Feasibility Study Clean Water Processing Business for the Needs of Crossing Vessels

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Abstract. The feasibility study for the clean water processing business for ferry needs aims to evaluate the potential sustainability and profitability of the project. The need for clean water on ferry ships, especially on long-distance routes, is very important to support ship operations, crew, and passenger needs. Clean water is used for consumption, sanitation and various other needs. This project utilizes Reverse Osmosis (RO) technology to process river water into clean water that is suitable for use, considering the limited sources of clean water. This study covers several main aspects, namely market, technical, and economic analysis. Market analysis shows that the demand for clean water for ferry ships and communities continues to increase along with the growth in the number of ships and trips as well as population growth. Technical analysis highlights optimal water treatment technology, production capacity, and supporting infrastructure needs. The RO system was chosen because of its efficiency in producing clean water of high quality and meeting international standards. The capacity of the RO system that needs to be built is a capacity of 10 m3/hour with a sales requirement of 159 m3 with a value of 2% of the total clean water needs of the community or around 65.45 m3/day and 5% of the total clean water needs for ships operating on the Musi River or around 90.05 m3.
Keywords: Business, Clean water treatment, Feasibility study, Reverse Osmosis, Ship crossings.

1 Introduction

Water is a primary need in human life, so if water needs are not met both in quality and quantity it will have a bad impact on human life. As population growth continues to increase, the need for water consumption will become greater, one of which is the need for clean water. To produce water that is suitable for use, it is necessary to process raw water into clean water. Clean water treatment is a series of steps to remove contaminants and dangerous substances from water so that it is safe for human consumption. There are many water sources that can be used as clean water, one of which is river water.

River water is one of the water sources that is widely used by people in daily life, for bathing, washing and toileting. River water can actually also be used for drinking water needs, but proper processing is needed to meet drinking water standards in accordance with Minister of Health Regulation Number 2 of 2023 considering the large amount of waste and rubbish that pollutes the quality of river water.

There are various ways to process river water into clean water, including using physical, chemical and biological methods. Of these methods, of course it is necessary

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to choose the most appropriate method for processing water because it will greatly affect the infrastructure that will be built, especially if the clean water treatment is used for clean water business purposes.

2 Research Methods

a. Research Flowchart

The research methodology that will be used in compiling the research report is as shown in Figure 1.

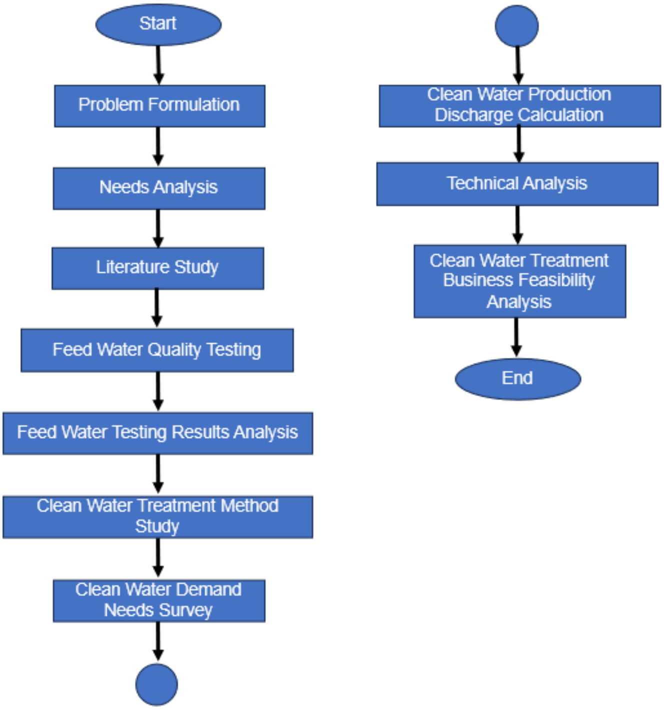

Figure 1. Research flowchart

3 Result and Discussion

Clean water is a basic human need, both for direct consumption and daily activities. However, providing clean air is often a challenge in various regions due to limited air resources, climate change, population growth, and rapid urbanization. Analysis of clean water production needs is important to ensure that air supply can meet current and future demand.

a. Discussion and Analysis of Production Needs

In this study, the number of residents in one sub-district with the Palembang River, Lake and Ferry Transportation Polytechnic Campus was obtained, namely Banyuasin I Sub-district. The population of Banyuasin I Sub-district is a potential market for clean water marketing, so a simulation of calculating the amount of clean water needs is needed to determine the supply that must be met.

