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Potential Pollution of Liquid Waste from the Agro-Industry to Rivers in the Area Around Tanjung Api-Api

Hasmawaty AR[1]*, Eriyana Yulistia[2], Renilaili[3]
[1,2]Environmental Engineering Study Program Universitas Baturaja
[3]Environmental Engineering Study Program Universitas Bina Darma
Corresponding Author: Hasmawaty AR hasmawaty@unbara.ac.id

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A B S T R ACT

Due to its high regional significance, Tanjung Api-api, currently the mainstay of South Sumatra Province, serves as a focal point for agro-industrial development programs. This research aims to identify the potential for liquid waste pollution in rivers from agro-industries around Tanjung Api-api. This research was carried out through four stages: (a) collecting physical data on land, forests, and rivers in the ecosystem conditions around the industrial area of the Tanjung Api-api area. (b) analyzing data on the physical and chemical parameters of the Telang River, (c) analyzing several physical and chemical parameters of Telang River water, (d) obtaining data on the physical and chemical parameters of liquid waste in the influent and effluent of several WWTP agro-industries in the Gasing area that have been operating. Water quality measurements were conducted in the Telang and Gasing rivers. The parameters measured and observed were TSS, pH, BOD, COD, and fatty oil parameters, respectively, once in the afternoon and evening during high and low tide, at three points: downstream, middle, and upstream. The results showed that the physical, organic, and inorganic chemical parameters in the Telang River were still below the BMLC threshold. The quantity and quality of industrial wastewater in Gasing are still below the BMLC standard for each industry but are almost close to the established quality standards. It is recommended to utilize the sludge into something more valuable, considering that the TSS produced from sludge dewatering is relatively high.

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INTRODUCTION

Freshwater is arguably the most essential substance for life on earth. All humans should ideally pay more attention to the availability of clean water for the health of ecosystems to sustain economies and human populations worldwide. (Anderson et al., 2019). Almost 71% of the earth's surface is covered with water, only 2.5% of which can be considered freshwater. (Hasan, Shahriar, & Jim, 2019). Rivers are a significant source of water due to their accessibility and availability. This situation has led to the growth of most civilizations near river banks (Tiyasha, Tung, & Yaseen, 2020).

The growing population has led to increased life activities along the river, one of which is business activities in the form of agro-industry (Rahayu, Juwana, & Marganingrum, 2018). Agro-industry can be defined as an economic activity that includes processing raw materials from the agricultural and forestry sectors to produce food and non-food source products that are commercially circulated. (Jos et al., 2021). The agro-industry is primarily responsible for creating and processing food and its waste and effluent. (Markou, Wang, Ye, & Unc, 2018). What is inevitable from agro-industrial operations is the processing of waste that flows into the river. (Yirgu, 2018). The output of the agro-industrial WWTP often generates organic and inorganic wastewater that the surrounding community must be aware of. (Haque et al., 2022). The physical characteristics of agro-industrial waste identified lie in the pungent aroma and odour (Uddin & Jeong, 2021), colour contours tend to be brown to blackish and rich in oil content (Aboye, 2022), where waste that forms solid can become sediment on the riverbed receiving agro-industrial waste (Mo et al., 2018).

Tanjung Api-api is an area with a high regional significance (Eka Putri et al., 2022). Tanjung Api-api is currently the mainstay area of South Sumatra Province. The existence of an ocean port in the area should be supported by an industrial area, which is an essential part of national development policy. (Refliss, 2017). Industrial activities are strategic for regional development, improving community welfare, and increasing local revenue (Mabtapud, 2014). This understanding means that the industrial planning area and others, together with the Tanjung Api-api Ocean Port, are expected to grow and develop into regional or national economic drivers and generators of development in the surrounding area, both directly and indirectly.

