AES MONG DUONG POWER CO. LTD.

MONG DUONG 2 BOT COAL FIRED POWER PLANT

---***---

ENVIRONMENTAL MONITORING REPORT FOR ASH POND 2

MONG DUONG 2 BOT COAL FIRED POWER PLANT

March- 2023

HA NOI, MARCH– 2023

AES MONG DUONG POWER CO. LTD.
MONG DUONG 2 BOT COAL FIRED POWER PLANT
---*---**

ENVIRONMENTAL MONITORING REPORT FOR ASH POND 2

MONG DUONG 2 BOT COAL FIRED POWER PLANT

MARCH- 2023

Invested by
AES MONG DUONG POWER CO. LTD.

Implemented by
BACH KHOA ENVIRONMENTAL AMICABLE TECHNOLOGY, JSC. (BKEST)

M.S.D.N: 0103772... C.T.C.P
CÔNG TY CỔ PHẦN CÔNG NGHỆ THÂN THIỆN MÔI TRƯỜNG BÁCH KHOA
Q. HAI BÀ TRƯNG - T.P HÀ NỘI

GIÁM ĐỐC
Nguyễn Ngọc Việt

HA NOI, MARCH- 2023

CONTENTS

FIGURES

TABLES

GENERAL INTRODUCTION ON ASH POND 2 - MONG DUONG 2 BOT COAL FIRED POWER PLANT

The area of ash pond 2 of Mong Duong 2 BOT Coal Fired Power Plant is 187 ha and it is located at the Cong Hoa commune, Cam Pha town. It was about 4.3 km in the North of Mong Duong plant and about 50 km far from Ha Long city and 18 km from Cam Pha town. The ash pond 2 was designed to contain the amount of ash during 30 years of Mong Duong plant's operations.

The ash pond 2 included the system of ash boxes, dam around ash pond and dam around ash boxes, collecting rainwater drainage system, sewage pipeline of the dimissing slag from the Mong Duong 2 BOT project to the ash pond 2 and circulation rainwater pipeline from the ash pond 2 to the plant (10ha).

The total area of other auxiliary construction is 0.204 ha. These include pump stations, operator house, electric lines supplying for recirculation wastewater pump station in ash pond 2, the roads leading to ash pond.

The auxiliary components of ash pond 2 detail as in the following table:

Table 1.1. The auxiliary components of ash pond 2

No.	Components	Technical parameters
1	Road to ash pond	- Length: 300m - Width: 6m
2	Road to ash pond B	Surface top of dikes, dams with a width of 10m
3	Drainage channel of basin	- Rectangular channel system, steel-rod concrete - Slope: 1:2 - Length: About 2500m.
4	Recirculation pump station	- In the West of ash pond, steel-rod concrete - Dimensions: 13.5 x 6.0 x 6.2 - Pump system configuration is 3x50%.
5	Operation house	- Office area: Area is 60m^2, steel frame structure - Storage area: Area is 100m^2.

Conterminous areas around ash pond 2 include:

- The West area and the South area of ash pond 2 abuts with Thac Thay river.

- The North area of ash pond 2 abuts with residental area of Ha Chanh village, Cong Hoa commune and is far about 250 m from residential area.

- The East area of ash pond 2 abuts with Thai Viet Long construction material producting company and is far 250 m from Ha Chanh inter-village road.

- About 750m from the North of Cam Pha brick factory

- About 300m from the South East of Ha Chanh clay mine.

- About 500m from the South of Thanh Dinh wood manufacturing company.

The feature of ash pond has good character of topography and geology, sparse population, mainly hills, mountains, river and stream. The main traffic is road. Rivers, canal around ash pond has small capacity of water and is not suitable for transportation. Therefore, ash transportation is mainly on the road.

