

# EVALUATING THE CURRENT STATE OF DOMESTIC WASTEWATER QUALITY OF SONG CONG GARMENT FACTORY AND THE AUXILIARY FACTORY – TNG INVESTMENT AND TRADING JOINT STOCK COMPANY, SONG CONG CITY, THAI NGUYEN PROVINCE, VIETNAM

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## ABSTRACT

*This study was undertaken to assess the current state of the domestic wastewater environment of TNG Song Cong Garment Factory and the Auxiliary Factory, under TNG Investment and Trading Joint Stock Company, Song Cong city, Thai Nguyen province. It was carried out from January 2023 to April 2023. The author collected secondary data and information, sampled domestic wastewater and analyzed samples. Synthesizing data was compared with Vietnamese Regulations: QCVN 14:2008/BTNMT national technical regulations on domestic wastewater. Samples were preserved and analyzed at Thai Nguyen Environmental and Natural Resources Monitoring Center. Analytical indicators were followed by international standards such as SMEWW and current Vietnamese regulations. The study revealed that domestic wastewater samples going through the treatment system of Song Cong TNG Garment Factory and the Auxiliary Factory had changes in indicators when analyzing. They had very good results within the limits of column B QCVN 14:2008/BTNMT. The quality of domestic wastewater over 3 years showed that it met the regulations issued by Vietnam. Based on the findings of the study, some implications were suggested and recommendations were made for further research.*

**Key words:** *Evaluating, domestic wastewater, TNG Song Cong Garment Factory, the Auxiliary Factory, Thai Nguyen province.*

## INTRODUCTION

Nowadays, people exploit the materials and energy necessary for living activities to survive and develop from the environment. The products produced by humans are derived from the forms of matter existing on the Earth and the space surrounding the Earth. Water, soil and air which exist in the environment are indispensable factors for life, existence and enhancement of humans and organisms [1]. However, along with the development of life, the growing process of urbanization, industrialization and agricultural intensification have had many detrimental effects on these resources. Humanity has been aware that if environmental issues are not fully and carefully considered in development policy, economic growth and industrialization at a certain speed will destroy the environment [2]. The environment is at an alarming state in developing countries, including Vietnam.

Regarding water pollution in rural areas and agricultural production areas, Vietnam currently has nearly 76% of the population living in rural areas where infrastructure is still outdated, most of the waste generated by human and livestock are untreated and washed away, leading to higher organic and microbial contamination of water. In agricultural production, due to the abuse of pesticides, water sources in rivers, lakes, canals and ditches are polluted, they have impacts on the water environment and people's health. [3].

According to statistics of the Ministry of Fisheries, the total water surface area used for aquaculture of the whole country is 751,999 ha. Because of the massive aquaculture, lack of planning, and not following the technical process, it has caused many negative impacts on the water environment. Along with the excessive and improper use of chemicals in aquaculture, the residual food settles on the bottom of ponds, lakes, and rivers, the water

environment is polluted with organic substances, causing the development of some pathogenic organisms and the appearance of some toxic algae; There are even signs of red tide appearing in some coastal areas of Vietnam [4].

The globalization trend has narrowed the geographical distance and the world market has unified. Vietnamese enterprises are increasingly integrating into the world economy and have matured in all aspects, actively participating in the general trend of global trade. Vietnam's textile and garment industry has made great progress. Textile and garment enterprises take advantage of this opportunity to learn from experience as well as absorb the world's technological and managerial levels. So they gradually apply and improve productivity, quality and strive to become enterprises of international stature. Thereby, businesses have contributed to promote the image of the country, turning it into a nation with a dynamically developing economy, attracting a lot of foreign investors to Vietnam. In the face of the country's strong innovation situation, Vietnamese garment enterprises have also taken steps to keep up with the world's realities.

TNG Investment and Trading Joint Stock Company is a public company in the TOP with the most transparency, the best governance, the most sustainable development as well as a manufacturing and retailing company from the domestic market to the global market with sales revenue reaching TOP US billion dollars. The company is gradually creating "Made in TNG" products, serving domestic and export customers. Instead of simply outsourcing, the dream of making Vietnamese fashion products is gradually being realized by TNG. With 40 years of construction, development and growth, TNG Investment and Trading Joint Stock Company has 15 factories with 314 sewing lines, 2 Auxiliary factories for embroidery, industrial washing, and carton producing, carton packaging and cotton and quilting factory.

