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ENVIRONMENTAL DETERIORATION IN THE CASE OF COAL-FIRED POWER PLANT

SAW HTUN HTUN NAUNG
Department of Engineering Chemistry, Technological University (Hpa- an), Myanmar
sawhtunhtunnaung@contractor.net

THAN THAN KHAING
Department of Engineering Chemistry, Technological University (Hpa- an), Myanmar
Khaing2136@gmail.com

PHYO PA PA AUNG
Department of Engineering Chemistry, Technological University (Hpa- an), Myanmar
Phyopapanov@gmail.com

ABSTRACT
As Myanmar is a developing country- it needs a rising demand for energy and water purification. Coal is the primary fuel source for producing electricity; thus, power plants using coal have grown-up in the last ten years. Coal-fired power generations are associated with air pollution as emissions of greenhouse gas emissions from fuel burning. Coal is also said to be a more progressive contributor to global climate change. This paper focuses on environmental damage and coal management. Coal may cause soil, air and water pollution, but it concentrates only on water pollution. National Health Laboratory, AMTT Co., Ltd, and Advancing Life and Regenerating Motherland performed sampling and water analysis. Most of the data from those are within WHO standards, but water pollution happens physically and biologically. Water pollution from those areas has occurred, and it will take so long to reach the original condition. Various water treatments should be employed for current evidence, and finally, high efficient technologies can be applied to protect those areas from pollution.

KEYWORDS: clean coal technology, coal-fired power plant, environmental damage, fossil fuel, global climate

INTRODUCTION
The developmental activities of a country mainly hang on its proper electricity service, as it influences the other sectors like industry, education, agriculture, and so on. The power sector is considered an essential and vital industry in many countries.

In Myanmar, hydropower plants mainly produce electricity. But on current, the generation of electricity is inadequate, and the shortage of electricity supply- frequently occurred that hampers the quality of electricity services for the nation.

For present and future power demand, evolving countries are going to choose other fuel resources alternatively. They are forced to manage appropriate and efficient policies for electrical power generation.

Coal is now standing an essential role in energy production, as it is a principal source for the entire developmental activities. It has harmful consequences, but coal utilization has been increased year by year around the world.

The present work is aimed to ensure long-term perpetuate environment and society without any harmless. It points out the beneficiation and harmful impacts on the practice of coal. Clean technologies about using fuels are also introduced for prevention from undesired damages to our nation.

LITERATURE REVIEW
The Role of Coal in Electricity
Coal is an essential source used for energy, fueling nearly 40% of electricity universal. Coal has remained the world- fastest-growing energy source in current years – quicker than oil, gas, nuclear, hydro, and renewables.

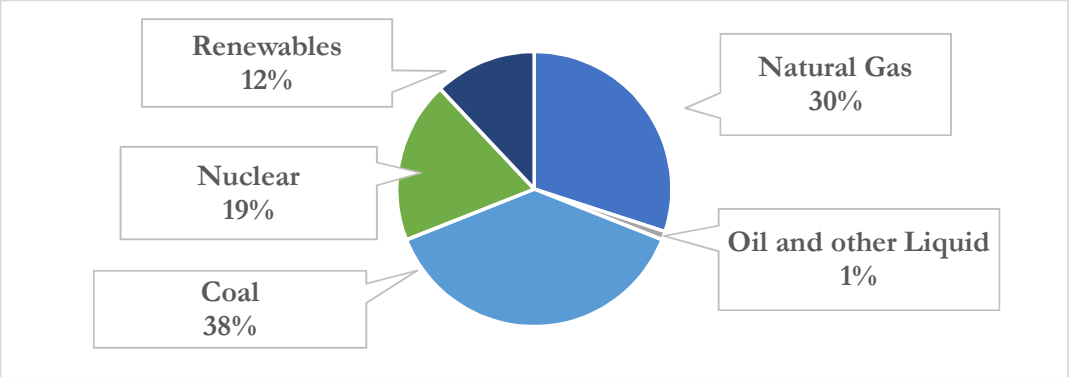

Figure 1: Electricity generation by fuel, 2012 (source: U.S. Energy Information Administration)