The location and total area of ash pond 2 are shown in **Figure 1.1; 1.2.**

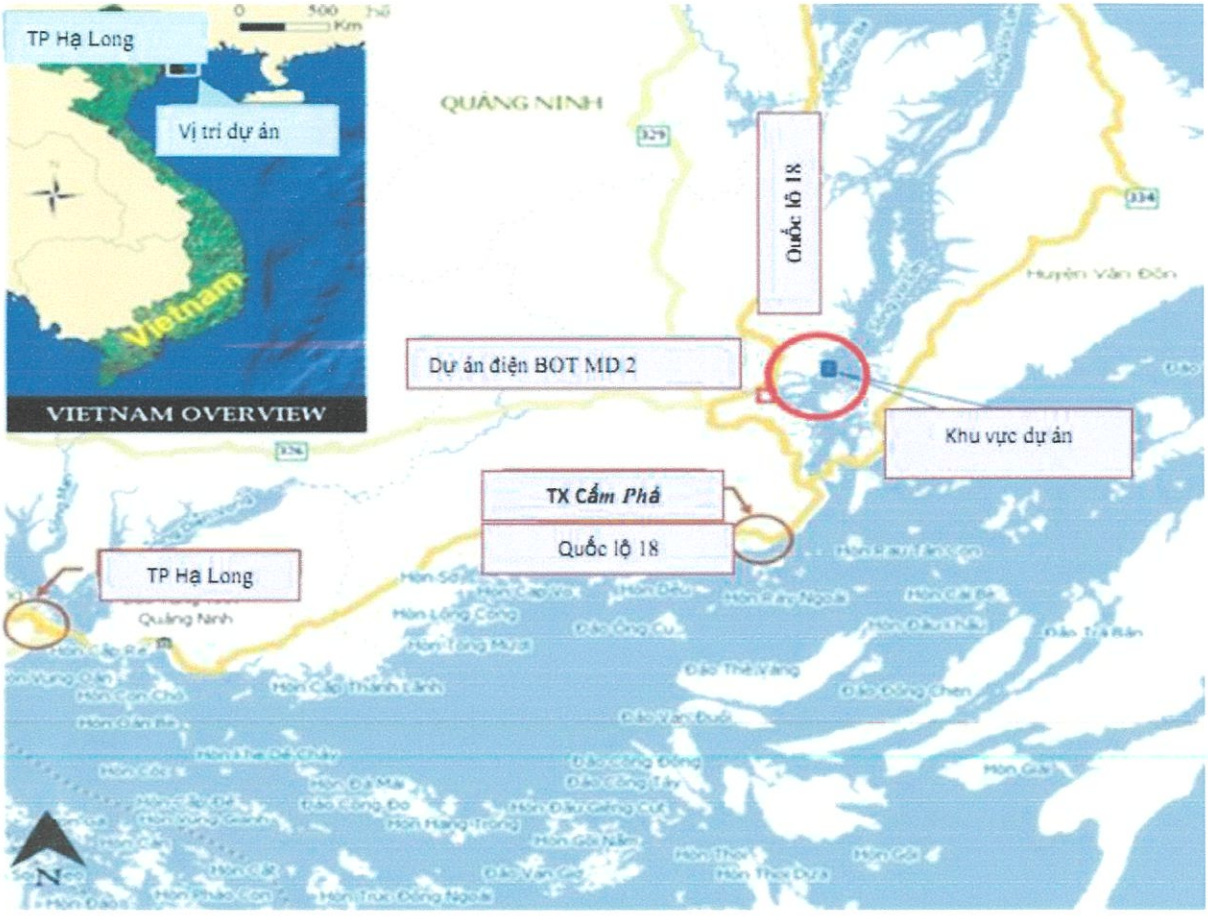


Figure 1.1. Geographical location of ash pond 2

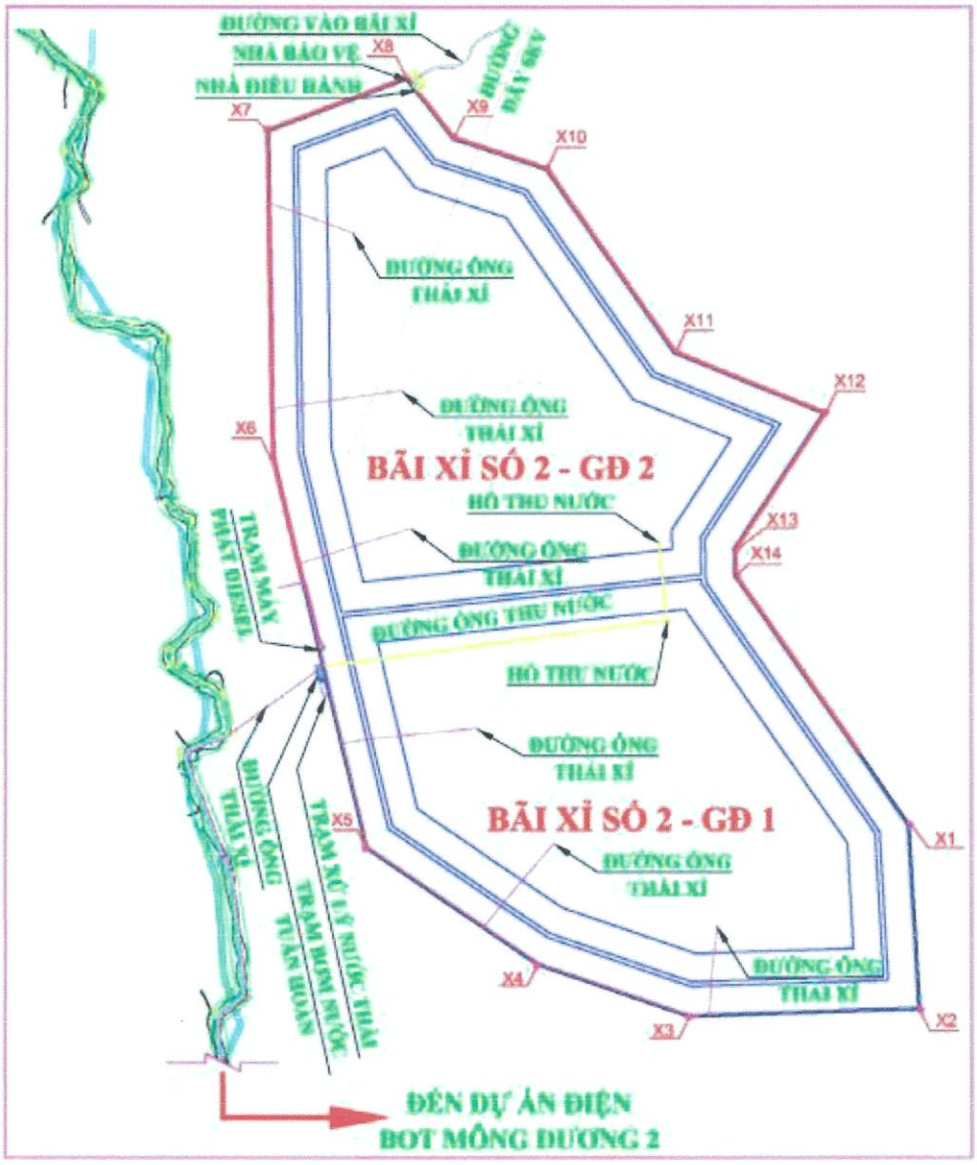


Figure 1.2. The general area of ash pond 2

CHAPTER I. PLAN OF ENVIRONMENTAL MONITORING PROGRAM IN ASH POND 2 - MONG DUONG 2 BOT COAL FIRED POWER PLANT IN 2023

The 1st monitoring time in ash pond 2 - Mong Duong 2 BOT Coal Fired Power Plant (operation stage) was implemented at the end of September, 2015 and the monitoring of environment in March 2023 was the 31st monitoring time. The main purpose is to evaluate the environment status of ash pond 2 during operation stage. Environmental monitoring program is conducted periodically (3 months/time) to make periodical report on environment quality of ash pond 2 in Mong Duong 2 BOT Coal Fired Power Plant.

I.1. The purpose of monitoring program

The purpose of monitoring program is to evaluate the environmental quality of ash pond 2 to examine the pollution level of each environmental component and to collect continuous data to serve environmental management works for Mong Duong 2 BOT Coal Fired Power Plant and Mong Duong Electricity Power Centre.

In detail:

- ✓ Components, sources, concentration/contents/intensity of environmental pollution agents
- ✓ The influence capacity of agents in environment
- ✓ Forecasting changes in the levels and effects of these agents
- ✓ Informing to managers, namely management board of Mong Duong thermal power plant to take measures in order to mitigate or prevent the harmful effects of environmental pollution caused by the operation of Ash pond 2.

Besides, this environmental monitoring program is also followed the requirements of approved EIA report of ash pond 2 - Mong Duong 2 BOT Coal Fired Power Plant (November, 2011); wastewater discharge permit No. 2736/GP-BTNMT (26th December, 2015) and permit for completing environmental protecting construction No 18/GXN-TCMT (4th February, 2016) and the latest is the Environmental License No. 199/GPMT-BTNMT issued on August 31st, 2022.

The environmental licenses include: Permit for wastewater discharge into water sources No. 2736/GP-BTNMT dated October 26th, 2015, Decision No. 2763/QD-

BTNMT dated October 28th, 2015 of the Minister of Natural Resources and Environment, and Certificate of completion of environmental protection works No. 18/GXN-TCMT dated February 4th, 2016 of the General Department of Environment and expired from the effective date of Environmental License No. 199/GPMT-BTNMT issued on August 31st, 2022.

I.2. Environmental monitoring parameters and frequency in 2023

All the environmental monitoring parameters are selected typically for each environmental component.

For ash pond 2 - Mong Duong 2 Thermal Power Plant, monitoring selected parameters are strictly complied with EIA report (2011) and are based on the fact operating stage of the ash pond 2.

Main monitoring parameters and frequency are shown in table below:

Table 1.2. Environmental monitoring parameters and frequency for the 31st (3/2023) monitoring program in AP2

No.	Ash pond 2	Quality	Parameters	Locations
I	**Water environment**			
1	Wastewater	2 locations	Temperature, pH, Color, TSS, COD, BOD_5, As, Hg, Pb, Cd, Cr3, Cr6, Cu, Zn, Ni, Mn, Fe, Total mineral Oil and Grease, residual chlorine, Sunfua, total N, total P, Ammonium, Florua, Cyanide, Phenol, Coliform	AP-W1: Wastewater from neutralization tank AP-W2: Wastewater from discharge point to Thac Thay river
2	Ground water	4 locations	pH, temperature, DO, E. Coli, turbidity, TDS, COD, BOD_5, NH_4^+, NO_3^-, Cl^-, total N, total P, Coliform, oil and grease, Cd, As, Hg, Pb, Fe, Cr, Zn	GW1: Operator house of ash pond 2 GW2: Residential area – Ha Chanh village, Cong Hoa commune – about 350m from the North of ash pond 2 (Mr. Tran Van Lai 's household-area 1) GW3: Residential area - Ha Chanh village, Cong Hoa commune – about 350m from the North East of ash pond 2 (Mr. Diep Van Sinh B's household- area 2) GW4: Residential area - Ha Chanh village, Cong Hoa commune – about 150m from the East of ash pond 2 (Mr. Diep Van Thu's household – area 2)
3	Surface water in receiving resource	2 locations	Temperature, pH, DO, TSS, Nitrit, Florua, COD, BOD_5, Ammonium, Nitrat, Clorua, Phosphat, Cyanide, total mineral oil and grease, Coliform, As, Cd, Pb, Hg, Fe, Ni,	SW1: Thac Thay river, about 100m from the upstream SW2: Thac Thay river, about 100m from the downstream

			Mn, Cr6, Cr, Cu, Zn, Surfactant, phenol, E.Coli	
II	**Noise**			
1	Noise	1	Leq, Lmax	AP2-N: Wastewater treatment plant

I.3. Monitoring positions

All the environmental monitoring positions are selected by the fact situation of ash pond 2 at operation stage and followed by Environmental License No. 199/GPMT-BTNMT issued on August 31st, 2022.