The company's head office is located in the center of Thai Nguyen province with a favorable geographical position in terms of roads and abundant natural resources. This is a very favorable condition to help Thai Nguyen promote its goal of becoming an industrial province soon. Besides the great economic contributions of the company, there are also negative impacts on the environment of this spearhead industry which is also a problem.

Although the environmental impact assessment records were fully guaranteed according to the approval decision when building factories under the company, there might be stages that did not really ensure the environmental safety in the production process. Therefore, it is necessary to evaluate the current state of the environment, especially the water environment to propose remedial solutions [5]. From the above fact, the author conducted a research: "Evaluating the Current State of Domestic Wastewater Quality of Song Cong Garment Factory and the Auxiliary Factory – TNG Investment and Trading Joint Stock Company, Song Cong City, Thai Nguyen Province, Vietnam".

## **SUBJECTS AND RESEARCH METHODS**

### **Subjects of the Study**

Domestic wastewater environment of TNG Song Cong Garment Factory and the Auxiliary Factory.

### **Research methods**

Methods of collecting documents and secondary data: Collecting documents and data on natural conditions, production process diagram, production situation of TNG Song Cong Garment Factory and the Auxiliary Factory; water quality, analysis data; domestic wastewater treatment situation; data collection place: TNG Song Cong Garment Factory and the Auxiliary Factory; Information relating to the topic was collected through the field, books, articles, and the internet.

Methods of field survey and analytical sampling: Production wastewater samples were taken and preserved according to current Vietnamese standards; Periodic sampling time: 18/11/2020; 18/2/2021; 16/8/2022.

Analytic methods in the laboratory: Samples were preserved and analyzed at Thai Nguyen Environment and Natural Resources Monitoring Center; Analytical parameters followed international standards such as SMEWW and current Vietnamese regulations.

Method of processing data: Using tools such as Microsoft Word, Microsoft Excel to synthesize and process information.

## **RESULTS AND DISCUSSION**

### **1. The current state of water use, wastewater and wastewater treatment process**

#### **1.1. TNG Song Cong Garment Factory**

All domestic wastewater generated from TNG Song Cong Factory is collected and treated in septic tanks before being discharged into the environment. The operating principle of the septic tank performs two main functions: sedimentation and sediment decomposition. The water in the tank is arranged to flow through the anaerobic sludge layer so that the organic matter is more exposed to the microorganisms in the sludge layer.

Wastewater is passed through the broken ceramic filter material before being discharged into the environment. When the water stays in the tank for 1-3 days, about 90% of the suspended solids will settle to the bottom of the tank. The residue is retained in the bottom of the tank for 3 - 6 months, under the influence of anaerobic microorganisms, the organic matter is partially decomposed, partly creating gases and partly forming soluble inorganic substances.

Domestic wastewater flow is about 1000 m<sup>3</sup>/day, of which black wastewater accounts for 20%, equivalent to 200 m<sup>3</sup>/day, black wastewater needs to be treated in septic tanks. The rest is water for washing and bathing (800 m<sup>3</sup>)... it is not treated in septic tanks. Therefore, the factory has built a system of septic tanks with a total capacity of 318 m<sup>3</sup>, meeting the treatment of all generated domestic wastewater.

## 1.2. Auxiliary Factory

The amount of generated domestic wastewater is 40 m<sup>3</sup>/day. The operating principle of the septic tank performs two main functions: sedimentation and sediment decomposition. The water in the tank is arranged to flow through the anaerobic sludge layer so that the organic matter is more exposed to the microorganisms in the sludge layer. Wastewater is passed through the broken ceramic filter material before being discharged into the environment. When the water stays in the tank for 1-3 days, about 90% of the suspended solids will settle to the bottom of the tank. The residue is retained in the bottom of the tank for 3 - 6 months, under the influence of anaerobic microorganisms, the organic matter is partially decomposed, partly creating gases and partly forming soluble inorganic substances.