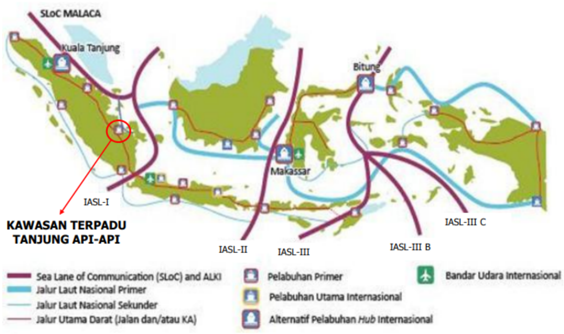

Figure 1. Location of Tanjung Api-Api Integrated Area

Near the Tanjung Api-api port, the government, in addition to holding a development program by providing space for industrial estates, also provides areas such as warehousing areas, fishing port areas and fish auction sites (TPI), coal stockpile areas, and drainage. The development of this agro-industry is expected to be an agent of significant change in the lives of local farming communities so that natural resources that become the attraction of sectoral economic development, especially the industrial sector, will have implications for increasing regional financial capacity, including in terms of regional income because economic growth will increase, all of this is for the welfare of the people of South Sumatra. (Mabtapud, 2014). The success in improving the community's welfare through the development of the Tanjung Api-Api integrated industrial area has implications for potential environmental sustainability problems, one of which is the disruption of the hydrological cycle, causing a deterioration in the quantity and quality of clean water. This condition allows the expansion of the inundation zone and results in limited availability of clean water. (Widyaningrum & Widyastuti, 2021). Further pollution relates to disconnected ecological systems due to wetland degradation. One example of the type of pollution that causes mangrove destruction comes from effluents or suspended solids released by various agro-industries. (Refliss, 2017).

This study aims to identify the potential for liquid waste pollution in rivers from agro-industries in the Tanjung Api-api neighbourhood.

METHODOLOGY

This research was conducted in the Tanjung Api-api area of Banyuasin Regency in South Sumatra Province and the Gasing industrial area of Banyuasin Regency.

Table 1. Location and Research Data

Study location	Primary and Secondary Data
Bappeda Banyuasin, and Bappeda Sumatera-South Sumatra Province.	Secondary Data, Physical; a. Soil properties in the Industrial plan area b. River data around the industrial area plan. c. Mangrove forest
Telang River in Tanjung Api-api area and in Gasing River.	Primary Data at several points of the river as Initial Hue Physical Parameters: TSS Inorganic Chemical Parameters: pH, BOD, and COD Organic Chemical Parameters: fatty oil Primary Data, Chemistry;
In the influent and effluent of WWTP, several industries, such as rubber, palm oil, and coconut industries.	Organic waste; fatty oil Inorganic waste; pH, BOD, COD. Effluent concentration Primary Data, Physical; TSS WWTP capacity Effluent discharge

This research aims to (a) obtain data on the initial hue of the Tanjung Api-api area, especially Telang River water, (b) obtain data on the Gasing River, which has been polluted by the presence of industry, especially the agro-industry, (c) analyze wastewater parameter data from Influent, Agro-industry effluent in the Gasing river to find out how much all parameters can still escape to the nearest river followed by comparing the data with the BMLC data set.

This research was carried out in four stages: (a) collecting physical data on land, forests, and rivers in the ecosystem conditions around the industrial plan for the Tanjung Api-api area. (b) analyzing data on the physical and chemical parameters of the Telang River, (c) analyzing several physical and chemical parameters of the river water, the aim is to identify the characteristics of industrial waste in Gasing, and as a parameter for the Telang River in estimating the possibility of liquid waste pollution from the agro-industry in the Tanjung Api-api industrial plan area to rivers around the Tanjung Api-api area, especially the Telang River, (d) obtaining data on the physical and chemical parameters of liquid waste in the influent and effluent of several WWTPs of the Gasing area agro-industry that have been operating. The data aims to illustrate how much wastewater is still discharged into the Gasing River after going through the existing WWTP conditions.

Method of Sampling (MPS) in the Telang River as the Tanjung Api-api industrial area, in the Gasing River near the operating industry, and in the industrial wastewater channel (WWTP influent) in Gasing. Data collection of several physical and chemical parameters was carried out as follows:

Table 2. MPS in Telang River and Gasing River

River Parameters		Instrument/method	Number of studies
A	pH	pH meter	Respectively, 1 x afternoon and evening, during high and low tide, at three points: downstream, midstream, and upstream.
B	BOD	Incubator, DO meter, and burette	
C	COD	Reflux closed spectrophotometer	
D	Fat oil	Gravimetry	
E	TSS	Gravimetry	

Description: Chemical and physical parameters were analyzed at the Environmental Laboratory of the BLH of South Sumatra Province.