Coal provided the energy to build modern civilization. This energy source raised standards of living, multiplied the earth's population, and enabled people in developed countries to enjoy available; climate change will endure increasing. But the routine of coal isn't purely an environmental issue; political and economic forces are also at play.[1]

Coal is a global trade commercially in over 50 countries and is used in over 70. Coal plays a vital role in power generation, and Worldwide coal production is projected to reach 7 billion tones in 2030. The United States, Austria, Indonesia, Russia, Colombia, South Africa, and were the largest coal exporting countries in 2016.[2,3]

Coal Utilization and Its Pollution

Coal is used mainly for iron and steel production, locomotives for transportation and household heat. Coal utilization is turned to the manufacturing sector for- producing steam and, to a minor extent- electricity, and some chemicals production.

Four grand processes of coal exploitation have been developed: carbonization, combustion, gasification, and liquefaction. Developments in materials of construction, system designs, and fuel firing have directed to increased capacity and higher steam functional temperatures and pressures.

Liquid and solid wastes arising from coal applications generally represent more limited problems. In contrast, coal may be said to appear in the land, water, and air pollution.

Coal also comprises trace quantities of Uranium, Thorium, and other unsurprisingly occurring radioactive isotopes that may contaminate the surrounding environment.

When coal is charred, it releases several flying toxins and pollutants. Health impacts can array from asthma and breathing difficulties to brain damage, heart problems, cancer, neurological disorders, and premature death.[4]

The power plant of coal-fired is one of the biggest water polluters, and it dumps more toxins into our rivers and streams than any other manufacturing, including the chemical, plastic, and paint-manufacturing industries. The contaminated waters pouring from coal plants are laced-up arsenic, mercury, and selenium. These toxins are dangerous in even tiny amounts.[5]

Coal plants also produce coal ash, coal sludge, and coal waste. As coal sludge contains toxins, leaks or spills can threaten underground and surface waters resulting in water pollution. Power plants are in charge of 30 percent of all toxic pollution discarded into surface waters.

Coal-fired power plants yield more than 100 million tons of coal ash each year. More than half of that waste splits end into ponds, lakes, landfills, and other sites where, over a period, it can pollute waterways and drinking water supplies.[4]

Clean Coal Technology

There is no clean coal in the world. But coal can be cleaned by a modernized technology. This technology has 16 types as follows;

(1) Wet Scrubbers (Wet FGD, FGD = Flue Gaw Desulfurization)
(2) Dry Scrubbers (Dry FGB)
(3) Dry Sorbent Injection (DSI)

(4) Low- NO_x Burners (LNB)
(5) Low- NO_x Burners with Overfire Air (LNB with OFA)
(6) Selective Non-Catalytic Reduction (SNCR)
(7) Selective Catalytic Reduction (SCR)
(8) Activated Carbon Injection (ACI)
(9) Halogenated ACI (HACI)
(10) Fabric Filter System/ Baghouse
(11) Electrostatic Precipitator (ESPs)
(12) ESPs with Baghouse
(13) Supercritical Boiler
(14) Ultra Supercritical Boiler (USC)
(15) Integrated Gasification Combined Cycle (IGCC)
(16) Carbon Capture and Storage (CCS)

No 1, 2 responsible for capturing fly ash and particulate matter (PM), can achieve 99.9% after adding with No11. No 4,5,6 and 7 can remove mainly NO_x from 40% to 90%. No 8 and 9, also reduce mercury by up to 90%. No 10,11 and 12 render the removal of particulate matter(PM), nearly 99.9%. No 14,15 and 16 reduce CO_2 emission from 10% to 30%. No 13 is capable of removing SO_2 from 75% to 98%. No 16 is still testing in small scale plants, and it will be costed up to 90% of the factory is built.

METHODOLOGY

Investigation on Water Polluted Area

Coal using power plants are located in Myaing Kalay village, west bank of Than Lwin River, Hpa-an township, as cement factories. These factories produce 900 tons and 4000 tons daily. Cement produced is distributed-around Myanmar and widely used in various construction services.