The fermentation process mainly takes place in the first stage of acid fermentation, the gases generated during the decomposition are CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S, etc. The sediment in the septic tank is periodically removed. However, each time, about 20% of the fermented residue must be left in the tank to make yeast for fresh sludge to settle, creating favorable conditions for the process of sludge decomposition. Wastewater is stored in the tank for a long time to ensure high settling efficiency, then it passes through the filter compartment and exits the pipeline. Each septic tank has a vent pipe to release gases from the decomposition process.

Currently, there are 3 septic tanks (total capacity 45 m<sup>3</sup>) at 3 factories: Cotton- workshop + Embroidery, Printing and Packaging workshop. Septic tank specifications: length x width x depth = 2 x 5 x 1.5 (m). Wastewater after being treated through the septic tank will be collected by the D200 sewer system, the length of the sewer system is 1240 (m) to the wastewater collection system of Song Cong I Industrial Zone for treatment to meet the requirements of regulations before being discharged into the receiving source.

## 2. Evaluating the domestic wastewater quality

### 2.1. 2020, 2021, 2022

#### a. Year 2020

All domestic wastewater was collected and treated in a septic tank system. Analytical samples were taken at the source discharged into the wastewater collection system of Song Cong I Industrial Zone and treated to meet regulations before being discharged into the receiving source. The analysis data of domestic wastewater quality in 2020, sampled on November 18, 2020 is presented in Table 1.

**Table 1. Results of periodic domestic wastewater environmental monitoring in 2020**

Params	Unit	Results		QCVN 14:2008/BTNMT (Col B)
		TNG Garment Factory	Auxiliary Factory	
pH	-	6,8	6,5	<b>5,0-9,0</b>
BOD <sub>5</sub>	mg/l	22,3	22,3	<b>50</b>
COD	mg/l	68,7	68,7	-
TSS	mg/l	17,5	12,8	<b>100</b>
TDS	mg/l	327	323	<b>1000</b>
*S <sup>2-</sup>	mg/l	<0,1	<0,1	<b>4</b>
As	mg/l	0,0013	0,0512	-
Cd	mg/l	<0,0005	<0,0005	-
Pb	mg/l	0,0041	0,0021	-
Total Chromium	mg/l	0,0107	x	-
*Cr(VI)	mg/l	<0,01	x	-
Hg	mg/l	<0,0005	<0,0005	-

Ni	mg/l	0,0029	x	-
Cu	mg/l	0,002	x	-
Co	mg/l	<0,0005	x	-
Sb	mg/l	<0,0005	x	-
Ag	mg/l	<0,0005	x	-
Zn	mg/l	0,02	x	-
Mn	mg/l	0,108	0,107	-
Fe	mg/l	0,65	1,43	-
NO <sub>3</sub> <sup>-</sup> -N	mg/l	3,06	2,08	<b>50</b>
*NH <sub>4</sub> <sup>+</sup> -N	mg/l	3,6	3,3	<b>10</b>
*Total Nitrogen	mg/l	19,8	23,7	-
PO <sub>4</sub> <sup>3-</sup> -P	mg/l	<0,01	<0,1	<b>10</b>
Total Phosphorus	mg/l	0,4	0,7	-
*Grease	mg/l	<0,3	<0,3	<b>20</b>
*Coliform	MPN/100ml	2100	600	<b>5000</b>
*CN <sup>-</sup>	mg/l	<0,01	x	-
*Phenol	mg/l	<0,01	<0,3	-
*Surfactant	mg/l	<0,08	<0,08	<b>10</b>
**AOX	µg/l	0,15	0,26	-
DO	-	4,3	3,5	-
*Flow	m <sup>3</sup> /h	x	3,5	-

(Source: analyzing at Thai Nguyen Environment and Natural Resources Monitoring Center, 2020)

Note:

- The value after the "<" sign represents the quantitative limit of the method;
- Sign (-) means not specified;
- Sign (x) means no value;
- Parameters marked with \* are unrecognized criteria according to ISO 17025:2017;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater quality.

From the analysis data of domestic wastewater samples in Table 1, it is shown that all parameters give results below the threshold of QCVN 14:2008/BTNMT (column B). Thus, the domestic wastewater of the factory and Auxiliary factory in 2020 was safe for the environment.

**b. Year 2021**

The analysis data of domestic wastewater quality in 2021, sampled on February 18, 2021 is presented in Table 2.