The survey was conducted before sampling to examine the monitoring points by GPS-Silva-21802-901, Sweden. The coordinates are listed as in **Table 1.3** follows:

Table 1.3. The coordinates of monitoring points in ash pond 2

Environmental Aspect	No	Locations	X	Y
I. WATER ENVIRONMENT				
Wastewater	AP-W1	Wastewwater from neutralization tank	21°11'21"N	107°35'44"E
	AP-W2	Wastewater from discharge point to Thac Thay river	21°11'21"N	107°35'42"E
Ground water	GW1	Operator house of ash pond 2	21°12'23" N	107°35'56"E
	GW2	Residential area – Ha Chanh village, Cong Hoa commune – about 350m from the North of ash pond 2 (Mr. Tran Van Lai 's household- area 1)	21°12'43" N	107°35'75"E
	GW3	Residential area - Ha Chanh village, Cong Hoa commune – about 350m from the North East of ash pond 2 (Mr. Diep Van Sinh B's household- area 2)	21°12'10" N	107°36'15"E
	GW4	Residential area - Ha Chanh village, Cong Hoa commune – about 150m from the East of ash pond 2 (Mr. Diep Van Thu's household – area 2)	21°11'88" N	107°36'21"E

Environmental Aspect	No	Locations	X	Y
Surface water (in receiving resource)	SW1	About 100m from outlet of Ash pond 2 to upstream, on Thac Thay river	21°11'82"N	107°35'06"E
	SW2	About 100m from outlet of Ash pond 2 to downstream, on Thac Thay river	21°11'02"N	107°35'24"E
Noise	AP2-N	Wastewater treatment plant	21°6'43.23"N	107°21'15.47"E

I.4. Environmental monitoring method and equipment/instruments

Main environmental monitoring methods are:

- ✓ Surveying, collecting data, sampling, on-field measurement;
- ✓ Sampling, preservation and measurement on-field and laboratory in compliance with current Vietnamese standards, circulars and regulations;
- ✓ Data processing and evaluation, statistical method in comparison to QCVN/TCVN.

Methods for measurements, sampling and preservation; equipment/instruments are as in **Table 1.4 and Table 1.5**

Table 1.4. Method for measurement, sampling and preservation

No	Environmental components	Name/ number of sampling and measurement methods	Equipment / LOD
SURFACE WATER		TCVN 6663-1:2011, TCVN 6663-3:2016, TCVN 5994-1995, TCVN 6663-6:2008, TCVN 8880:2011	
1	pH	SMEWW 2550B:2017	4 - 50°C
2	Temp	TCVN 6492:2011	2 - 12
3	Conductivity (EC)	SMEWW 2510:2017	0 - 100 mS/cm
4	Dissolved Oxygen (DO)	TCVN 7325:2016	0 - 16 mg/L

WASTEWATER		TCVN 6663-1:2011, TCVN 5999:1995, TCVN 6663-3:2016, TCVN 8880:2011	
1	Temp.	SMEWW 2550B:2017	4 - 50°C
2	pH	TCVN 6492:2011	2 – 12
GROUND WATER		TCVN 6663-1:2011, TCVN 6663-11:2011, TCVN 6663-3:2008, TCVN 8880:2011	
1	pH	TCVN 6492:2011	2 - 12
2	Temp	SMEWW 2550B:2017	4 - 50°C
3	Conductivity (EC)	SMEWW 2510B:2017	0 - 100 mS/cm
4	Dissolve Oxygen (DO)	TCVN 7325:2016	0.1 - 20 mg/L
NOISE		TCVN 7878-2:2010	30 - 130 dB

Table 1.5. Analytical methods in the Laboratory

No	Environmental components	Name/ number of analytical methods	MDL/LOD
WASTEWATER			
1	Colour	TCVN 6185: 2015	5 Pt -Co
2	BOD_5 (20^OC)	TCVN 6001–1:2008	1 mg/L
3	COD	SMEWW 5220C:2017	2 mg/L
4	Total suspended solid (TSS)	TCVN 6625 : 2000	2 mg/L
5	TDS	SOP-TDS	0 - 1.999mg/L
5	Arsenic (As)	EPA 200.8	0.001 mg/L
6	Mercury (Hg)	EPA 200.8	0.001 mg/L
7	Lead (Pb)	EPA 200.8	0.0005 mg/L
8	Cadmium (Cd)	EPA 200.8 TCVN 6193:1996	0.0005 mg/L 0.016 mg/L
9	Chrome VI	TCVN 6658:2000	0.006 mg/L
10	Chrome III	EPA 200.8 & TCVN 6658:2000	0.006 mg/L
11	Copper (Cu)	EPA 200.8 TCVN 6193:1996	0.001 mg/L 0.05 mg/L
12	Zinc (Zn)	EPA 200.8	0.005 mg/L

No	Environmental components	Name/ number of analytical methods	MDL/LOD
		TCVN 6193:1996	0.03 mg/L
13	Nickel (Ni)	EPA 200.8	0.001 mg/L
14	Manganese (Mn)	EPA 200.8	0.0015 mg/L
15	Iron (Fe)	EPA 200.8	0.005 mg/L
16	Mineral Oil	SMEWW 5520B&F:2017	0.3 mg/L
17	Fluoride (F-)	SMEWW 4500-F.B&D:2017	0.03mg/L
18	Sulfide (calculated by H_2S)	TCVN 6637:2000	0.03 mg/L
19	Total Nitrogen	TCVN 6638:2000	3 mg/L
20	Total Phosphorus	TCVN 6202: 2008	0.01 mg/L
21	Residual Chlorine	TCVN 6225 – 3:2011	0.1 mg/L
22	Ammonium (calculated by N)	SMEWW 4500 NH_3.F:2017	0.03 mg/L
23	Coliform	TCVN 6187-2:1996	3 MPN/100mL
SURFACE WATER			
1	Color (pH=7)	TCVN 6185: 2008	5 Pt -Co
2	Total Suspended solids (TSS)	TCVN 6625 : 2000	2 mg/L
3	BOD_5 (20^oC)	TCVN 6001–1:2008	1 mg/L
4	Ammonium NH_4^+	SMEWW 4500 NH_3.F:2017	0.03 mg/L
		TCVN 6179-1:1996	0.03 mg/L
5	Arsenic (As)	EPA 200.8	0.001 mg/L
6	Mercury (Hg)	EPA 200.8	0.0005 mg/L
7	Lead (Pb)	EPA 200.8	0.0005 mg/L
8	Cadmium (Cd)	EPA 200.8	0.0005 mg/L
9	Chrome	EPA 200.8	0.006 mg/L
10	Copper (Cu)	EPA 200.8	0.001 mg/L
11	Zinc (Zn)	EPA 200.8	0.005 mg/L
12	Nickel (Ni)	EPA 200.8	0.001 mg/L
13	Manganese (Mn)	EPA 200.8	0.003 mg/L
14	Iron (Fe)	EPA 200.8	0.005 mg/L
15	Selene (Se)	EPA 200.8	0.005 mg/L
16	Total Oil and grease	SMEWW 5520B -2017	0.3 mg/L
17	Coliform	TCVN 6187-2:1996	3 MPN/100mL
GROUND WATER			