Figure 2: 4000 Tonne cement factory in Myaing Kalay, Hpa- an

The cement factory was built since 1980 and developed as 900 tons Myaing Kalay Cement Factory. Four thousand tons of Cement Factory also emerged after the 1990s. In early periods, these factories used fuel oil and natural gas but substituted coal for the power plant in 2018.

Data Collection of Water Samples

There was an event about surface water in villages nearby cement factories. The water was changed to black colour in surface wells, lakes, and streams. People in- these villages were anxious about water pollution, and they can not use- black water any longer.

Water from these villages was collected as a sample and- transported to National Health Laboratory to determine constituents in the black coloured water. Moreover, AMTT co., Ltd and Advancing Life and Regenerating Motherland performed sampling and water analysis too.

The samples were collected from surface wells, stream, lake, and yeah of infected villages and determined by-physically, chemically, and biologically. Water samples from different places based on Yay Twin Gon, Nyet Pyaw Taw, Nat Gon, Kaw Pa Taing village, and lakes of cement factory were collected, and National Health Laboratory analyzed 11 parameters.

AMTT Co., Ltd. gathered water sampling from 13 places, including Yay Twin Gon, Nat Gon, Nyet Pyaw Taw, Kaw Pa Taing, factory- drain waste, and four parameters of copper, lead, nitrate, and phosphate were determined.

Advancing Life and Regenerating Motherland also collected ten samples from Yae Twin Gon, Zee Taw, Ma Yin Gon, Nyet Pyaw Taw, Kaw Pa Taing, Kyon Taw, Nat Gon, Kaw Pa Taing, and Myaing Ka Lay villages. Finally, 26 parameters and- bacterial tests were performed.

Adverse Effects Resulting in Polluted Area

Water pollution was not stopped and extended to distant villages. Most of the villagers were suffered from body itching and skin rash after bathing. Cow, cattle, pets were in difficulties getting clean and pure water. Thus, water can not be performed as drinking as well as bathing purposes. Clean and freshwater were urgently required for various purposes.

Moreover, fishes died in a stream and raised on the outward of the water. In this condition, consumers were received into difficulty, and local fishery service also- got worsened.

FINDING AND DISCUSSION

Results of Water Sample

Water samples collected from selective villages were determined by National Health Laboratory, AMTT Co., Ltd, and Advancing Life and Regenerating Motherland. All the results were stated with the WHO (World Health Organization) standards as quickly as possible.

Table 1. Results of water parameters expressed by the national health laboratory

Test	Unit	WHO	A	B	C	D	E	F	G	H	I	J
Colour (TCU)	Pt-Co	15	3	6	> 50	48	5	12	13	9	2	46
Turbidity	NTU	5	1	3	35	15	4	9	15	8	Nil	49
Total Dissovled Solvents(TDS)	ppm	1000	14.1	14.7	52.9	61	17	135	67.3	136	39.3	67.9
Chloride	ppm	250	8.55	14.4	5.4	4.95	4.95	4.5	3.6	4.95	5.4	4.95
Total Hardness	ppm	500	7	22	51	62	14	90	58	130	44	70
Iron	ppm	0.3	0.15	0.5	7.4	4.3	0.4	0.55	0.55	0.45	0.15	3.8
pH		6.5-8.5	5.3	6.47	6.72	6.98	5.91	8.1	7.9	7.61	6.71	7.42
Sulphate	ppm	500	2	10	18	8	7	7.9	46	66	10	24
Calcium	ppm	300	1.2	4.4	16	18	4.40	28.4	19.2	32	10.8	24
Magnesium	ppm	150	1.12	3.08	3.08	4.76	0.84	5.32	2.8	14	4.46	2.8
Electrical Conductivity	µs/cm	1000	25.9	25.4	110.1	120.1	52.1	263	139.4	275	77.3	142.6

A- Yay Twin Gon Village Surface Well
B- Nat Gon Village Surface Well
C- Yay Twin Gon Village Yeah(Source: National Health Laboratory, Yangon)
D- Inn between Nat Gon and Yay Twin Gon
E- Surface Well of U Saw Aung
F- No (1) Lake from Cement Factory
G- No (2) Lake from Cement Factory
H- Factory Waste
I- Surface Well from Kaw Pa Taing Monestry
J- Nyet Pyaw Taw Inn