**Table 2. Results of periodic domestic wastewater environmental monitoring in 2021**

Params	Unit	Results		QCVN 14:2008/BTNMT (Col B)
		TNG Garment Factory	Auxiliary Factory	
pH	-	6,9	6,8	<b>5,0-9,0</b>
DO	-	4,6	4,7	-
BOD <sub>5</sub>	mg/l	18,6	19,2	<b>50</b>
COD	mg/l	39,43	38,06	-
TSS	mg/l	48,2	48,6	<b>100</b>
TDS	mg/l	302	304	<b>1000</b>
*S <sup>2-</sup>	mg/l	<0,1	<0,1	<b>4</b>
*NH <sub>4</sub> <sup>+</sup> -N	mg/l	4,3	4,5	<b>10</b>
NO <sub>3</sub> <sup>-</sup> -N	mg/l	2,81	2,81	<b>50</b>
*Grease	mg/l	<0,3	<0,3	<b>20</b>
*Surfactant	mg/l	<0,08	<0,08	<b>10</b>
PO <sub>4</sub> <sup>3-</sup> -P	mg/l	<0,1	<0,1	<b>10</b>
*Coliform	MPN/100ml	2800	3000	<b>5000</b>



As	mg/l	0,0033	0,0033	-
Pb	mg/l	0,0009	0,0009	-
Cd	mg/l	<0,0005	<0,0005	-
Cu	mg/l	0,0007	0,0007	-
Hg	mg/l	<0,0005	<0,0005	-
Ni	mg/l	0,0009	0,0009	-
Sn	mg/l	<0,0005	<0,0005	-
*Cr(VI)	mg/l	<0,01	<0,01	-
*Cr(III)	mg/l	<0,03	<0,03	-
* Total Chromium	mg/l	0,0134	0,0134	-
Fe	mg/l	<0,3	<0,3	-
Ag	mg/l	<0,0005	<0,0005	-
Mn	mg/l	0,062	0,062	-
Co	mg/l	<0,0005	<0,0005	-
Zn	mg/l	0,139	0,139	-
F <sup>-</sup>	mg/l	<0,15	<0,15	-
Sb	mg/l	<0,0005	<0,0005	-
Cl <sup>-</sup>	mg/l	62,35	63,2	-
*Total Nitrogen	mg/l	54,9	54,3	-
Total Phosphorus	mg/l	1,0	1,2	-
*Phenol	mg/l	<0,001	<0,001	-
*CN <sup>-</sup>	mg/l	<0,01	<0,01	-
Total Organochlorine Pesticide (*)	µg/l	<0,003	<0,003	-
Total organophosphorus pesticides (**)	µg/l	<0,04	<0,04	-
**AOX	µg/l	<1	<1	-
Total PCB (**)	µg/l	<0,1	<0,1	-
*Flow	m <sup>3</sup> /h	3,5	3,5	-

(Source: analyzing at Thai Nguyen Environment and Natural Resources Monitoring Center, 2021)

Note:

- The value after the "<" sign represents the quantitative limit of the method;
- Sign (-) means not specified;
- Sign (x) means no value;
- Parameters marked with \* are unrecognized criteria according to ISO 17025:2017;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater quality.

From the analysis data of production wastewater samples in Table 2, it is shown that all parameters give results below the threshold of QCVN 14:2008/BTNMT (column B). Thus, the production wastewater of the factory and Auxiliary factory in 2021 was safe for the environment.

**c. Year 2022**

The analysis data of domestic wastewater quality in 2022, sampled on August 16, 2022 is presented in Table 3

**Table 3. Results of periodic production wastewater environmental monitoring in 2022**

Params	Unit	Results		QCVN 14:2008/BTNMT (Col B)
		TNG Garment Factory	Auxiliary Factory	
pH	-	6,8	6,9	<b>5,0-9,0</b>
DO	-	3,6	3,2	-
BOD <sub>5</sub>	mg/l	48,9	7,4	<b>50</b>
COD	mg/l	89,24	<15	-
TSS	mg/l	25,4	<2,5	<b>100</b>