No	Environmental components	Name/ number of analytical methods	MDL/LOD
1	Turbidity	TCVN 6184:2008	0 - 1.000 NTU
2	TDS	SOP-TDS	0 - 1.000 mg/L
3	COD (KMnO4)	SMEWW 5220C:2017	0.5 mg/L
4	BOD_5	TCVN 6001-1:2008	1.0 mg/L
5	Arsenic (As)	EPA 200.8	0.0005 mg/L
6	Mercury (Hg)	EPA 200.8	0.0005 mg/L
7	Lead (Pb)	EPA 200.8	0.0005 mg/L
8	Cadmium (Cd)	EPA 200.8	0.0005 mg/L
9	Chrome	EPA 200.8	0.0015 mg/L
10	Zinc (Zn)	EPA 200.8	0.006 mg/L
11	Iron (Fe)	EPA 200.8	0.001 mg/L
12	Ammonium (calculated by N)	SMEWW4500 NH_3.F:2017	0.03 mg/L
13	Nitrate	SMEWW4500 NO_3^-: 2017	0.03 mg/L
14	Chloride (Cl-)	TCVN 6194-1996	2.0 mg/L
15	Total Nitrogen	TCVN 6638:2000	3 mg/L
16	Total phosphorus	TCVN 6202:2008	0.01 mg/L
17	Total Oil and grease	SMEWW 5520B :2017	0.3 mg/L
18	Coliform	TCVN 6187-2:1996	3 MPN/mL

Notes:

- *TCVN: Viet Nam standard*
- *AS/NZS: Australian/New Zealand Standard*
- *EPA: Environment Protection Agency*
- *SMEWW: Standard Method for The Examination of Water and Waste Water*

CHAPTER II. RESULTS AND ASSESSMENT

The environmental monitoring 31st time in ash pond 2 was implemented on 15/03/2023 with the 04 underground water samples, 02 wastewater samples, 02 surface water (in receiving resource) samples, 01 noise sample. The monitoring results are shown in the following sections.

II.1. Water Environment

II.1.1. Wastewater

A part of wastewater from ash pond is collected and recycle to plant with max volume is about 200 m^3/h. It is re-used for collecting ash from bottom, processing concentrated sludge and ash discharging system. It isn't discharged directly to water resource. The construction which collects wastewater from ash pond cyclically includes water collecting hole and cyclic pump.

Another part comes through wastewater treatment system that includes sedimentation tank using flocculation compound. After treating, wastewater is discharged to Thac Thay river. In this monitoring time, 02 wastewater samples were sampled one sample in treatment tank and one sample after treated

Wastewater positions is as follow:

- AP-W1: Wastewater in neutralization tank
- AP-W2: Wastewater in discharged position to Thac Thay river

The monitoring results are showed in **Table 2.1**

Table 2.1. Wastewater results in ash pond 2

No.	Parameters	Unit	Analytical methods	Results		QCĐP 3:2020/QN	
				AP-W1	AP-W2	C (B Column)	Cmax
1.	Temperature	°C	SMEWW 2550B:2017	22.3	22.6	40	40
2.	pH	-	TCVN 6492:2011	7.6	7.1	5.5 – 9.0	5.5 - 9.0
3.	Colour (pH=7)	Pt/Co	TCVN 6185:2015	<5	<5	150	150
4.	TSS	mg/L	TCVN 6625:2000	<2	<2	100	90
5.	COD	mg/L	SMEWW 5220C:2017	19	16	150	135
6.	BOD_5	mg/L	TCVN 6001-1:2008	7	6	50	45

No.	Parameters	Unit	Analytical methods	Results		QCĐP 3:2020/QN	
				AP-W1	AP-W2	C (B Column)	Cmax
7.	Arsenic (As)	mg/L	EPA method 200.8	0.013	0.012	0.1	0.09
8.	Mercury (Hg)	mg/L	EPA method 200.8	<0.001	<0.001	0.01	0.009
9.	Lead (Pb)	mg/L	EPA method 200.8	<0.0005	<0.0005	0.5	0.45
10.	Cadmium (Cd)	mg/L	EPA method 200.8	<0.0005	<0.0005	0.1	0.09
11.	Chromium III	mg/L	EPA Method 200.8 & TCVN 6658:2000	0.032	0.031	1	0.9
12.	Chromium VI	mg/L	TCVN 6658:2000	<0.006	<0.006	0.1	0.09
13.	Copper (Cu)	mg/L	EPA method 200.8	0.0033	0.0032	2	1.8
14.	Zinc (Zn)	mg/L	EPA method 200.8	0.0112	0.0057	3	2.7
15.	Nikel (Ni)	mg/L	EPA method 200.8	0.0447	0.0351	0.5	0.45
16.	Manganese	mg/L	EPA method 200.8	0.0633	0.0607	1	0.9
17.	Iron (Fe)	mg/L	EPA method 200.8	1.49	1.49	5	4.5
18.	Total mineral oil & grease	mg/L	SMEWW5520B&F:2017	<0.3	<0.3	10	9
19.	Residue Chlorine	mg/L	TCVN 6225-3:2011	<0.1	<0.1	2	1.8
20.	Sulfide (as	mg/L	TCVN 6637:2000	<0.03	<0.03	0.5	0.45
21.	Total N	mg/L	TCVN 6638:2000	4.73	4.51	40	36
22.	Total P	mg/L	TCVN 6202:2008	0.18	0.13	6	5.4
23.	Ammonium (NH_4^+)	mg/L	SMEWW 4500 NH_3.F:2017	0.11	0.09	10	9
24.	Fluoride (F^-)	mg/L	SMEWW 4500-F^- .B&D:2017	1.46	1.43	10	9
25.	Total Cyanide (CN^-)	mg/L	SMEWW 4500 CN^- C&E:2017	<0.002	<0.002	0.1	0.09
26.	Total Phenol	mg/L	SMEWW 5530 B&C:2017	0.018	<0.001	0.5	0.45
27.	Coliform	MPN/ 100mL	TCVN 6187-2:1996	1,100	750	5,000	5,000

The monitoring results show that all of monitoring parameters in wastewater meet allowed standard QCĐP 3:2020/QN.

II.1.2. Surface water in receiving resource

In order to estimate the quality of surface water in receiving resource in March 2023, the monitoring team took surface water in receiving resource samples to analysis. Monitoring positions include:

- SW1: Thac Thay river, about 100m from discharge point to upstream
- SW2: Thac Thay river, about 100m from discharge point to downstream

Surface water in receiving resource samples were taken on the river mainly. Monitoring results show that all of parameters meet the allowed standard. This indicates that the surface water at the reception area of the ash pond 2 has no signs of pollution

II.1.3. Ground water

The hydro-geological characteristics of monitoring positions in ash pond 2 are determined as follow:

- Ground water well in Ash pond 2 is shallow, just about 1 - 3 m to the ground.
- The flow direction of ground water run mainly from the West to the East.