Table 1. Population data

Subdistrict	Population by District and Gender (People)		
	Male	Female	Total
	2022	2022	2022
Rantau Bayur	21.157	20.055	41.212
Betung	28.087	26.828	54.915
Suak Tapeh	9.666	9.353	19.019
Pulau Rimau	11.092	10.271	21.363
Tungkal Ilir	15.096	13.698	28.794
Selat Penuguan	11.771	10.764	22.535
Banyuasin III	33.752	32.865	66.617
Sembawa	16.363	16.020	32.383
Talang Kelapa	74.624	70.666	145.290
Tanjung Lago	20.861	19.649	40.510
Banyuasin I	27.879	26.664	54.543
Air Kumbang	13.276	12.877	26.153
Rambutan	23.364	21.661	45.025
Muara Padang	16.425	15.053	31.478
Muara Sugihan	19.620	18.621	38.241
Makarti Jaya	15.021	14.035	29.056
Air Saleh	17.858	17.166	35.024
Banyuasin II	16.819	15.826	32.645
Karang Agung Ilir	6.675	6.109	12.784
Muara Telang	19.399	18.294	37.693
Sumber Marga Telang	12.204	11.917	24.121
Population of Banyuasin Regency	431.009	408.392	839.401

Based on the data in table 1. the population of Banyuasin I District is 54,543 people. According to the Regulation of the Minister of Home Affairs No. 71 of 2016, it is stated that the basic clean water needed by each person is a minimum of 60 liters per person per day. Referring to the population data of Banyuasin I District and Permendagri No. 71 of 2016, it can be said that the total clean water requirement needed

by the population of Banyuasin I District is 3,272.58 m3/day. Based on the results of a field survey, it was found that the average PDAM water used by the people of Banyuasin I District has a medium level of turbidity and smells.
Based on the results of the calculation of the water needs needed by the people of Banyuasin I District, the author took a value of 2% of the total clean water needs or around 65.45 m3/day to be the target for daily sales targets.
In addition to population data that is a potential market for clean water sales, data on ships operating on the Musi River is also the basis for calculating the amount of clean water production capacity. The number of ships operating on the Musi River is described in Table 2.

Table 2. Number of ships operating on the Musi River

No	Jenis Kapal	Total (Unit)	Daily Water Requirements Per Ship (m^3)	Daily Water Requirement Amount (m^3)
1	*Speed Boat*	178	2	356
2	Kapal Motor Jukung	289	5	1445
Total Daily Water Requirements				1801

Based on the data in table 2, it is found that the number of Speed Boat type ships is 178 units with an average daily requirement for clean water use of 2 m3/day/ship, so that the total daily requirement is 356 m3. Meanwhile, for Jukong Motor Ships operating on the Musi River, there are 289 units with an average daily clean water usage of 5m3/day/ship, so that the total daily requirement for Jukong Motor Ships is 1445 m3. Based on the calculation results of clean water needed for ships operating on the Musi River with a total requirement of 1801 m3 per day, the author took a value of 5% of the total clean water requirement for ships operating on the Musi River or around 90.05 m3 per day for the minimum sales target per day. From the calculation results that have been submitted, it was found that the daily sales target for clean water for ships and the surrounding community is 155.5 m3. With an estimated production error of 2.25%, the capacity that needs to be installed is 159 m3 per day.

b. Technical Analysis of Processing

The clean water processing business process carried out in this study uses raw water or raw water sourced from the Musi River. The characteristics of the Musi River, which is a type of river that experiences ebb and flow, result in water conditions that are not suitable for use for daily needs, because in addition to the water being quite turbid, there is a chemical content that is above the threshold required to meet the quality of clean water.

Before processing the Musi River water to become clean water, initial data is needed regarding the characteristics of the Musi River water. In this study, laboratory tests were carried out to determine the condition of the Musi River water quality so that a method could be determined to carry out activities to determine the type of processing. Laboratory test activities were carried out from June 25 to July

8, 2024. Testing was carried out to test the physical and chemical content of the Musi River water. Testing activities were carried out at the Laboratory belonging to the Palembang Public Health Laboratory Center, Ministry of Health. The results of the test are presented in Figure 2.