TDS	mg/l	145	100,5	<b>1000</b>
*S <sup>2-</sup>	mg/l	<0,1	<0,1	<b>4</b>
*NH <sub>4</sub> <sup>+</sup> -N	mg/l	3,4	2,8	<b>10</b>
NO <sub>3</sub> <sup>-</sup> -N	mg/l	<0,3	0,92	<b>50</b>
*Grease	mg/l	<0,3	<0,3	<b>20</b>
*Surfactant	mg/l	<0,08	<0,08	<b>10</b>
PO <sub>4</sub> <sup>3-</sup> -P	mg/l	<0,1	0,26	<b>10</b>
*Coliform	MPN/100ml	4500	2800	<b>5000</b>
As	mg/l	0,0025	0,0025	-
Pb	mg/l	0,0009	<0,0005	-
Cd	mg/l	<0,0005	<0,0005	-
Cu	mg/l	0,0022	0,0012	-
Hg	mg/l	<0,0005	<0,0005	-
Ni	mg/l	0,0012	0,0005	-
Sn	mg/l	<0,0005	<0,0005	-
*Cr(VI)	mg/l	<0,01	<0,01	-
*Cr(III)	mg/l	<0,03	<0,03	-
* Total Chromium	mg/l	0,0008	<0,0005	-
Fe	mg/l	2,29	<0,3	-
Ag	mg/l	<0,0005	<0,0005	-
Mn	mg/l	0,052	0,017	-
Co	mg/l	<0,0005	<0,0005	-
Zn	mg/l	0,038	0,048	-
F <sup>-</sup>	mg/l	<0,15	<0,15	-
Sb	mg/l	<0,0005	<0,0005	-
Cl <sup>-</sup>	mg/l	11,7	11,9	-
*Total Nitrogen	mg/l	7,8	7,2	-
Total Phosphorus	mg/l	<0,3	0,4	-
*Phenol	mg/l	<0,01	<0,01	-
*CN <sup>-</sup>	mg/l	<0,01	<0,01	-
Total Organochlorine Pesticide (*)	µg/l	<0,0005	<0,0005	-
Total organophosphorus pesticides (**)	µg/l	<0,001	0,001	-
**AOX	µg/l	<1	<1	-
Total PCB (**)	µg/l	<0,001	<0,001	-
*Flow	m <sup>3</sup> /h	3,5	3,5	-

(Source: analyzing at Thai Nguyen Environment and Natural Resources Monitoring Center, 2022)

Note:

- The value after the "<" sign represents the quantitative limit of the method;
- Sign (-) means not specified;
- Sign (x) means no value;
- Parameters marked with \* are unrecognized criteria according to ISO 17025:2017;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater quality.

From the analysis data of domestic wastewater samples in Table 3, it is shown that all parameters give results below the threshold of QCVN 14:2008/BTNMT (column B). Thus, the domestic wastewater of the factory and Auxiliary factory in 2022 was safe for the environment.

## 2.2. Progress of domestic wastewater status at TNG Song Cong Garment Factory

The factory's domestic wastewater was generated from hand washing water, toilets in offices, factories and canteens of employees with an average flow of 1012 m<sup>3</sup>/day. The domestic wastewater was ordinary domestic wastewater mainly containing suspended substances (SS), organic compounds (BOD, COD), nutrients (N, P) and microorganisms. The progress of domestic wastewater quality in 3 years in Table 4 shows that all analytical parameters are within the allowable limits of the regulations (QCVN 14:2008/BTNMT column B).