Wastewater sampling procedures at the Gasing industrial WWTP are carried out by collecting from influent and effluent and carried out when the industry is running. The Gasing River and Telang River sampling methods were carried out compositely at each sampling point on the surface with a depth of 0.5m (Lumunon, Riogilang, & Supit, 2021). Parameter data samples that will be used to calculate the number of variables to be studied in the integrated WWTP treatment, taken from industries that are operating in the Gasing industrial area, can be seen in the following table:

Table 3. Parameter Data at the WWTPs of Some Industries

Industrial Influent	*WWTP*	*Parameters*	*Many Studies*
Rubber, Palm, Coconut Oil	and	Q, TSS, BOD, and X	Each one during industry operation

Variable data that will be simulated to obtain safe variables for several integrated WWTP treatment units can be seen in table 4.

Table 4. Variable Data at WWTP for Simulation

	Variables at the Gasing Industry WWTP Unit, Integrated Plan WWTP, and Dave & Lycon Theory WWTP	Parameters
1	*Primary clarifier overflow,* Q_1/A_1,	TSS
2	Tinggi *primary and secondary clarifier,* H	TSS
3	*Temperature in the aeration tank,* T_a *dan Temperature in the clarifier*, T_c	TSS
4	*Secondary clarifier overflow concentration,* Q_{E4}/A_{R4}	TSS
5	Average MLSS biosolids in the reactor, X_{E4}	TSS
6	*Residence time in reactor*, r_4	TSS

RESULTS

Data on the physical and chemical parameters of the Gasing River were analyzed at the environmental laboratory at the South Sumatra Province Environmental Agency. The physical parameters of the two rivers, both the Gasing River and the Telang River, have many similarities, including (a) the condition of the flow rate of the rivers both empty into the sea and (b) they are both influenced by sea tides. (c) both have a waste load due to population and industrial activities around the river. This research does not go so far as to analyze the water quality in natural tributaries or channels near tributaries. The number of river water quality samples from the 6 (six) representative points was 6 (six) samples, which were analyzed only by selecting the dominant parameters issued by the agro-industry as in the following table:

Table 5. Results of Telang River Water Analysis

Parameter River water	**downstream**		**Middle**		**upstream**		**BMLC (*)**
	low tide	**high tide**	**low tide**	**high tide**	**low tide**	**high tide**	
TSS, mg/l	16,30	11,90	18.60	15,60	20,30	10,900	50,00
pH, unit	6,36	6,51	6,13	6,70	6,68	6,77	6,00
BOD, mg/l	2,93	1,.30	1,12	2,83	1,08	1,29	2,00
COD, mg/l	9,70	4,10	6,35	4,01	8,10	3,75	10,00
Fat Oil	500	300	500	200	500	300	1000

, µg/l

Table 6. Gasing River Water Analysis Results

Parameter River water	downstream		Middle		upstream		BMLC (*)
	low tide	high tide	low tide	high tide	low tide	high tide	
TSS, mg/l	53,00	50,00	47,00	45,00	57,20	48,70	50,00
pH,unit	,46	4,84	4,73	5,23	4,68	5,75	6,00
BOD, mg/l	4,12	2,01	1,95	3,00	2,40	2,10	2,00
COD, mg/l	11,8	6,49	8,48	5,33	11,80	6,11	10,00
Fat Oil , µg/l	900	700	859	650	870	750	1000

The Telang River water data in the Tanjung Api-api area in table 5 is initial baseline indicator data, the aim of which is to determine the condition of the river water before the operation of agro-industrial activities. The results of the analysis show that overall physical, organic chemical and inorganic chemical parameters in the Telang River are still below the specified BMLC threshold; only the BOD parameter should be of concern because downstream of the Telang River at low tide, it reaches 2.93 mg/l and in the Telang River the middle part at high tide reaches 2.83 mg/l, where the BMLC for BOD is two mg/l (Andika, Wahyuningsih, & Fajri, 2020). This increased data, both in the lower Telang River and the middle Telang River, is caused by the activities of residents who dispose of organic waste in river waters. Gasing River water analysis data illustrates that some average parameters are almost close to the established BMLC thresholds. Several parameters exceed the BMLC standard threshold, such as the downstream TSS at low tide reaches 53 mg/l, at high tide it is 50 mg/l, and in the upstream part at low tide it reaches 57.2 mg/l, while the permitted standard BMLC parameter is 50 mg/l. The downstream fatty oil at low tide comes to 900 µg/l; at high tide, it reaches 700 µg/l, and the fatty oil is almost close to the permitted BMLC. The middle part of the Gasing River at low tide comes to 859 µg/l; at high tide, 650 µg/l, this parameter should not be greater than 1000 µg/l. The high level of some of these parameters is due to rogue industries that also do not implement their WWTP properly. The results of the analysis of tidal conditions for both the Telang River and the Gasing River can be seen in data tables 5 and 6 or read using graphs 1-4.