SERTIFIKAT HASIL UJI
IR.02.02/VIII.8/...698.../2024

FR. 5.10.1.1

UMUM

No. Urut : 166
Laboratorium : **KIMIA AIR**
Nama Konsumen : M. Fahmi Amrillah
Diambil oleh : M. Fahmi Amrillah (Pengambilan Sampel Tanggungjawab Konsumen)
Lokasi Sampling : Palembang
Jenis Sampel/Baku Mutu : Air Permukaan/ Air Minum
Kode Sampel : Raw Water
Diambil/Diterima tanggal : 24 Juni 2024/ 24 Juni 2024
Tgl Pengujian di Lab : 25 Juni 2024 – 08 Juli 2024
Kode Lab : 590

HASIL UJI

No.	Parameter	Satuan	Nilai Baku Mutu	Hasil	Metode Pemeriksaan
	FISIK				
1	Bau	#	Tidak Berbau	Tidak Berbau	Organoleptik
2	Total zat padat terlarut *(TDS)*	mg/L	< 300	28	Direct Reading
3	Kekeruhan	Skala NTU	< 3	**161**	SNI 06-6989.25-2005
4	Suhu *(di Laboratorium)*	°C	Suhu Udara ± 3	24	SNI 06-6989.23-2005
5	Warna	Skala TCU	10	**182**	Spektrofotometri
	KIMIA				
1	pH *(di Laboratorium)*	#	6,5 - 8,5	7,23	SNI 6989.11:2019
2	Nitrit (Sebagai NO_2)	mg/L	3	0,18	SNI 06-6989.9-2004
3	Besi *(Fe)*	mg/L	0,2	**3,79**	SNI 6989.4:2009
4	Mangan *(Mn)*	mg/L	0,1	0,08	SNI 6989.5:2009
5	Sisa Khlor	mg/L	0,2 - 0,5 dengan waktu kontak 30 menit	0,00	Fotometri
6	Kadmium *(Cd)*	mg/L	0,003	< 0,0015	SNI 6989.16:2009
7	Timbal *(Pb)*	mg/L	0,01	0,01	SNI 6989.8:2009
8	Fluorida *(F)*	mg/L	1,5	0,10	SNI 06-6989.29-2004

#) : Tidak ada satuan

Catatan : Nilai baku mutu mengacu pada Permenkes RI No. 2 Tahun 2023 Tentang Standar Baku Mutu Kesehatan Lingkungan untuk Air Minum.

Mengetahui,
Kepala Subbag ADUM

Rahmadi Sularso, S.Kom, M.Kes
NIP. 19780101 199903 1002

Palembang, 08 Juli 2024
Kepala Instalasi Kesehatan Lingkungan, Vektor dan BPP

Yundri Yanita, SKM
NIP. 19780916 199903 2001

Figure 2. Results of the Musi River water quality test

Based on testing conducted by the Palembang Public Health Laboratory Center of the Ministry of Health, data was obtained that there were 3 water parameters that were not met by the Musi River water. These parameters are physical in the form of turbidity and color and chemical in the form of iron content that exceeds the threshold. Content that does not meet the standard must be processed so that water quality results are obtained that can meet the threshold in accordance with applicable regulations related to clean water quality.

In this study, the author recommends using a reverse osmosis treatment system to process Musi River water into water that meets clean water standards. Reverse Osmosis (RO) machines are a technology used to purify water by filtering dissolved particles, including salts, minerals, bacteria, and chemicals. This machine works on the principle of reverse osmosis, where water is forced through a semi-permeable membrane at high pressure to separate contaminants from pure water.

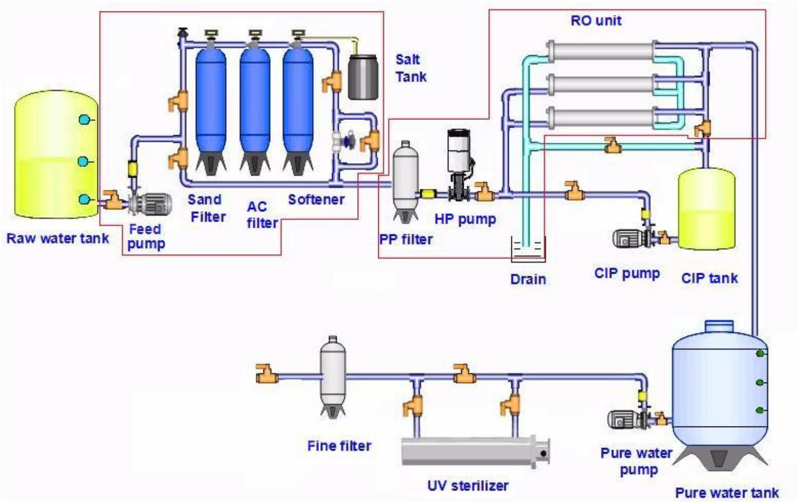

Figure 3. RO working system

The way the RO system works is before the water enters the RO membrane, it usually passes through an initial filter (pre-filter) to remove large particles such as sand, mud, or rust. Pre-filtration is important to protect the RO membrane from damage and extend its life. Activated carbon filters are usually used to remove chlorine, organic chemicals, and odors that can damage the membrane or affect the taste of the water.

