

# A study of waste water impacts of main factories on water quality of To Lich river, Ha Noi

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**Abstract.** Waste water from industrial sites amounts to one third of total waste water discharged into To Lich river, and may have serious effects on the river water quality. With the total amount waste water of factories (Hanoi beer alcohol and beverage joint stock corporation (HABECO), Trang An JSC and Thuong Dinh industrial park) of 45,000 m<sup>3</sup>/day, these factories accounts for more than a half of total industrial waste water released into To Lich river. The analytic results of water samples taken from To Lich river show that the parameters of DO, COD, BOD<sub>5</sub>, TSS, NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup> and coliform exceed the Vietnamese Standards (QCVN 08:2008, column B<sub>2</sub>). However, the concentrations of Fe and heavy metals (Zn, Cd, Cr, Cu, Mn), are lower than the Vietnamese Standards (QCVN 08:2008, column B<sub>2</sub>), except the concentration of ion Pb, especially in the area from Thuong Dinh Industrial Park to the last segment of the river. The analytic results of waste water from the main factories (HABECO, Trang An JSC and Thuong Dinh industrial park, Hanoi Soap Joint Stock Company (HASO); Saovang Joint-stock Rubber Company (SRC); Tool No.1 Joint-stock Company (TJC)) show that, the parameters of TSS, BOD<sub>5</sub>, COD, total of nitrogen, total of phosphorus are higher than the Vietnamese standards for Industrial waste water QCVN 24:2009/BTNMT (column B). In particular, all waste water parameters of Trang An JSC are lower than the Vietnamese Standard for Industrial waste water QCVN 24:2009/BTNMT (column B), because the factory has an effective waste water treatment system. The heavy metals parameters of waste water from all factories are lower than QCVN 24:2009/BTNMT. Estimated loads of contaminants in waste water from the factories by load coefficient of IPC software show that without treatment, HABECO can release 1974 tons of BOD, 766 tons of TSS, 8.4 tons of phosphorus and 52.5 tons of nitrogen annually; Trang An JSC can release 64.8 tons of BOD, 48.6 tons of TSS, 0.6 ton of phosphorus, 1.6 tons of nitrogen and 25 tons of oil and grease; HASO releases 30 tons of BOD, 33 tons of TSS and 5 tons of oil and grease. Thus, if the waste water is not treated, it can lead to a very seriously pollution for To Lich river.

**Keywords:** To Lich river, sewage, IPC (Intergrated Pollution Control) software.

## 1. Introduction

Recently, there have recently been many studies of status of water quality and solutions of To Lich river. However, there is not much data surveys and impacts assessment of sources

affecting to water quality of the river, especially industrial waste water. These sources account for more than one-third of total volume of waste water of To Lich river (about 70.000 – 75.000 m<sup>3</sup>/day) [1], but industrial waste water containing toxic compounds are cumulative of heavy metals or persistent organic biological compounds, research of waste water will positively contribute to the understanding of

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pollution status and sources. Since then, the proposed measures can help to manage the water quality of To Lich river.

## 2. Materials and methods

To study the influence of waste water from some main factories on water quality of To Lich river, in this research findings previous studies of river water quality were collected and synthesized. Then field surveying, site selecting and sampling the river's water and industrial waste water from some main factories to analyze and compare. The water samples were preserved and analyzed in the Laboratory of Environmental Analysis, Faculty of Environmental Sciences, Ha Noi University of Sciences, VNU in accordance with the Vietnamese standard methods. Analytic apparatus, including machine atomic absorption spectrometry (AAS 6800, Japan), UV-VIS Spectrometer, and a number of common laboratory instruments and equipment are used.

From the analytic results of waste water components and data about flows from the factories, the pollutants loads are calculated (based on the parameters of software IPC - Integrated Pollution Control) [3] and the impact of this waste water on To Lich river water quality is assessed.

## 3. Results and discussion

### 3.1. Current Status of To Lich river water quality

According to the analytic results of river water samples, To Lich river is generally very polluted especially in the dry season. In rainy season, although pollutants water have been diluted but it still does not ensure environmental hygiene. In particular, DO value

increases from upstream to downstream river; BOD<sub>5</sub> value at the Hoang Quoc Viet Street and Cau Moi (Nga Tu So) are the lowest in the rainy season, respectively about 35 and 33mg/l, while that in Thuy Khe in the dry season is the highest (68mg/l), COD is 65–91mg/l (dry season) and about 50–74 mg/l (rainy season). Ratio between BOD/COD decreased gradually from upstream (0.78 mg/l) to the downstream side (0.65 mg/l).