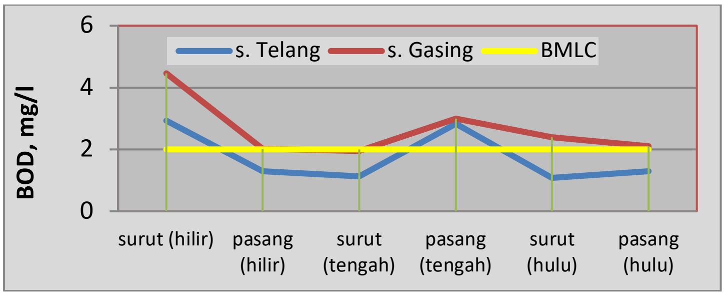

Figure 2. BOD analysis of tidal conditions

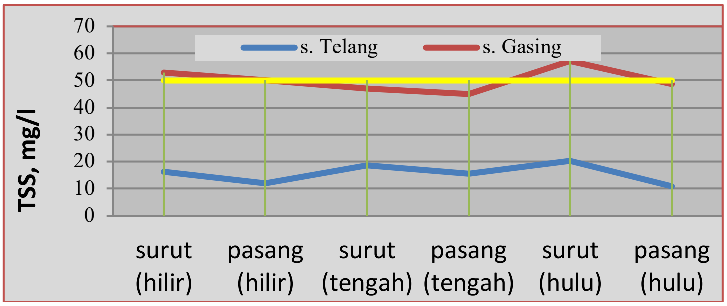

Figure 3. TSS analysis of tidal conditions

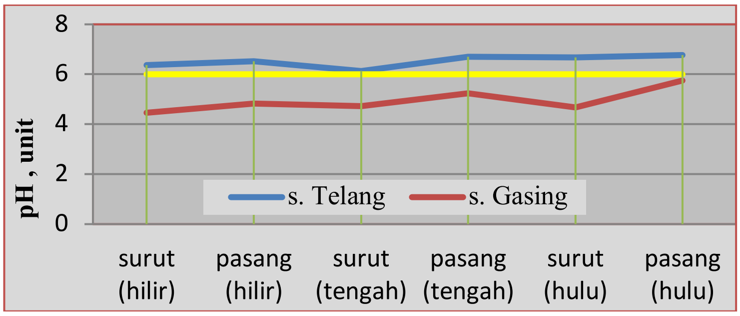

Figure 4. pH analysis of tidal conditions

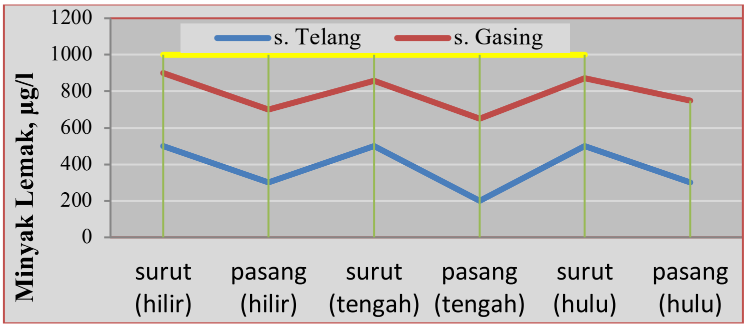

Figure 5. Fatty Oil Analysis for Tidal Conditions

The results of the analysis above can estimate that in the future, the condition of the Telang River will be more or less the same as the condition of the Gasing River if the large discharge from agro-industrial wastewater is not taken into account. So, there is a need for an integrated WWTP to address river conservation (Couto, Lange, & Amaral, 2019), especially the Telang River. Parameter analysis in the Telang River has value; it can be estimated due to (a) other activities that have been running for a long time; even though the activities are far from the industrial plan area, the water flow carries them to the river, such as the example of industries in Gasing, where the wastewater is discharged into the Gasing River where the water flows into the sea which passes through Telang River. (b) Sea tides influence the Telang River, so these rivers can receive runoff from peat swamps in the planned industrial area when sea water recedes. In contrast, river water quality is greatly influenced by the characteristics of peat water quality due to tides (Fitria, Desmaiani, Marcelina, Syafrianto, & Khairi, 2020). The influence of tides on rivers and the water quality characteristics of peat is characterized by high organic matter content and low pH (Agustina & Febriza Aquarista, 2021), so the oxygen content will be low (Wijaya, Olivia, Wibisono, Saputra, & Wang, 2019). The high level of organic matter in peat is illustrated by the high BOD value in the river (Salimi & Scholz, 2021). High BOD also affects the solubility of oxygen in water (Salimi & Scholz, 2022), so a lot of organic biomass experiences decomposition (Alvian Febry Anggana, 2018); this has the consequence of low pH values because the decomposition process produces acidic humus, causing the pH value to be quiet. (Liu, Zak, Rezanezhad, & Lennartz, 2019). The impact of water quality like this can be felt directly by the community in the form of complaints on the skin, including itching, redness and scaling (Agustina & Febriza Aquarista, 2021).