Ground water samples were sampled in 04 wells (GW1 to GW4). Wells from GW2 to GW4 are dug well of household living in area, except for GW1 is drilled well in area of operation house in ash pond 2. Monitoring positions are shown in following table:

Table 2.2. Monitoring positions of ground water samples

No.	Positions	Description	Coordinates	
1	GW1	Operator house of ash pond 2	21°12'23" N	107°35'56"E
2	GW2	Residential area – Ha Chanh village, Cong Hoa commune – about 350m from the North of ash pond 2 (Mr. Tran Van Lai 's household-area 1)	21°12'43" N	107°35'75"E
3	GW3	Residential area - Ha Chanh village, Cong Hoa commune – about 350m from the North East of ash pond 2 (Mr. Diep Van Sinh B's household-area 2)	21°12'10" N	107°36'15"E
4	GW4	Residential area - Ha Chanh village, Cong Hoa commune – about 150m from the East of ash pond 2 (Mr. Diep Van Thu's household – area 2)	21°11'88" N	107°36'21"E

The monitoring results show that:

- pH meets the QCVN 09-MT:2015/BTNMT.

- The content of NO_3^-, NH_4^+, Cl^-, Fe are smaller than the QCVN 09-MT :2015/BTNMT
- The COD concentration at GW1, GW2, and GW4 exceed about 1.75, 1.25 and 2 times than QCVN09-MT: 2015/ BTNMT, respectively

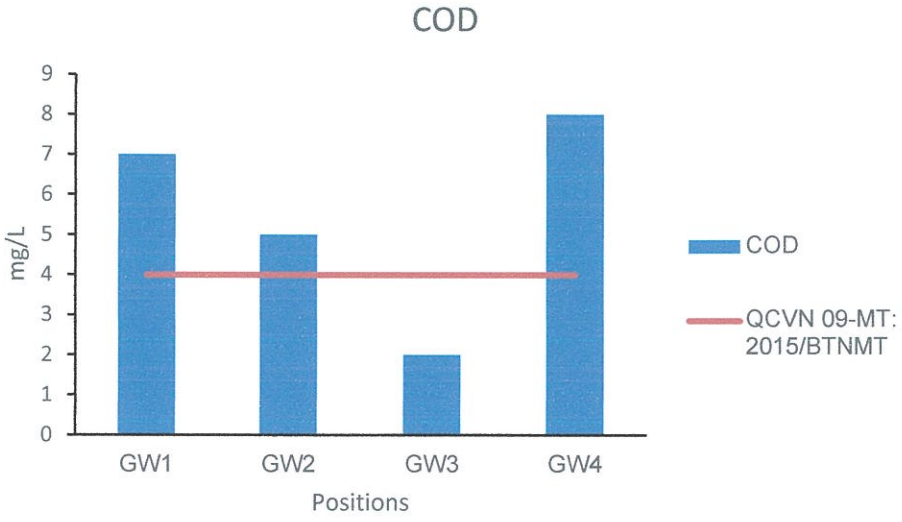


Figure 2.1. COD content in ground water samples

II.2. Noise

The noise was measured at the wastewater treatment system of ash pond 2 - Mong Duong 2 BOT Coal Fired Power Plant. The measurement results of noise at the wastewater treatment system location showed that all values met the permissible standard of QCVN 26:2010/BTNMT.

Within the premises of the wastewater treatment system area of ash pond 2, the noise from personnel movement and operation of the treatment system in the treatment station area was detected. Although the values did not exceed the standard, noise control and reduction must be continuously implemented. The measured values were only instantaneous, and noise measurement should be conducted more frequently to have timely preventive and mitigation measures.

CHAPTER III. CONCLUSION AND RECOMMENDATION

III.1. Conclusion

The 31st environmental monitoring program in operation stage of ash pond 2 was conducted at the middle of March 2023, the sampling locations were approved according to plan, the environmental monitoring components includes: wastewater, ground water, surface water in receiving resource and noise. Based on the results of environmental monitoring, the assessment of environmental quality in the area of the plant in operation stage as follows:

Wastewater

Wastewater of the ash pond 2 includes wastewater samples in treatment tank, neutralization tank and samples after treating. The results showed that all parameters met QCVN 40: 2011/BTNMT.

Surface water in receiving resource

The parameters monitored in the surface water samples of the receiving sources meet the permitted standards. As for the factory, the management of the BOT company as well as the labor safety and environmental sanitation departments should also closely monitor the operation of the slag area, wastewater treatment systems as well as reminding people not to directly use surface water for living purposes.

Ground water

The groundwater monitoring results show that there are 3 wells where COD concentration exceeds the allowed standard by 1.25 to 2 times.

Monitoring program around ash pond 2 not only estimates quality of water but also warns the risk to limit incidents affecting to environment and people. This ground water source is needed to pretreat before using.

Noise

At the monitoring location, the noise level meets the permissible standard of QCVN 26:2010/BTNMT. However, in the area where workers operate the system, they must be fully equipped with personal protective equipment and noise reduction devices such as helmets and earplugs

III.2. Recommendation

Based on the monitoring results in Ash Pond 2, the monitoring team and implementing units may give some recommendations to the management board of Mong Duong 2 BOT Coal Fired Power Plant and the Contractor at the plant as follows:

- Continue operating implementation of environmental monitoring activities periodically with wastewater, surface water, coastal water and soil environment according to plan, the roadmap setting out in the region during the operation stage of Ash Pond 2. This is in order to detect early signs of environmental pollution due to the impact of the plant through each stage or other events affecting the region.
- Continue maintaining operations and technical plan in Ash Pond 2 to collect, treat ash, wastewater. With above plans, negative effects may be reduced to air environment, surface water, ground water, soil and ecology.
- Establish and prepare the emergency response plan for environmental incidents such as ash pipeline incident, dyke safety and effluent discharge activities and have plan for minimizing pollution to environment area.
- Providing updated information of the Plant and Ash Pond 2 environment protection activities to communicate to local authority and residents at the Cong Hoa and Cam Hai commune.

With all above measurements, it is neccessary to coordinate with the training and education on environment awareness for both workers force and contractors. In addition, sharing and public information is also the good sollution to increase awareness the environmental protection of Mong Duong 2 BOT Coal Fired Power Plant and Ash Pond 2 in order to fully compliance with applicable regulations.

APPENDICE

APPENDIX 1. APPLICATION OF QA/QC IN MONITORING PROGRAM

APPENDIX 2. IMAGES OF MONITORING ACTIVITIES ON FIELD

APPENDIX 3. MAP OF SAMPLING AREAS

APPENDIX 4. THE MONITORING RESULTS

APPENDIX 1. APPLICATION OF QA/QC PROGRAM FOR ENVIRONMETAL MONITORING IN ASH POND 2

1. Apply QA/QC for environmental monitoring program in ash pond 2 in March 2023

a. QA/QC in designing environmental monitoring program

Activities to ensure quality in the design of environmental monitoring program are summarized in Table 4.1 follows (compare current status with the requirements of Circular 10/2021/TT-BTNMT on 30/6/2021, Ministry of Natural Resources and Environment guiding the quality assurance and quality control in environmental monitoring).

Table 4.1. Summary of quality assurance activities in the design of environmental monitoring program in ash pond 2

No.	Activities	Current status in comparison to the requirements of Circular 10	Note
1	Determine the objectives of monitoring program	+	
2	Design the environmental monitoring program	+	For Ash Pond 2 in Mong Duong 2 BOT Coal Fired Power Plant and surrounding area with environmental components of wastewater, surface water, ground water, noise
2.1.	Compliance with environmental protection programs and national strategies	+	
2.2.	To comply with the technical guidance, procedures and regulations for each environmental component	+	Circular No. 10/2021/TT-BTNMT of Ministry of Natural Resources and Environment: Technical Regulation on environmental monitoring procedures

2.3.	Follow all steps in design environmental monitoring program	+	

Note: (+) full (-) not enough

2. QA/QC on field monitoring

The activities on field can be classified as follows:

- ✓ QA/QC in direct measurement on field (this activity can be operated independently out of other activities);
- ✓ QA/QC in sampling, sample pre-treatment, samples preservation;

In this environmental monitoring program for ash pond 2, QC samples were carried out include on field blank sample (code: QCHT). This is defined as the small sample of handled clean material, which is stored, transported and analyzed in laboratory similar to real samples. These QC samples are used to control contamination in the sampling process.