After the pre-filtration stage, the water enters a pressure pump. This pump functions to provide high pressure to the water (around 2-15 bar, depending on the type of water being treated), so that it can pass through a semi-permeable membrane. High pressure is needed to overcome natural osmotic pressure and force water molecules through the membrane, while dissolved contaminants are left on the other side of the membrane.

The RO membrane is the main component of the RO machine. This membrane is very thin and microporous, allowing water molecules to pass through, but retaining almost all types of contaminants, including salts, bacteria, viruses, heavy metals, and other dissolved particles. When pressurized water passes through the membrane, pure water molecules will pass through the membrane and flow to the output section as clean water, while contaminants are trapped on the other side of the membrane.

After the water passes through the RO membrane, there is usually a post-filtration stage to ensure water quality. Carbon filters or mineral filters are often added to balance the pH of the water and improve the taste of the resulting water. Contaminants left on the other side of the membrane will be concentrated in wastewater, which is then discharged out of the system.

The RO machine produces two types of output, namely pure water (permeate), which is water that has passed through the membrane and is ready to use. The second is wastewater (reject/brine), which contains salts, minerals, and contaminants that are filtered by the membrane. The separation efficiency varies, usually around 50-70% of raw water becomes clean water, while the rest becomes wastewater.

The advantage of the RO water treatment system compared to other systems is its high effectiveness because RO is able to remove up to 99% of dissolved particles including metal ions, salts, chemicals, and microorganisms. In addition, the flexibility of using the RO machine can be used to process various types of raw water, from well water, brackish water, to sea water, by adjusting the pressure and type of membrane used. And the water quality is very good because the water from the RO process is very clean and pure, it can even be used for medical purposes such as kidney dialysis and can further be used for drinking water. Based on the results of the Musi River water test which was carried out by passing it through the RO system carried out by the water laboratory owned by PT Puji Lestari, the results were obtained as in Figure 4.

PT. PUJI LESTARI PURNAMA

Ready Sentra Cimone Blok B No..5-16 Jl.Jend.GatotSubroto KM.2 CimoneTangerang 15114 Telp.(021) 55795815, 5587777 (hunting) Fax.(021) 55795816

LABORATORY REPORT

Industrial Water & Waste Water Treatment Specialist

PAY - OFF®

Company : **Muhamad Fahmi A**
Attention : Muhamad Fahmi A
Date Sampling : 24 Agustus 2024
Marketing : Bpk. Harry
Technical Service : Eritha Paramitha

Water Condition	Raw Water	RO Tangki
pH	7.35	7.10
TDS (ppm)	29.5	21.65
Total Hardness (ppm $CaCO_3$)	278.47	1.21
Bicarbonate Alkalinity(ppm $CaCO_3$)	291.16	13.86
Carbonate Alkalinity (ppm $CaCO_3$)	0	0
Hydroxy Alkalinity (ppm $CaCO_3$)	0	0
Chloride (ppm Cl)	84.60	6.5
Iron (ppm Fe)	3.79	0
Silica (ppm SiO_2)	64	2

Figure 4. Results of testing Musi River water with RO system

Based on the results of laboratory tests owned by PT Puji Lestari, test data was obtained that the water quality was very good because it could remove 100% of the iron content in Musi River water and obtain a quality that was almost close to the quality of drinking water.

4 Conclusion

Based on the discussion and analysis that has been done in the previous chapter, the conclusion data can be obtained, namely the water treatment method used is the Reverse Osmosis (RO) system because it has very good effectiveness compared to other treatments. The capacity of the RO system that needs to be built is a capacity of 10 m3 / hour with a sales requirement of 159 m3 with a value of 2% of the total clean water needs of the community or around 65.45 m3 / day and 5% of the total clean water needs for ships operating on the Musi River or around 90.05 m3.

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