In quantitatively interpreting or predicting the magnitude of river water parameters before and after the industry operates, several river parameters must be compared to the samples studied, such as in the Gasing River. However, to see how significant the impact will be, further research is needed, such as identifying effects; for example, due to the disposal of organic waste into the waters, there will be a deficit of dissolved oxygen (Chapra, Camacho, & McBride, 2021). After identifying impacts, we can determine the water parameters that are expected to experience changes. The magnitude of the effect can use informal methods such as simple methods that are based on intuition or experience using the Leopold matrix (Momayez & Atefeh, 2019), which is continued with a formal process, namely to answer matrix questions, using the Streeter Phelps mathematical model (Long, 2020).

The results of sample analysis from industry shown in table 7 are an interpretation of all industries in general in the Gasing area and its surroundings. Analysis of wastewater data from the WWTP was carried out in the environmental laboratory at the South Sumatra Province Environmental Agency. Data analysis is aimed at reviewing two main topics describing the output value of WWTPs produced from the three industries based on upstream industrial objects with samples of upstream industries such as rubber, palm oil, and coconut industries.

Table 7. Wastewater Laboratory Analysis Results at Gasing Industrial Influent-Effluent WWTP

Industry WWTP	**TSS**			**BOD**		
	***Influent*,mg/l**	***Effluent*, mg/l**	**mg/l/ kg/ton**	***Influent*, mg/l**	***Effluent*, mg/l**	**mg/l/ kg/ton**

Rubber	187	125	100	2318	64,1	60
Palm	481	220	250	4046	89,8	100
Coconut	155	83	60	698	69.9	75

Wastewater entering and leaving each WWTP for several industries is immediately collected and analyzed in the laboratory of the Environmental Agency of South Sumatra Province. Observation results show that wastewater quality in several rubber industries is far from the safe threshold. In general, parameters still exceed the specified quality standards. This is possible because (a) the wastewater treatment plant is poorly maintained due to the existing wastewater treatment installation's lack of care and maintenance. (b) technology still uses a physical-chemical processing system, but the WWTP is not functioning optimally; for example, the analysis results in table 7, where the TSS level of the WWTP outlet is 125 mg/l, and the BOD is 64.1 mg/l. This is a problem for waste-receiving water bodies, so it is necessary to handle the WWTP optimally so that wastewater from the WWTP output can reach the BMLC by carrying out treatment stages (Cremonez, Teleken, Weiser Meier, & Alves, 2021).

The palm oil industry still uses conventional processing patterns by disposing of production waste with high levels of inorganic compounds, which produce high concentrations of solids and take a long time to decompose (Sato et al., 2019). As in table 7, the TSS parameters with outlet data reached 220 mg/l and BOD reached 89.8mg/l; both parameters are slightly below the maximum permitted limit (Asami, Golabi, & Albaji, 2021).

The indicator for coconut industrial wastewater in the form of TSS, which flows into the waters, is relatively high, with a value of 83 mg/l. This condition shows that the waste processing installation is not functioning correctly, so it may cause pollution at any time.