On-field blanks for water are TSS and COD

- ✓ QA/QC in transporting samples to the laboratory

QC sample was selected transportation blank sample (code: QCVC). QCVC is a small sample of the clean material transporting and researching with true samples in the same environment, the preservation and analysis of laboratory parameters as true sample. This QC sample types are used to control contamination during transporting samples.

QC sample at the laboratory (code: QCPTN) is replicate analyzed for the same above parameters.

Activities to quality assurance in the field of monitoring are summarized in Table 4.2 follows:

Table 4.2. The current status of quality assurance and quality control activities on field (Mong Duong 2 BOT Coal Fired Power Plant)

No.	Activities	Current status in comparison to the requirements of Circular 10	Notes
1	**Environmental Monitoring on field**	+	Followed the plan
1.1.	Determination of environmental parameters	+	Represent for each environmental component, based on proposed report of EIA
1.2.	Analytical method	+	Current Vietnamese standards (TCVN)
1.3.	On-field environmental facilities and equipment	+	Periodically maintenance and calibration
1.4.	Chemicals, standards	+	Prepare before going to the field
1.5.	Personnel	+	Assign members of performing each items
1.6.	Data processing and reporting	+	
1.7.	Quality control	-	Applied QC samples for some parameters of water, not for all parameters.
2.	**Sampling, samples pre-treatment and preservation on field**	+	Followed current Vietnamese standards (TCVN)
2.1.	Quality assurance	+	

No.	Activities	Current status in comparison to the requirements of Circular 10	Notes
2.1.1.	Determination of sampling site	+	Representative for the area, followed the surveyed results
2.1.2.	Assurance of monitoring parameters	+	Followed the plan
2.1.3.	Assurance of sampling time and frequency	-	Followed the plan, some changes in accordance to train schedule
2.1.4.	Sampling methods, samples pre-treatment and preservation	+	Followed current Vietnamese standards (TCVN)
2.1.5.	Equipment and instruments	+	Periodical maintenance and calibration
2.1.6.	Personnel	+	Group work
2.1.7.	Sample containers	+	Cleaned and sterilized
2.1.8.	Chemicals	+	
2.1.9.	On-field sampling minutes	+	
2.2.	Quality control	-	Applied QC samples for some parameters of water, not for all parameters
3.	**Sample transportation to laboratory**	+	
3.1.	Quality assurance	+	
3.1.1.	Sample transportation	+	
3.1.2.	Sample delivery	+	Using delivery minute

No.	Activities	Current status in comparison to the requirements of Circular 10	Notes
3.2.	Quality control	-	Applied QC samples for some parameters of water, not for all parameters

Notes: **(+) full** **(-) not enough**

3. Quality assurance and quality control (QA/QC) in laboratory

a. QA in laboratory

ISO/IEC 17025-2005 gives management requirements and technical requirements for the operation QA/QC laboratory. Here are the management requirements:

1. Organization.
2. Quality system.
3. Document control.
4. Review of requests, proposals and contracts.
5. Subcontracting of tests and calibrations.
6. Procurement services and supplies.
7. Service to customers.
8. Complaints (or suggestions).
9. Control testing and/or calibration mismatch
10. Remedies.
11. Precautions.
12. Control of records.
13. Internal assessment.
14. Review of leadership.

The technical requirements include:

1. General requirements.
2. Personnel.
3. Facilities and environmental conditions.
4. Test methods, calibration and approved methods.

5. Devices.
6. Trace ability of measurement.
7. Sampling.
8. Sample management and calibration.
9. Quality assurance test results and calibration
10. Report the results.

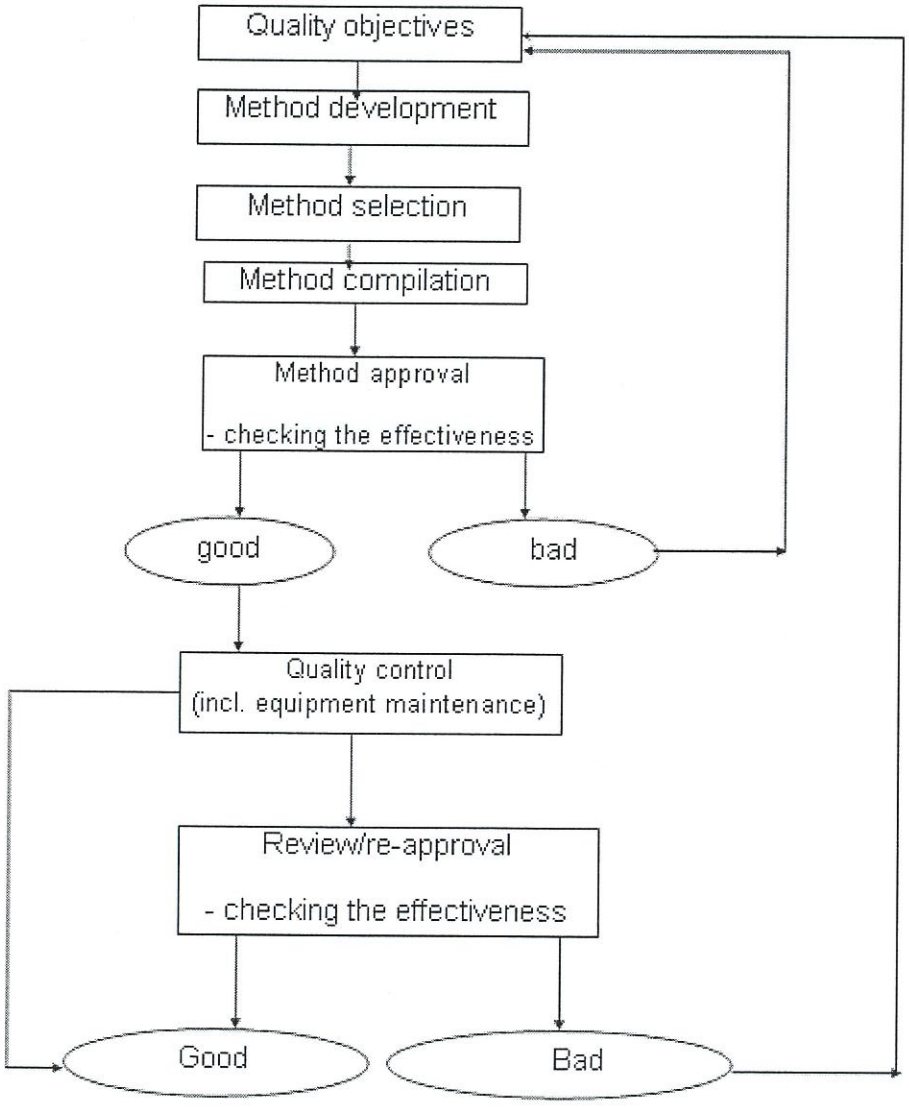


Figure 4.1. QA/QC in lab (ISO/IEC 17025:2005)

Table 4.3. The current status of quality assurance and quality control activities at the laboratory