TSS in river water is rather high from 69 to 135 mg/l. Ammonium concentration in the river is very high (approximately the lowest is 2 times and the highest is 8.3 times higher than with QCVN 08:2008, column B<sub>2</sub>). NO<sub>2</sub><sup>-</sup> concentration varies between 0.120 to 0.863 mg/l, higher than QCVN 08:2008, column B<sub>2</sub> (0.05 mg/l). Coliform beyond permissible limits in all samples (from 7 to 25 times) varies from  $6.9 \cdot 10^4$  to  $2.5 \cdot 10^5$  MPN/100ml.

pH value and concentrations of Fe and heavy metals (Zn, Cd, Cr, Cu, Mn) in all positions lie within the limit permitted under QCVN 08:2008, column B<sub>2</sub>. However, Pb levels exceed permissible limits in some parts of the river, which flows through the Thuong Dinh industrial zone and river sites are influenced by discharge of industrial activity (0.1295 mg/l at Nga Tu So). These results are relatively consistent with other studies' findings [1, 2, 4].

### 3.2. The composition of waste water from factories into To Lich river

To assess the impact of waste water from chosen factories on To Lich river water quality, sampling and components analysis in waste water from : HABECO (NM1); Trang An JSC (NM2); General discharge of waste water in Thuong Dinh Industrial Zone (NM3); HASO (NM4) SRC (NM5); TJC (NM6) are conducted. The analytic results are given in Table 1.

Table 1. Composition analytic results of waste water from some main factories

Parameters	Unit	Samples of waste water from factories						QCVN 24-2009, Column B
		NM1	NM2	NM3	NM4	NM5	NM6	
Temperature	$^{\circ}\text{C}$	29,2	29,4	28,1	28,9	28,7	29,1	40
pH	-	8	7,9	6,4	8,5	8,1	6,8	5,5 – 9
TSS	mg/l	200	85	160	185,3	81	115	100
N – Total	mg/l	35	25	25	26	23	22	30
P – Total	mg/l	5,1	5,3	5,8	5,7	5,4	5,9	6
BOD <sub>5</sub>	mg/l at 20 $^{\circ}\text{C}$	250	45	70	69	81	60	50
COD	mg/l	350	75	108	104	79	106	100
Fe	mg/l	0,5689	0,5102	0,6421	0,6576	2,1512	1,8715	5
Cr <sup>+3</sup>	mg/l	0,0125	0,0312	0,0625	0,0571	0,0781	0,0421	1
Cu	mg/l	0,0116	0,0183	0,0541	0,0149	0,0176	0,0132	2
Cd	mg/l	0,0013	0,0017	0,0054	0,0065	0,0057	0,0036	0,01
Zn	mg/l	0,0172	0,0234	0,0417	0,0167	0,0453	0,0716	3
Pb	mg/l	0,4110	0,2391	0,4961	0,4902	0,5012	0,4892	0,5
Mn	mg/l	0,0438	0,0517	0,1319	0,1376	0,1392	0,1903	1

(Source: Laboratory for Environmental Analysis–Faculty of Environmental Sciences–Ha Noi University of Sciences - VNU).

TSS, BOD<sub>5</sub>, COD of almost factories exceed the legal standards. TSS in waste water of HABECO is the highest (200mg/l), exceeding the correspondent standard QCVN 24:2009, column B by 2 times. TSS in the waste water of Trang An JSC and SRC are the lowest, respectively at 85 and 81mg/l; BOD<sub>5</sub> in waste water of all factories varies from 45 to 250mg/l, and almost exceed the QCVN

24:2009, column B, except at Trang An JSC; COD in waste water from factories is quite high, three factories exceed QCVN 24:2009 column B, except Trang An JSC and SRC.

Total nitrogen in waste water of HABECO exceed the permitted limit, while other factories meet the standard. Only parameters in Trang An JSC are standards. Because the factory has built a relatively efficient water treatment system.

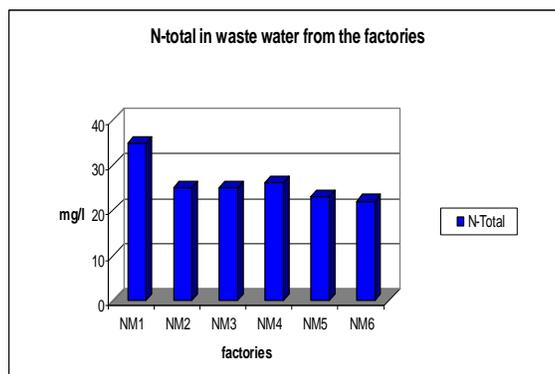


Figure 1. Total nitrogen in waste water of factories.