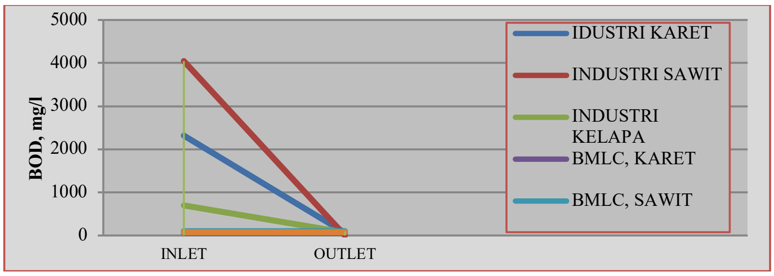

Figure 6. BOD analysis at the WWTP Inlet-Outlet

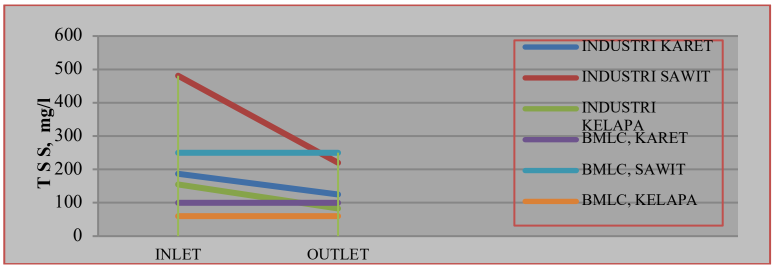

Figure 7. TSS analysis at WWTP Inlet-Outlet

In practice, the WWTP stages do not meet the proper theoretical requirements, as can be seen from the discovery that several processes at the treatment stage were not carried out, so the waste output levels did not meet the permitted environmental quality standards. Sample data from several industries representing the agro-industry in the Gasing industrial area, as follows:

Table 8. Wastewater data at the wastewater influent of the Agro Gasing Industry WWTP

Influent WWTP Industry	**Q Ton/hari**	**TSS**		**BOD**		**X mg/litre**
		mg/l	***BPM***	**mg/l**	***BPM***	
P (rubber)	1600	**187**	**100**	2318	**60**	0,9253
P (palm)	603	481	**250**	4046	**100**	0,8937
P (coconut)	168	155	**60**	698	**75**	0,8182
Total P	**2371**	**823**	**-**	**7062**	**--**	**2,6373**

Note: BPM is Maximum Pollution Load = kg parameters per unit of product

The magnitude of the TSS and BOD values from E5 in the integrated wastewater treatment plant effluent in the agro-industrial plan for the industrial area in Tanjung Api-api, and from all 3 (three) industries: rubber, palm oil and coconut were calculated using integrated WWTP, produce parameters below the permitted industrial BMLC. The simulation uses an integrated WWTP model planned for the Tanjung Api-api industrial area, using variable data values from the Lycon experiment as in table (8-11). The calculation results can be seen in the table and graph below.

Table 9. Results of TSS and BOD analysis in the effluent of the Gasing agro-industrial wastewater treatment plant and integrated wastewater treatment plant

Wastewater Parameters in Effluent	**Agro-Industry WWTP, with Q Influent (tons/day)**			
	Gasing			Tanjung Api-api: Integrated
	rubber (1600)	palm (603)	coconut (163)	(2.371)
TSS, mg/l	85/100	213/250	53/60	87,16/200
BOD, mg/l	41/60	98/100	69/75	32,19/50

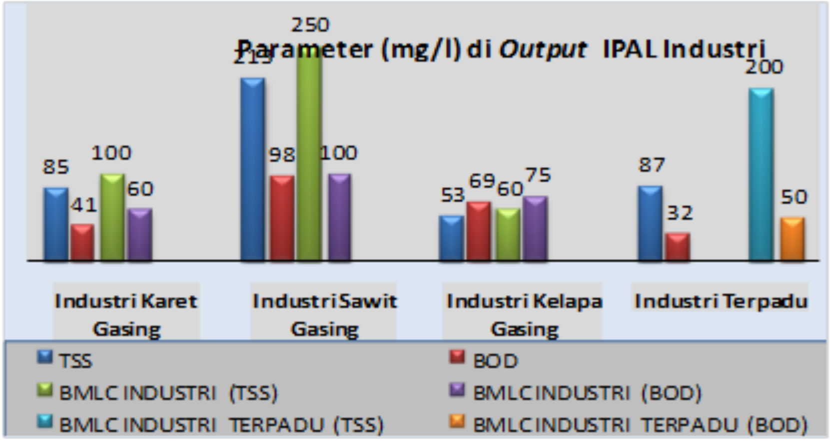

Figure 7. Parameters in the Effluent of the Agro Gasing and Integrated Agro Industry WWTPs

In terms of quantity and quality, industrial wastewater in Gasing, although below the standards of the BMLC for each industry, is almost close to the quality standards set. This can be seen from the TSS levels of WWTP outlets from the rubber industry of 85 mg/l and BOD of 41 mg/l, while the TSS of palm oil industry outlets reached 213 mg/l and BOD reached 98 mg/l. These two parameters are also almost close to the maximum permitted limits. TSS from the coconut industry is 53 mg/l, and BOD is 69 mg/l. This BOD is tight to the maximum allowable limit. The analysis results include industrial waste in the form of copra and palm oil, which contains relatively high levels of organic compounds because the waste has a high concentration of solids, so it takes longer to break down.

