection by membrane filtration.

No.	Sample	Membrane	Size (µm)			Remark	Rejection (%)
			x	y	z		
1	Syiah Kuala	MPO_0	-	-	-	Not found	100
		MPO_1	-	-	-	Not found	100
		MPO_3	-	-	-	Not found	100
		MPO_7	-	-	-	Not found	100
2	Kuta Alam	MPO_0	143	86	129	Exist	82
			118	85	103	Exist	
		MPO_1	-	-	-	Not found	100
		MPO_3	-	-	-	Not found	100
		MPO_7	-	-	-	Not found	100
3	Kuta Raja	MPO_0	-	-	-	Not found	100
		MPO_1	-	-	-	Not found	100
		MPO_3	-	-	-	Not found	100
		MPO_7	-	-	-	Not found	100
4	Meuraxa	MPO_0	195	33		Exist	87.5
		MPO_1	-	-	-	Not found	100
		MPO_3	-	-	-	Not found	100
		MPO_7	-	-	-	Not found	100

The types of microplastics identified after filtration are presented in Table 7. Only two types of microplastic shapes were recovered after filtration: fragments and fibers. The inability of microplastics to be rejected is significantly affected by their size and abundance in water. For instance, the fragment shape noticed in Kuta Alam after filtration can be caused by the abundance of fragment shapes in community wells, possibly because of the use of synthetic ropes. In the Murata sample, fiber-type microplastics could pass through the membrane. This occurred because the size at the upper end of the microplastic is smaller than the membrane pore; thus, this type of microplastic is vulnerable to pass through a membrane even after filtration [1,41].

Table 7. MP shape.

No.	Sample	Shape	
1.	Kuta Alam 2: A Day of Learning		*Fragment*
2.	Meuraxa 1		*Colorful fiber*

The microplastics successfully passed through the membrane stemmed from MPO_0, a pristine membrane that does not contain additives. This was closely related to the membrane surface pore size, which was larger (Table 6). The membrane surface denotes dark circles with larger diameters than the other three types of membranes. In accordance with a previous study [42], the inability of microplastics to be rejected was clearly influenced by the membrane pore. Hence, to improve the rejection performance, the membrane pore should be modified. In water treatment containing a membrane, the flux and rejection coefficient should be directly proportional. Therefore, an increase in the concentration of additives in the membrane generates an increase in the flux of pure water [43] and the rejection coefficient [44].

3.5. Economic analysis

A simple economic feasibility analysis was conducted by comparing the use of consumables in this study with commercial membranes available on the market. Based on the analysis, the MPO_0 (PES) and MPO_7 (PES/P-188/PO) membranes cost \$3.20 and \$3.37, respectively (all prices obtained from Sigma-Aldrich, October 2024), with a size of 100 × 200 mm. In comparison, the commercial PES membrane is priced at \$27 with a size of 200 × 200 mm. The results indicate that the fabricated membranes are significantly cheaper than commercial membranes. This suggests that the fabricated membrane is feasible for use in the microplastic separation process. In addition to delivering satisfactory performance, the membrane offers a very affordable price, making it suitable for long-term use.

4. Conclusion

In conclusion, this study successfully investigated MP removal from community well water in Banda Aceh. The results confirmed that contamination by MPs was most commonly unearthed in samples collected from Kuta Raja. Observations employing a microscope showed that the dominant shape was fibers originating from rope fibers and synthetic fabrics commonly found in washing clothes, fishing nets, industrial raw materials, household appliances, and weathering plastic products. FTIR analysis proved that MP contamination was primarily composed of the two most prevalent types of MPs found on the Asian continent, specifically polyethylene and polypropylene plastic. This study also established that MP contamination could be eliminated via ultrafiltration using a membrane, with pure PES producing a rejection value of 87.5%. However, the PES membrane with the addition of poloxamer and patchouli oil produced a 100% rejection value due to the hydrophilicity effect. This phenomenon contributed to equal pore distribution characterized by a substantial number of small pores, thereby increasing the selectivity of membranes for MP removal.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Author contributions

Conceptualization, N.A.; Data curation, R.D.H.; Formal analysis, R.D.H., S.M.; Investigation, W.A.D., N.H., S.S.; Project administration, C.M.R, S.M.; Supervision, N.A., C.M.R., S.M., I.R., Writing – original draft, W.A.D., R.D.H,; Writing – review and editing, N.A., M.A., M.U.

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Conflict of interest

The author declares no conflicts of interest regarding the publication of this manuscript.

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