**Table 4. Progress of the production wastewater quality in 3 years of TNG Song Cong Garment Factory**

Params	Unit	2020	2021	2022	QCVN 14:2008/BTNMT (Col B)
pH	-	6,8	6,9	6,8	5,0-9,0
DO	-	4,3	4,6	3,6	-
BOD <sub>5</sub>	mg/l	22,3	18,6	48,9	50
COD	mg/l	68,7	39,43	89,24	-
TSS	mg/l	17,5	48,2	25,4	100
TDS	mg/l	327	302	145	1000
*S <sup>2-</sup>	mg/l	<0,1	<0,1	<0,1	4
*NH <sub>4</sub> <sup>+</sup> -N	mg/l	3,6	4,3	3,4	10
NO <sub>3</sub> <sup>-</sup> -N	mg/l	3,06	2,81	<0,3	50
*Grease	mg/l	<0,3	<0,3	<0,3	20
*Surfactant	mg/l	<0,08	<0,08	<0,08	10
PO <sub>4</sub> <sup>3-</sup> -P	mg/l	<0,01	<0,1	<0,1	10
*Coliform	MPN/100ml	2100	2800	4500	5000
As	mg/l	0,0013	0,0033	0,0025	-
Pb	mg/l	0,0041	0,0009	0,0009	-
Cd	mg/l	<0,0005	<0,0005	<0,0005	-
Cu	mg/l	0,002	0,0007	0,0022	-
Hg	mg/l	<0,0005	<0,0005	<0,0005	-
Ni	mg/l	0,0029	0,0009	0,0012	-
Sn	mg/l	x	<0,0005	<0,0005	-
*Cr(VI)	mg/l	<0,01	<0,01	<0,01	-
*Cr(III)	mg/l	x	<0,03	<0,03	-
* Total Chromium	mg/l	0,0107	0,0134	0,0008	-
Fe	mg/l	0,65	<0,3	2,29	-
Ag	mg/l	<0,0005	<0,0005	<0,0005	-
Mn	mg/l	0,108	0,062	0,052	-
Co	mg/l	<0,0005	<0,0005	<0,0005	-
Zn	mg/l	0,02	0,139	0,038	-
F <sup>-</sup>	mg/l	x	<0,15	<0,15	-
Sb	mg/l	<0,0005	<0,0005	<0,0005	-
Cl <sup>-</sup>	mg/l	x	62,35	11,7	-
*Total Nitrogen	mg/l	19,8	54,9	7,8	-
Total Phosphorus	mg/l	0,4	1,0	<0,3	-
*Phenol	mg/l	<0,01	<0,001	<0,01	-
*CN <sup>-</sup>	mg/l	<0,01	<0,01	<0,01	-
Total Organochlorine Pesticide (*)	µg/l	x	<0,003	<0,0005	-
Total organophosphorus pesticides (**)	µg/l	x	<0,04	<0,001	-
**AOX	µg/l	0,15	<1	<1	-
Total PCB (**)	µg/l	x	<0,1	<0,001	-
*Flow	m <sup>3</sup> /h	x	3,5	3,5	-

As described in Table 4 above, all analytical parameters were within the allowable limits of QCVN 14:2008/BTNMT (column B).

However, the typical parameters of the output wastewater sample during the 3 monitoring periods of the TNG Song Cong garment factory treatment system also fluctuated, specifically: BOD value had a strong fluctuation, while the data in the first 2 years of observation fluctuated at about 18-22 mg/l, it increased sharply to 48.9 mg/l in 2022 (although not exceeding, it was quite close to the allowable limit of QCVN 14:2008/BTNMT); Although the COD value was not specified in QCVN 14:2008/BTNMT column B, in general, the monitoring results had complicated fluctuations in 3 years; TSS had a strong fluctuation with a sharp increase of about 2.5 times in 2021 to approximately 50 mg/l and decrease to about half in 2022. However, all of them do not exceed QCVN 14:2008/BTNMT (column B); NO<sub>3</sub><sup>-</sup>-N tended to decrease gradually in 3 years of observation and was much lower

than the allowable limit; Grease, surfactant and  $\text{PO}_4^{3-}\text{-P}$  were all in very small ranges, almost negligible compared to the limit. Coliforms tended to increase gradually over time with data in 2022 were 4500 MPN/100ml (approximately but still 1.1 times lower than QCVN 14:2008/BTNMT column B).

It can be seen from the results of the domestic wastewater samples after going through the treatment system of TNG Song Cong Garment Factory that there were generally complicated and erratic changes in the indicators when analyzing, but all of them had very good results within the limits of column B QCVN 14:2008/BTNMT. Thus, the factory's domestic wastewater met the safety requirements when discharged into the environment outside the factory.