No	Activities	Current status in comparison to the requirements of Circular 10	Notes
4.	**QA/QC at the laboratory**	+	According to the laboratory regulations (ISO/IEC 17025 VILAS No 406 of R & D laboratory – Institute for Environmental Science and Technology)
4.1.	Management requirement	+	-as above-
4.1.1.	Determine the laboratory organization, appoint the duty and responsibility for each staff	+	-as above-
4.1.2.	Document system	+	-as above-
4.1.3.	Internal evaluation	+	-as above-
4.1.4.	Periodical review the quality management system and laboratory operation to ensure the effectiveness and continuous	+	-as above-
4.2.	Technical requirement	+	-as above-
4.2.1.	Quality assurance (analytical method, method selection, and method approval)	+	-as above-
	Facilities and equipment (calibration, labelling, maintenance)	+	-as above-
	Inter-laboratory comparison	+	-as above-
	Environmental condition	+	-as above-
	Sample management	+	-as above-

No	Activities	Current status in comparison to the requirements of Circular 10	Notes
	Data quality assurance	+	-as above-
4.2.2.	Quality control	+	-as above-
	Using QC samples	+	-as above-
	Develop the QC accepted criteria	+	-as above-
5.	**QA/QC in data processing and reporting**	+	-as above-
5.1.	Environmental Monitoring data processing and management	+	Using software issued by Ministry of Natural resources and environment
5.1.1.	Documents related to monitoring process needed to update	+	According to the laboratory regulations (ISO/IEC 17025 VILAS No 406 of R & D laboratory – Institute for Environmental Science and Technology)
5.1.2.	Store all document related to monitoring process	+	Followed the form issued by Ministry of Natural Resources and Environment
5.1.3.	Check, calculate and process all data from the field and/or laboratory	+	According to the laboratory regulations (ISO/IEC 17025 VILAS No 406 of R & D laboratory – Institute for Environmental Science and Technology)
5.2.	Reporting	+	-as above-
5.2.1.	Phase report needed to ensure the accuracy and honest	+	-as above-

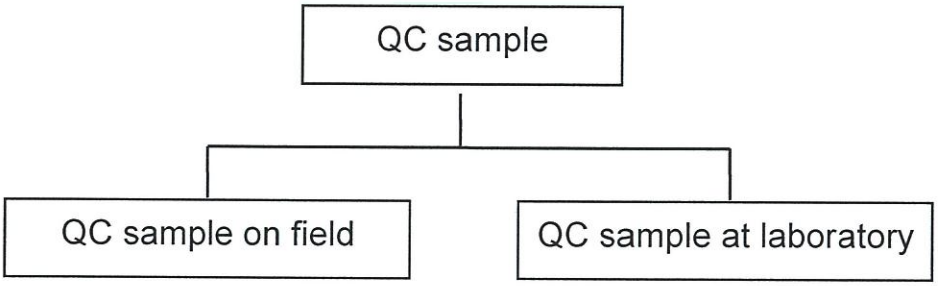
No	Activities	Current status in comparison to the requirements of Circular 10	Notes
5.2.2.	Review the reports	+	-as above-
5.2.3.	Report submitting	+	Submit to client and save the data

b. (QC) in Lab

QC samples include:

- QC sample for equipment
- QC sample for methods: Selected the duplicates at the Lab with TSS and COD in water.

QC sample types:



In this environmental monitoring program for ash pond 2 in March 2023, QC samples (blanks and duplicates) were carried out at all sampling sites with some parameters of wastewater in parallel with true samples.

QC sample on field is included: On-fields blank sample (code: QCHT), transportation blank sample (code: QCVC), applied for 02 parameters of water (TSS and COD). The analytical requirement for blank is less than MDL (method detection limit) or LOD (Limit of detection). In case the result is higher than these levels, it is needed to analyse again in order to remove the error cause.

QC sample at the laboratory (code: QCPTN) is replicate analysed for the same above parameters.

Results were calculated, compared, followed the formula:

RPD: Relative Percent Difference

$$RPD = \frac{|LD1 - LD2|}{[(LD1 + LD2)/2]} \times 100(\%)$$

In which:

- RPD: Relative Percent Difference
- LD1: first analytical result
- LD2: second analytical result (duplicate)

The requirement of dispersion level between duplicate and true samples is not over ±20% (expected quality target of the laboratory).

c. On-field blank sample analytical results

The 31st environmental monitoring time in ash pond 2 conducted with 02 QC samples: On-field blank sample, transportation blank sample of parameters: TSS and COD

Table 4.4. On-field blank samples

Type of sample	Code	TSS (mg/L)		COD (mg/L)	
		% value ≤2	% value ≥2	% value ≤2	% value ≥2
QCHT: on-field blank samples	AP-W1_0	100	0	100	0
	AP-W2_0	100	0	100	0

3.3.2. Duplicate sample analytical results

Selected QC samples were duplicates in Lab (QCPTN) with parameters of TSS and COD in water. In detail:

Table 4.5. % RPD of QC duplicate samples (water)

No	Code	% RPD	
		TSS	COD
1	AP-W1_1	12.4	11.8
2	AP-W2_1	13.9	10.5

QA/QC activity was conducted fully as design in monitoring program; therefore, the above results shown rather good with the expected quality target of the laboratory within RPD ±20% (meet the requirements of the Lab). Percentage of limited differences to the

parameters TSS and COD of the duplicated samples in water samples were met the requirement.

3.3.3. Evaluation on completed monitoring data

Completed monitoring data is evaluated by percent of full data in comparison to the expected data in the begin of plan.

Formula using for percent of completed data as bellows:

$$C = \frac{V}{T} \times 100(\%)$$

In which:

- C: % of completed data
- V: number of acceptable samples
- T: total samples in beginning plan

Here C ≥ 95% is acceptable.

In this monitoring program (March 2023) for ash pond 2, there were 8 water samples, 01 noise sample. There are total 09 samples

Therefore:

$$C = \frac{V}{T} \times 100(\%) = \frac{9}{9} \times 100(\%) = 100\%$$

C =100% is ensured the completed data in this monitoring program in Ash pond 2 of March 2023.

APPENDIX 2. IMAGES OF MONITORING ACTIVITIES ON FIELD

Figure 4.2. Taking surface wastewater samples, ground water samples

APPENDIX 4: THE MONITORING RESULTS

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Address: R301-C10 Building, Hanoi University of Science and Technology, Bach Khoa Ward, Hai Ba Trung Dist, Hanoi
Tel.: (84-24).38681686 Email: inest@hust.edu.vn Fax: (84-24).38693551 http: //inest.hust.edu.vn

No: 03/23/TTQT-2023-EN

VILAS 406; VIMCERTS 055

ENVIRONMENTAL MONITORING RESULTS

Sampling Site : Ash pond 2 - Mong Duong 2 BOT Coal Fired Power Plant
Address : Cong Hoa commune – Cam Pha city – Quang Ninh province
Sampling Date : March 15th ,2023
Type of Samples : Wastewater
Number of Samples : 02 samples