Solids such as sludge can become a big problem if the solution is not thought about because two effects on oxygen solubility will occur, including (a) the impact of oxygen solubility due to the presence of suspended solids, meaning that solids dissolved and suspended in river water are in the form of sludge which will increasingly become Increasingly, the solubility of oxygen in the water will decrease, so that the quality of the river will decrease. The dissolved solids in the river should not be more than 500 mg/l (Chen, Oldfield, Patsios, & Holden, 2019). River water can still be considered good if signs of plant and animal life are found in it. However, if the WWTP does not function, it will cause the river water quality to have minimal oxygen. Excess organic substances will settle on the surface. These deposits rot due to a lack of oxygen. These conditions cause the quality of the river to become dystrophic or the river water to become dead, and conditions like this also cause the river water to become anaerobic or without oxygen. River biota eventually died. (b) The influence of oxygen solubility due to the organic waste degradation process can occur if wastewater with high levels of organic material undergoes a biochemical process, namely the degradation process, which changes these compounds by taking dissolved oxygen in the water so that the presence of organic wastewater causes reduced dissolved content in water during the degradation process. Integrated WWTP can provide a solution to control and regulate wastewater output by considering the polluting load in a body of water, especially for organic waste. This is also important for project initiators to avoid costs that are too high due to waste processing that is too intensive.

Solids such as sludge can become a big problem if a solution is not thought about because there will be two effects on oxygen solubility. First, the balance of oxygen levels is disturbed due to suspended solids in the form of sludge. The increasing amount of sludge reduces the solubility of oxygen in water, so the quality of river water cannot support its biota life. The dissolved solids in the river should not be more than 500 mg/l (Chen et al., 2019). Second, is the influence of oxygen solubility due to organic waste degradation. This process occurs when wastewater with high levels of organic matter experiences a biochemical process, namely degradation. This process changes waste compounds by taking dissolved oxygen in water. As a result, this organic wastewater undergoes a decrease in the dissolved oxygen content in the water (Amor, Fernandes, Lucas, & Peres, 2020). Wastewater from industry, which predominantly contains sludge and organic substances, can cause problems for the land because sludge and organic substances from industry can degrade the land. After all, it can break the ecological cycle of the land, which can cause mangrove forests to be damaged. Likewise, rivers near industrial plants will experience a degradation process because the formed nitrite (NO2) compounds will decompose into nitrate (NO3), ultimately reducing the oxygen in the river water. All of this can cause a decline in river quality. Besides that, sludge in rivers can erode the land in its path and sludge can settle into a delta in the upper reaches of the Telang River.

CONCLUSIONS AND RECOMMENDATIONS

Overall physical, organic, and inorganic chemical parameters in Telang River are still below the specified BMLC thresholds. The wastewater load of the Gasing River is currently still relatively high, especially BOD in the downstream area with a value of 4.12 mg/l (low tide conditions) and a value of 2.01 mg/l (tide conditions), as well as TSS in the upstream area of 57.2 mg/l (common tide conditions). In terms of quantity and quality, industrial wastewater in Gasing, although below the standards of the BMLC for each industry, is almost close to the quality standards set.

It is recommended that sludge be utilized for something more valuable, considering that the TSS produced from sludge dewatering is relatively high.

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REFERENCES

Amin, Z. (2018). Penegakan Hukum Terhadap Hak Cipta Dalam Bidang Industri

Kreatif Di Negara Kesatuan Republik Indonesia. *Mimbar Keadilan, Feb*.

Bamakan, S. M. H., Nezhadsistani, N., Bodaghi, O., & Qu, Q. (2021). *A decentralized framework for patents and intellectual property as nft in blockchain networks*.

Bamakan, S. M. H., Nezhadsistani, N., Bodaghi, O., & Qu, Q. (2022). Patents and intellectual property assets as non-fungible tokens; key technologies and challenges. *Scientific Reports*, *12*(1), 2178.