### 2.3. Progress of domestic wastewater status at the Auxiliary Factory

The factory's domestic wastewater was generated from hand washing water, toilets of workers at Cotton Embroidery workshop, Printing workshop and Packaging workshop with an average flow of  $40 \text{ m}^3/\text{day}$ . The progress of domestic wastewater quality in 3 years of the Auxiliary factory in Table 5 shows that:

**Table 5. Progress of the domestic wastewater quality in 3 years of Auxiliary Factory**

Params	Unit	2020	2021	2022	QCVN 14:2008/BTNMT (Col B)
pH	-	6,5	6,8	6,9	5,0-9,0
DO	-	3,5	4,7	3,2	-
BOD <sub>5</sub>	mg/l	22,3	19,2	7,4	50
COD	mg/l	68,7	38,06	<15	-
TSS	mg/l	12,8	48,6	<2,5	100
TDS	mg/l	323	304	100,5	1000
*S <sup>2-</sup>	mg/l	<0,1	<0,1	<0,1	4
*NH <sub>4</sub> <sup>+</sup> -N	mg/l	3,3	4,5	2,8	10
NO <sub>3</sub> <sup>-</sup> -N	mg/l	2,08	2,81	0,92	50
*Grease	mg/l	<0,3	<0,3	<0,3	20
*Surfactant	mg/l	<0,08	<0,08	<0,08	10
PO <sub>4</sub> <sup>3-</sup> -P	mg/l	<0,1	<0,1	0,26	10
*Coliform	MPN/100ml	600	3000	2800	5000
As	mg/l	0,0512	0,0033	0,0025	-
Pb	mg/l	0,0021	0,0009	<0,0005	-
Cd	mg/l	<0,0005	<0,0005	<0,0005	-
Cu	mg/l	x	0,0007	0,0012	-
Hg	mg/l	<0,0005	<0,0005	<0,0005	-
Ni	mg/l	x	0,0009	0,0005	-
Sn	mg/l	x	<0,0005	<0,0005	-
*Cr(VI)	mg/l	x	<0,01	<0,01	-
*Cr(III)	mg/l	x	<0,03	<0,03	-
*Total Chromium	mg/l	x	0,0134	<0,0005	-
Fe	mg/l	1,43	<0,3	<0,3	-
Ag	mg/l	x	<0,0005	<0,0005	-
Mn	mg/l	0,107	0,062	0,017	-
Co	mg/l	x	<0,0005	<0,0005	-
Zn	mg/l	x	0,139	0,048	-
F <sup>-</sup>	mg/l	x	<0,15	<0,15	-
Sb	mg/l	x	<0,0005	<0,0005	-
Cl <sup>-</sup>	mg/l	x	63,2	11,9	-
*Total Nitrogen	mg/l	23,7	54,3	7,2	-
Total Phosphorus	mg/l	0,7	1,2	0,4	-
*Phenol	mg/l	<0,3	<0,001	<0,01	-
*CN <sup>-</sup>	mg/l	x	<0,01	<0,01	-
Total Organochlorine Pesticide (*)	µg/l	x	<0,003	<0,0005	-
Total organophosphorus pesticides (**)	µg/l	x	<0,04	0,001	-



**AOX	µg/l	0,26	<1	<1	-
Total PCB (**)	µg/l	x	<0,1	<0,001	-
*Flow	m <sup>3</sup> /h	3,5	3,5	3,5	-

The progress of domestic wastewater quality in 3 years of the Auxiliary Factory in Table 5 show that all analytical parameters were within the allowable limits of QCVN 14:2008/BTNMT column B.

However, the typical parameters of the wastewater sample in the three monitoring periods of the treatment system of the Auxiliary factory had different developments: BOD value in the first 2 years of monitoring fluctuated around 19-22 mg/l but it dropped significantly to 7.4 mg/l in 2022; Although COD value was not specified in QCVN 14:2008/BTNMT column B, in general, monitoring results decreased in 3 years from 68.7 mg/l to < 15mg/l; TSS had complicated fluctuations with a sharp increase from 12.8 mg/l in 2020 to 48.6 mg/l in 2021 and a dramatic decrease in 2022 with almost negligible monitoring results (<2, 5 mg/l). However, all of them did not exceed QCVN 14:2008/BTNMT (column B); NO<sub>3</sub><sup>-</sup>-N tended to be balanced in 3 years of observation and fluctuated in the range of 0.9 - 2 mg/l; Grease, surfactant and PO<sub>4</sub><sup>3-</sup>-P were all in very small ranges, almost negligible compared to the limit; Coliform had a rather low result in the first year of monitoring (600 MPN/100ml), but it increased sharply to about 3000 MPN/100ml in the remaining 2 years (still 1.7 times lower than QCVN 14:2008/BTNMT column B).