No.	Parameters	Unit	Analytical methods	Results		QCĐP 3:2020/QN	
				AP-W1	AP-W2	$C_{(Column\ B)}$	C_{max}
1.	Temperature	°C	SMEWW 2550B:2017	22.3	22.6	40	40
2.	pH	-	TCVN 6492:2011	7.6	7.1	5.5 – 9.0	5.5 - 9.0
3.	Color (pH=7)	Pt/Co	TCVN 6185:2015	<5	<5	150	150
4.	TSS	mg/L	TCVN 6625:2000	<2	<2	100	90
5.	COD	mg/L	SMEWW 5220C:2017	19	16	150	135
6.	BOD_5	mg/L	TCVN 6001-1:2008	7	6	50	45
7.	Arsenic (As)	mg/L	EPA method 200.8	0.013	0.012	0.1	0.09
8.	Mercury(Hg)	mg/L	EPA method 200.8	<0.001	<0.001	0.01	0.009
9.	Lead (Pb)	mg/L	EPA method 200.8	<0.0005	<0.0005	0.5	0.45
10.	Cadmium (Cd)	mg/L	EPA method 200.8	<0.0005	<0.0005	0.1	0.09
11.	Chromium III	mg/L	EPA Method 200.8 & TCVN 6658:2000	0.032	0.031	1	0.9
12.	Chromium VI	mg/L	TCVN 6658:2000	<0.006	<0.006	0.1	0.09
13.	Copper (Cu)	mg/L	EPA method 200.8	0.0033	0.0032	2	1.8
14.	Zinc (Zn)	mg/L	EPA method 200.8	0.0112	0.0057	3	2.7
15.	Nikel (Ni)	mg/L	EPA method 200.8	0.0447	0.0351	0.5	0.45
16.	Manganese (Mn)	mg/L	EPA method 200.8	0.0633	0.0607	1	0.9
17.	Iron (Fe)	mg/L	EPA method 200.8	1.49	1.49	5	4.5
18.	Total mineral oil & grease	mg/L	SMEWW5520B&F:2017	<0.3	<0.3	10	9
19.	Residue Chlorine	mg/L	TCVN 6225-3:2011	<0.1	<0.1	2	1.8
20.	Sulfide (as H_2S)	mg/L	TCVN 6637:2000	<0.03	<0.03	0.5	0.45
21.	Total N	mg/L	TCVN 6638:2000	4.73	4.51	40	36
22.	Total P	mg/L	TCVN 6202:2008	0.18	0.13	6	5.4
23.	Ammonium (NH_4^+)	mg/L	SMEWW 4500 NH_3.F:2017	0.11	0.09	10	9
24.	Fluoride (F^-)	mg/L	SMEWW 4500-F^- .B&D:2017	1.46	1.43	10	9
25.	Total Cyanide (CN^-)	mg/L	SMEWW 4500 CN^- C&E:2017	<0.002	<0.002	0.1	0.09

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENVIRONMENTAL SCIENCE AND TECHNOLOGY
Address: R301-C10 Building, Hanoi University of Science and Technology, Bach Khoa Ward, Hai Ba Trung Dist, Hanoi
Tel.: (84-24).38681686 Email: inest@hust.edu.vn Fax: (84-24).38693551 http: //inest.hust.edu.vn

No: 06/23/TTQT-2023-EN

VILAS 406; VIMCERTS 055

ENVIRONMENTAL MONITORING RESULTS

Sampling Site : Ash pond 2 - Mong Duong 2 Thermal Power Plant
Address : Cong Hoa commune – Cam Pha city – Quang Ninh province
Sampling Date : March 15th ,2023
Type of Samples : Ground Water
Number of Samples : 04 samples

No.	Parameter	Units	Analytical methods	Results				QCVN 09-MT: 2015/BTNMT
				GW1	GW2	GW3	GW4	
1.	Temperature	°C	SMEWW 2550B:2017	22.4	24.5	24.2	24.5	-
2.	pH	-	TCVN 6492:2011	7.3	5.9	7.1	6.5	5.5 – 8.5
3.	DO	mg/L	TCVN 7325:2016	4.2	3.6	2.6	4.7	-
4.	Turbidity	NTU	TCVN 6184:2008	0.84	0.37	0.74	0.68	-
5.	TDS	mg/L	SOP-TDS	168	39	142	39	1,500
6.	COD ($KMnO_4$)	mg/L	SMEWW 522C:2017	7	5	2	8	4
7.	BOD_5	mg/L	TCVN 6001-1:2008	2	<1.0	<1.0	3	-
8.	Arsenic (As)	mg/L	EPA method 200.8	0.0020	0.0035	0.0060	0.0055	0.05
9.	Mercury(Hg)	mg/L	EPA method 200.8	<0.0005	<0.0005	<0.0005	<0.0005	0.001
10.	Lead (Pb)	mg/L	EPA method 200.8	<0.0005	<0.0005	<0.0005	0.0006	0.01
11.	Cadmium (Cd)	mg/L	EPA method 200.8	<0.0005	<0.0005	<0.0005	<0.0005	0.005
12.	Chromium (Cr)	mg/L	EPA method 200.8	0.006	<0.006	<0.006	<0.006	-
13.	Zinc (Zn)	mg/L	EPA method 200.8	0.055	0.021	0.016	0.020	3.0
14.	Iron (Fe)	mg/L	EPA method 200.8	1.100	0.132	0.292	0.120	5.0

No.	Parameter	Units	Analytical methods	Results				QCVN 09-MT: 2015/BTNMT
				GW1	GW2	GW3	GW4	
15.	Ammonium	mg/L	SMEWW 4500 NH_3.F:2017	0.08	0.08	0.08	0.08	1
16.	Nitrate (NO_3^--N)	mg/L	SMEWW 4500 NO_3^-E:2017	0.25	0.86	1.23	4.45	15
17.	Chloride (Cl^-)	mg/L	TCVN 6194-1996	242	36	32	12	250
18.	Total N	mg/L	TCVN 6638:2000	<3.0	<3.0	<3.0	<3.0	-
19.	Total P	mg/L	TCVN 6202:2008	0.06	0.05	0.05	<0.01	-
20.	Total Oil & Grease	mg/L	SMEWW 5520B:2017	<0.3	<0.3	<0.3	<0.3	-
21.	E.Coli	MPN/100mL	TCVN 6187-2:1996	0	0	0	0	0
22.	Coliform	MPN/100mL	TCVN 6187-2:1996	<3	<3	<3	<3	3

Note:

- *The result is valid only for samples at the monitoring time. Symbol (-): unstipulated;*
- *The samples will be destroyed after 5 days from the date of issue of environmental monitoring results unless otherwise agreed with the customer.*
- ***QCVN 09-MT:2015/BTNMT** - National technical regulation on ground water quality*
- *Sampling positions: Ground water well*

	Coordinates	
GW1: Operator house of Ash pond 2	*21°07'19.9"N*	*107°21'21.2" E*
GW2: Residential area – Ha Chanh village, Cong Hoa commune – about 350m from the North of Ash pond 2 (Mr. Tran Van Lai 's household-area 1)	*21°07'26.5"N*	*107°21'27.8"E*
GW3: Residential area - Ha Chanh village, Cong Hoa commune – about 350m from the North East of Ash pond 2 (Mr. Diep Van Sinh B's household- area 2)	*21°07'21.3"N*	*107°21'37.3"E*
GW4: Residential area - Ha Chanh village, Cong Hoa commune – about 150m from the East of Ash pond 2 (Mr. Diep Van Thu's household – area 2)	*21°07'19.7"N*	*107°21'36.8" E*

Ha Noi, March 24th 2023

Centre for industrial environmental monitoring and pollution control
Director

pp.

MSc. Ton Thu Giang

School of Environmental Science and Technology

BỘ GIÁO DỤC VÀ ĐÀO TẠO
VIỆN KHOA HỌC VÀ CÔNG NGHỆ MÔI TRƯỜNG
TRƯỜNG ĐẠI HỌC BÁCH KHOA HÀ NỘI

VIỆN TRƯỞNG
PGS.TS. Nguyễn Thị Ánh Tuyết