Budiman, H., & Dialog, B. L. (2019). Sosialiasi Hak Cipta Dan Hak Merek Pada Kelompok Usaha Kecil Dan Menengah (Ukm) Sebagai Aset Bisnis Di Era Industri Kreatif. *Empowerment: Jurnal Pengabdian Masyarakat*, *2*(02).

Dusollier, S. (2020). Intellectual property and the bundle-of-rights metaphor. *Kritika, Essays in Intellectual Property, Edward Elgar*, *4*.

Fagundes, D., & Perzanowski, A. (2020). Abandoning Copyright. *Wm. & Mary L. Rev.*, *62*, 487.

Gorda, A. A. A. N. S. R. (2020). Sosialiasi Hak Cipta Dan Hak Merek Pada Kelompok Usaha Kecil Dan Menengah (Ukm) Sebagai Aset Bisnis di Era Industri Kreatif (Sosialisasi Hak Merek dan Hak Paten Pada Masyarakat Desa Celuk Kabupaten Gianyar). *Parta: Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 27–31.

Handayani, W. M. (2019). Keberlakuan Hukum Hak Cipta Sebagai Objek Jaminan Fidusia Berdasarkan Undang-Undang Nomor 28 Tahun 2014 Tentang Hak Cipta. *Jurnal Legislasi Indonesia*, *16*(2), 214–224.

Undang-undang (UU) Nomor 28 Tahun 2014 tentang Hak Cipta, (2014).

Kilanta, D. R. (2017). Penegakan Hukum terhadap Hak Cipta Berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta. *Lex Crimen*, *6*(3).

Liuw, S. F. S., Gosal, V. Y., & Tampi, B. (2020). Tinjauan Hukum Pengaturan Hak Cipta sebagai Objek Jaminan Fidusia menurut Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta. *Lex Privatum*, *VIII*(4), 76–85.

Mahadi. (1985). *Hak Milik Immaterial. BPHN, Jakarta*.

Munawar, A., & Effendy, T. (2016). Upaya Penegakan Hukum Pelanggaran Hak Cipta Menurut Undang-Undang Nomor 28 Tahun 2014 Tentang Hak Cipta. *Al-Adl: Jurnal Hukum*, *8*(2).

Muslihun, M. (2018). Legal Positivism, Positive Law, and the Positivisation of Islamic Law In Indonesia. *Ulumuna*, *22*(1), 77–95.

Rayes, K. L. (2020). Kedudukan Hukum PT. Inter Sport Marketing Sebagai Pemegang Lisensi Hak Cipta Piala Dunia Tahun 2014 Terhadap Penyiaran Piala Dunia Tidak Berizin oleh Pihak Ketiga. *JIPRO: Journal of Intellectual Property*, 1–30.

Senftleben, M. (2020). User generated content: towards a new use privilege in EU copyright law. In *Research handbook on intellectual property and digital technologies* (pp. 136–162). Edward Elgar Publishing.

Simatupang, K. M. (2021). Tinjauan Yuridis Perlindungan Hak Cipta Dalam Ranah Digital. *Jurnal Ilmiah Kebijakan Hukum*, *15*(1), 67.

Stim, R. (2022). *Patent, Copyright & Trademark: an intellectual property desk reference*. Nolo.

Suhayati, M. (2016). Pelindungan Hukum Terhadap Hak Ekonomi Pemilik Hak Terkait Dalam Undang-Undang Nomor 28 Tahun 2014 Tentang Hak Cipta

(Legal Protection For The Of Economic Rights Of The Related Rights'owner In Law Number 28 Of 2014 On Copyright). *Negara Hukum: Membangun Hukum Untuk Keadilan Dan Kesejahteraan*, *5*(2), 207–221.

Thalib, P. (2013). Perlindungan Hukum Terhadap Pemegang Hak Cipta Dan Pemilik Lisensi Rekaman Berdasarkanundang-Undang Tentang Hak Cipta. *Yuridika*, *28*(3), 352.

Triantoro, R. A. N., & Hadi, H. (2019). Perlindungan Hukum Bagi Pemegang Lisensi Hak Cipta Menurut Undang-Undang Nomor 28 Tahun 2014 Tentang Hak Cipta (Studi Putusan Nomor: 09/HKI. Hak Cipta/2014/PN Niaga Jo Putusan MA Nomor: 80 K/Pdt. Sus-Hki/2016). *Jurnal Privat Law*, *7*(2), 265–274.