

Comparison Of Vietnam And Poland Industrial Wastewater Regulation: A Study Of Trang Bach Coal Mine Wastewater Treatment

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Abstract: The research about wastewater treatment in laboratory scale of Trang Bach coal mine in Vietnam was carried out in the year of 2016. We concluded the content of chemical compound that needed to treat the pH, Fe, Mn component and Turbidity & Suspended Solids (TSS) in the wastewater to meet the requirement of the Technical Regulation for Industrial Water of Vietnam. In this article, we suppose to compare the Vietnam and Poland regulations for industrial wastewater based on the result of our research about Trang Bach coal mine wastewater treatment before and then assess the potential to exchange the scientific works about wastewater treatment between Vietnam and Poland.

1. Introduction:

The coal mining industry in Vietnam has played an important role in economic growth [1]. It is estimated that the coal consumption of Vietnam in 2018 is 40 million tons, with 29 million tons for the coal electric plants [4]. The current direction of coal industry development plan in Vietnam is not to develop at any cost but to find a way for sustainable socio-economic development, satisfying human's both physical and spiritual needs, enhance the international cooperation to apply the advantage technology into the exploitation and management tasks [2]. In parallel with it, Vietnamese and Polish people have started since the last decade of the 20th century their efforts in promoting human resource capacities and to enhancing international understanding and friendship between the two countries, especially in the mining field [3]. This article is also a result of the research cooperation between Vietnam and Poland. The first author, a Vietnamese student, continues the Master degree in AGH University of Science and Technology, Krakow, Poland (AGH UST) after his graduation in Hanoi University of Mining and Geology, Vietnam (HUMG). Meanwhile, the second author, a Polish Ph.D. student in AGH UST, takes part in the "Erasmus+ exchange program" in HUMG.

The authorities in Vietnam are putting a huge effort to minimize the environmental risk in mining, especially in the wastewater treatment [2]. In this article, we suppose to compare the technical regulation for the wastewater of Vietnam and Poland, not only in theory but also in practice, base on our previous research about the wastewater treatment research in laboratory scale for the Trang Bach coal mine in Vietnam. We hope that this will be a contribution for the sustainable development of the coal mining industry in Vietnam as well

as a suggestion for a new direction for student scientific exchange between the two countries in the future.

2. Methodology:

In this article, we will use national technical regulations for the industrial wastewater from both countries, Vietnam and Poland, Vietnam to compare these regulations and point out the differences and similarity between them. After that, we will base on our previous research about the wastewater treatment in laboratory scale for the Trang Bach coal mine, Vietnam as a case study to bring the theory to practice.

3. The technical regulations on the industrial wastewater in Vietnam and Poland:

The current national technical regulation on industrial wastewater in Vietnam is QCVN 40:2011/BTNMT, issued by the Ministry of Natural Resources and Environmental, Vietnam in 2011 [[5]. It controls the maximum allowance value of 33 pollution parameters in industrial wastewater before discharging into the natural channel. These parameters are separated into 2 ranks, rank A is for discharging directly into the sources that be used for water supply, serving human demand (drinking, daily needs,...), otherwise, the rank B is the requirement discharging the wastewater into the other sources [[5]. The Department of Water Resource Management, Ministry of Natural Resources and Environmental, Vietnam is responsible for the supervision of the implementation of this regulation [6]. This regulation is the innovation of QCVN 24:2009/BTNMT - National Technical Regulation on Industrial Wastewater, which was issued in 2009 [[5]. The first regulation about the quality of industrial wastewater quality in Vietnam was promulgated in 1995, named TCVN 5945 – 1995 [7]. Ten years later, it was replaced by the “TCVN 5945 - 2005: Industrial wastewater - Discharge standards” [8]. In 2009, the industrial wastewater regulation of Vietnam was upgraded to “ QCVN 24: 2009/BTNMT, National Technical Regulation on Industrial Wastewater” before being represented by the QCN 40:2011 since 2011.

Regulations for wastewater in Poland before discharging to natural channels are represented by Regulation of the Minister of Environment from 18 of November 2014 when pumping sewage into waters or to land and on substances particularly harmful to the aquatic environment and by the Regulation of the Minister of Environment from 27 November 2002 when pumping sewage into the surface waters that used for supply. The regulation first specifies:

- substances particularly harmful to the aquatic environment, causing water pollution that should be eliminated, and substances in particular harmful to the aquatic environment, causing pollution of water, which should be restricted;
- conditions to be met when introducing sewage into waters or into the ground, incl maximum permissible contamination values, and conditions to be met in the purpose of agricultural use of sewage;
- location and minimum frequency of sampling of wastewater, reference methodologies
- analysis and assessment of whether sewages meet the required conditions;

- maximum permissible pollution values for wastewater from sewage treatment plants for household and municipal purposes as well as for wastewater from sewage treatment plants in the agglomeration.

Meanwhile, the second specifies:

- the requirements for surface water used to supply the population in water intended for consumption called hereinafter "waters";
- the frequency of sampling water, methodology reference analyzes and assessment of whether the water meets the required conditions.