The concentrations of total phosphorus in waste water from factories increase from upstream to downstream of the river (ranging

from 5.1 to 5.9 mg/l). In particular, total phosphorus concentration in Thuong Dinh industrial zone is the highest (Figure 2).

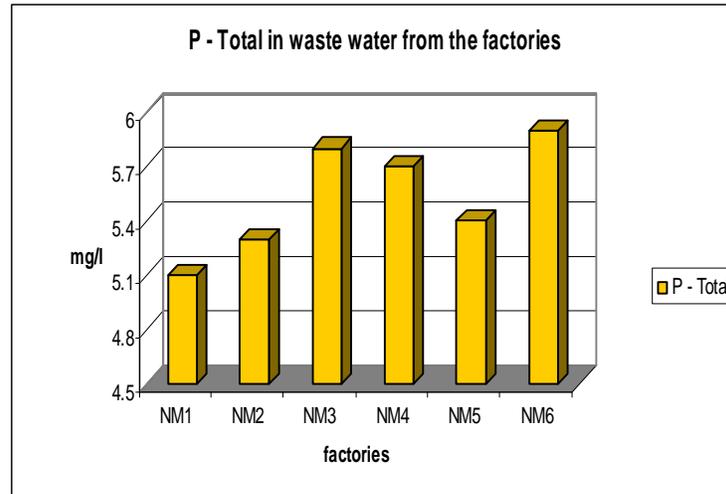


Figure 2. Total phosphorus in waste water of factories.

So, factories impact the water quality of the To Lich River. From the factory waste water analysis it is found that, the main pollutants in waste water in To Lich river Watershed (HABECO, Trang An JSC) are organic matter, nitrogen, TSS. The concentrations of non-biodegradable compounds, phosphorus, iron and other heavy metals in waste water of the factories in downstream of To Lich river (Thuong Dinh industrial zone) are higher.

Total waste water of the surveyed factories (HABECO, Trang An JSC, Thuong Dinh industrial zone), is about 45,000 m<sup>3</sup>/day, accounting for more than a half of total industrial waste water discharged into the river. Although, the waste water flow from factories is not high compared with the main sources of the river. Because it includes many non-biodegradable pollutants, it can cause severe and lasting pollution for the To Lich river.

### 3.3. The influence of pollutants loads in factory waste water on water quality of To Lich river

To assess the pollutants load in factory waste water to water quality of the river some parameters from the Integrated Pollution Control (IPC) software of the World Bank and the World Health Organization applied for developing countries were used [3].

Results show that, with current capacity the annual pollutants loads in factory waste water are as follows: HABECO discharges about 1974 tons of BOD, 766 tons of TSS, 8.4 tons of phosphorus and 52.5 tons of nitrogen; Trang An JSC - 64.8 tons of BOD, 48.6 tons of TSS, 0.6 tons of total phosphorus, 1.6 tons of nitrogen and 25 tons of oil and grease; HASO - 30 tons of BOD, 33 tons of TSS and 5 tons of oil grease.

Thus, the pollutants loads in waste water by three surveyed factories are quite high and the

highest is at HABECO. If this waste water is not treated before being discharged into the river, it will greatly affect the water quality of To Lich river.

#### 4. Conclusions

In most of the entire of To Lich river the parameters of DO, COD, BOD<sub>5</sub>, TSS, NH<sup>4+</sup>, NO<sub>2</sub><sup>-</sup>, coliform are higher than standards. However, the levels of Fe and heavy metals such as Zn, Cd, Cr, Cu, Mn meet the standard, only the concentration of Pb exceeds the permitted standards, especially in Thuong Dinh Industrial Zone.

The quality of discharge water from factories into rivers: the parameters such as TSS, BOD<sub>5</sub>, COD, nitrogen, phosphorus in waste water discharging into the To Lich river from the factories (HABECO, Thuong Dinh Industrial Zone, HASO, SRC, TJC) do not meet the permitted standards. Only Trang An JSC has installed a water treatment system, so its waste water discharge meets the standard. The concentrations of heavy metals in waste water of the factories meet the standard.

Calculations of pollutants loads in waste water from some factories by IPC software show that, if not treated, the annual pollutants loads of HABECO are about 1974 tons of

BOD, 766 tons of TSS, 8.4 tons of phosphorus and 52.5 tons of nitrogen; Trang An JSC approximately 64.8 tons of BOD, 48.6 tons of TSS, 0.6 tons of phosphorus, 1.6 tons of nitrogen, 25 tons of oil and grease; HASO about 30 tons of BOD, 33 tons of TSS, 5 tons of oil and grease. So, if not treated before being discharged into To Lich River, it will cause serious pollution to the river.

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