It can be seen from the results of domestic wastewater samples that after going through the treatment system of the Auxiliary factory, there were generally complicated and erratic changes in the analysis, but all of them had very good results within the limits of column B QCVN 14:2008/BTNMT.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

Domestic wastewater was collected through a system of wastewater collection and storage facilities, then strictly treated at the Wastewater Treatment Station. Wastewater quality showed that the water quality parameters were within the allowable limits. The company closely supervised the operation of wastewater collection and treatment works, without any problems in wastewater treatment and discharge. It can be seen from the results of domestic wastewater samples that after going through the treatment system of the TNG Song Cong Garment Factory and Auxiliary Factory, there were generally complicated and erratic changes in indicators when analyzing and commenting, but all had very good results within the limits of column B QCVN 14:2008/BTNMT. Thus, the factory's domestic wastewater met the safety requirements when discharged into the environment outside the plant.

Through surveying the current status and basing on the basis of analysis and assessment of water pollution control at Song Cong TNG Garment Factory and Auxiliary Factory, the following conclusions can be drawn: Basically, the issue of environmental protection has been cared, especially the problem of wastewater generated in the process of production and daily life. The factory had a relatively well-functioning wastewater treatment system, wastewater was collected through a system of wastewater collection and storage systems, then strictly treated at the wastewater treatment system. Wastewater quality showed that the water quality parameters were within the allowable limits of QCVN 14:2008/BTNMT.

The factory has closely monitored the operation of wastewater collection and treatment works, without any problems in wastewater treatment and discharge. In addition, the factory's wastewater flow into the general drainage system of the area for treatment rather than being discharged directly into the surrounding environment. Thereby, it can be seen that the factory has ensured good working environment conditions for employees in the factory as well as not letting the company's production activities affect the surrounding environment. The wastewater quality of the factory and Auxiliary factory has been controlled very well, it is advisable to continue with the plans established to maintain control and prepare for incident response.

### Recommendations

Since the factory's wastewater after treatment had all parameters within the safe limits specified in QCVN 14:2008/BTNMT, the factory should continue to maintain and ensure the wastewater treatment system working well. The factory needs to continue to periodically check the criteria of domestic wastewater to ensure that the water quality meets the requirements of the current Vietnamese standards and regulations. Inspection and maintenance of centralized wastewater treatment should be made regularly after completing construction as well as water supplying and drainage systems during operation.

Factory managers need to be trained about environmental and occupational safety. The Environment Department organizes educational programs and general cleaning sessions on the occasion of New Year's tree planting, World Environment Day and other holidays to raise employees' awareness of environmental protection.

Officials and employees must regularly study, exchange experiences and information on production technology innovation, waste collection and treatment with domestic and foreign facilities. Policies and regulations on environmental protection are fully propagated on the public media or general information of the factory and Song Cong City for officials and employees in particular and surrounding community in general.

Management and implementation of environmental protection are planned and the factory has a specific and detailed environmental protection program every year. The management and protection of the environment must be assigned to each management department and production workshop. The data regularly update, record and evaluate the results. If there is an incident, it will be immediately reported to the competent environmental authorities for appropriate handling measures. The Environment Department conducts monthly inspections to ensure the observance of occupational safety and health, environmental protection of employees as well as the operation of wastewater treatment systems in accordance with the working principle. The Environment Department is always ready to prevent and respond to emergencies in the factory's wastewater collection, treatment and control system.

The domestic wastewater of the TNG Song Cong Garment Factory and the Auxiliary Factory was not polluted and met the discharge standards, however, in order to ensure the effectiveness of wastewater treatment, the company needs to continue to strictly comply with management and supervision measures for environmental protection, ensure that the wastewater treatment station operates continuously and has regular supervision and inspection of the treatment system.

TNG Investment and Trading Joint Stock Company needs to commit to strictly implementing the contents of the approved Environmental Protection Scheme. The Department of Natural Resources and Environment of Thai Nguyen province and relevant agencies are requested to guide and support the Company to better implement environmental protection in accordance with the law.

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