The important parameters of wastewater in coal underground mining are pH value, the content of Iron (Fe), Manganese (Mn) and Turbidity & Suspended Solids (TSS) [9]. They are clarified in both regulations from Vietnam and Poland (Tab.1 and Tab.2)

Table 1. The requirement parameters on pH, Iron, Manganese, and TSS in industrial wastewater in Vietnam [5]

	pH	Fe (mg/l)	Mn (mg/l)	TSS (mg/l)
A level - QCVN 40:2011/BTNMT	6 – 9	1	0.5	50
B level - QCVN 40:2011/BTNMT	5.5 - 9	5	1	100

Table 2. The requirement on pH, Iron, Manganese, and TSS in industrial wastewater in Poland [14-15]

	pH	Fe (mg/l)	Mn (mg/l)	TSS (mg/l)
Regulation of the Minister of Environment from 18 of November 2014 (entering sewage into waters or into the soil)	6.5 – 9.0	10	-	50
Regulation of the Minister of Environment from 27 November 2002 (water intended for consumption) – Category A1 will be considered only	6.5 – 8.5	0.1 – 0.3	0.05	25

4. Identification Of The Optimal Dosage Of Chemical Compounds In The Wastewater Treatment Of Trang Bach Coal Mine On Laboratory Scale:

The Trang Bach coal mine is 80km far from Hanoi, the capital city of Vietnam, this is an underground coal mine which has a large amount of contamination in the wastewater due to the accumulation of the material within the wastewater during the exploitation activities [11]. The wastewater in the Trang Bach coal mine is highly acidic and contains a great amount of iron, manganese and suspended solid content [12-13]. The quality of wastewater after treatment in the Trang Bach coal mine sometimes did not meet the requirement of the technical regulation on the industrial wastewater in Vietnam and Poland (Tab.3)

Table 3. The quality of wastewater of Trang Bach coal mine after treatment in 2014, 2015 [12-13]

No	Value	2014			2015			QCVN 40:2011 /BMT	Regulation of the Minister of Environment from 18 of November 2014 (entering sewage into waters or into the soil)	Regulation of the Minister of Environment from 27 November 2002 (water intended for consumption) – Category A1 will be considered only
		5-2014	8-2014	11-2014	5-2015	9-2015	10-2015	B level		
1	pH	6.8	4.8	5.2	3	5.6	5.9	5.5-9	6.5-9	6.5-8.5
2	TSS (x10 mg/l)	1.1	6	5.3	3.4	2.7	1.8	10	50	25
3	Fe	0.8	5.9	3.91	5.7	5.0	5.52	5	10	0.1-0.3

	(mg/l)	1	5		1	5				
4	Mn (mg/l)	0.5 6	0.7 1	0.64	0.9 6	1.2 5	1.46	1	-	0.05

The wastewater samples in Trang bach coal mine were collected in the dry season of 2016, they are highly acidic and contaminated by iron, manganese, and TSS [10]. Table 4 shows the average quality of Trang Bach coal mine's wastewater samples:

Table 4. The quality of wastewater samples in comparison with the regulations [10]

	pH	Fe (mg/l)	Mn (mg/l)	TSS (mg/l)
Result	3.31	5.9	24.4	148
B level - QCVN 40:2011/BTNMT standard	5.5 - 9	5	1	100
Regulation of the Minister of Environment from 18 of November 2014 (entering sewage into waters or into the soil)	6.5 – 9	10	-	50
Regulation of the Minister of Environment from 27 November 2002 (water intended for consumption) – Category A1 will be considered only	6.5 – 8.5	0.1 – 0.3	0.05	25

Firstly, the calcium oxide was used to increase the pH value to meet the requirement of the B level - QCVN 40:2011/BTNMT standard, which also brings a positive effect in decreasing the iron content. Secondly, the authors used the PAC - Poly Aluminium Chloride ($Al_m(OH)_nCl_{3m-n} \cdot xH_2O$, with $m \leq 10$, $2 \leq n \leq 5$) to deal with the manganese and TSS content, the performance of the chemical reaction was supported by the Jar-test stirring standard [10]. The study concluded that on the laboratory scale, the optimal dosage of chemical compounds for the wastewater treatment process in Trang Bach coal mine is 280 mg/l CaO 70 % and 125 mg/l PAC to meet the requirement of national technical regulation on industrial wastewater of Vietnam (Table 5).

Table 5. The quality of wastewater sample after the treatment with 280 mg/l CaO 70 % and 125 mg/l PAC [10]

pH	Fe (mg/l)	Mn (mg/l)	TSS (mg/l)
5.53	0.11	1	0

Final results after wastewater treatment are not accepted by Polish regulations for water conditions to be met when introducing sewage into waters or to land, and on substances, particularly harmful to the aquatic environment and also did not meet an agreement with regulations about water for supply population in water intended for consumption.

5. Discussion and Conclusion

The wastewater quality of Trang Bach coal mine is not good enough to be discharged immediately into the surface water. After treatment process by using 125 mg/l PAC quality is still too low to pass all regulations from Regulation of the Minister of Environment from 27 November 2002 on the requirements to be met by surface waters used for supply population in water intended for consumption. In comparison with both Polish regulations, the content of Fe and TSS meet the requirement but the pH and Mn does not. This result shows that there is a possibility to apply a similar study into the wastewater treatment for the coal mines in Poland.

In term of the corporation enhancement between Vietnam and Poland, based on the education background of the first and the second authors and the positive which was obtained after the time we were working together, we recommend the authorities from both countries to think about a new approach for student scientific exchange between the two countries. The student from Poland could come to Vietnam and do the research with Vietnamese student in laboratory scale, in contrast, the Vietnamese student could improve their skills through exchange programs in Poland under the support of Polish student.

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