Many data fall in the WHO range, except colour, turbidity, and iron. It was remarkable that water is not- thoroughly polluted, but all villagers were afraid of using water for any purposes.
Watercolour results from- complex organic matters and turbidity are mostly due to pathogenic organisms. Iron is also related to colour, turbidity, and quite harmful to aquatic life.
From the expression of AMTT Co., Ltd, copper and lead are not found in samples. Amounts of phosphate- lie within the permissible limits and nitrate concentrations from U Saw Aung's well, and Nyet Pyaw Taw inn are higher than the limits. Excessive levels of nitrate can cause blue baby disease or methemoglobinemia.

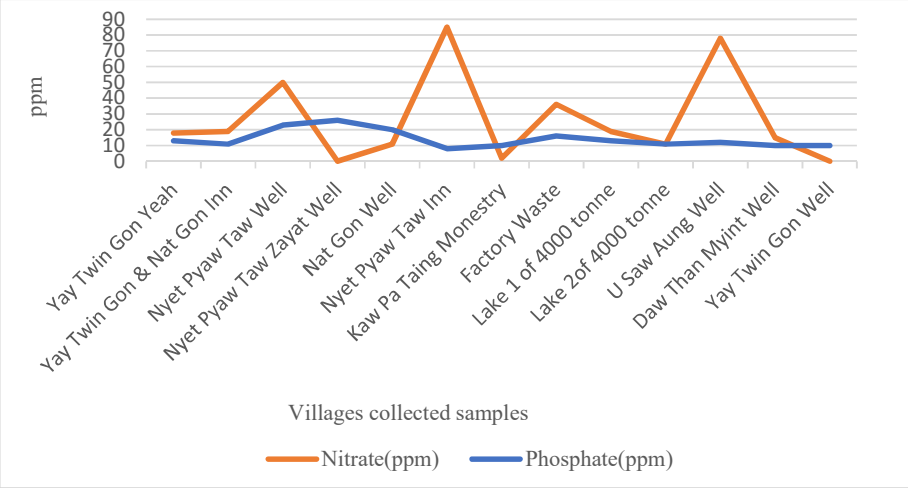

Figure 3: Concentrations for nitrate and phosphate in selected villages (source: AMTT Co., Ltd)
Conferring to the report of Advancing Life and Regenerating Motherland, chlorine, nickel, BOD, and COD are found as higher levels and can impact toxic to freshwater fishes.

Table 2. Higher levels of four parameters (Source: Advancing Life And Regenerating Motherland)

Parameter	Yay Twin Gon	Zee Taw Inn	Ma Yin Gon Stream	EPA Standard
BOD(ppm)	3.6	3	9	< 5
COD(ppm)	30	30	49	< 40
Nickel(ppm)	0.2	0.2	0.2	0.02
Chlorine(ppm)	0.64	0.37	0.21	≤ 0.05

Suggestion On Water Changing To Black Colour

Surface water from the selected area is changed colour physically, but contaminations are low in qualitative and quantitative analysis. It is challenging to display whether water pollution is possible or not.
Some parameters, such as iron, nitrate, chlorine, nickel, colour, turbidity, BOD, and COD, are higher in some places, pose a danger to the usage of water. The rest of the- parameters also fall within the standard range. However, the quality of water is influenced by a higher concentration of some parameters mentioned above.
Other hints have logically emerged as follows;

- Water pollution like this can not be occurred once before using coal in cement factories.
- Grate economical services which cause water pollution are not found in these villages; most of the villagers are working on agricultural and fishery services.
- Pollution is apparent after the rainy season.

Coals are piled randomly, and some- are split on the road while transporting. It can be concluded that water from the coal mound infiltrate and go into farm, stream, lake, and surface wells when it rains.
Coal sludge, coal ash, and- coal waste possibly leak and end up in lake and- surface wells. If a large amount of- particulate matter (PM) is present, water may be changed to black colour. It can be said that cement factories are now using clean coal methods to capture particulate matter or not.
Since iron is also concerned with the colour and turbidity of the water, the greater concentration of iron (> 0.3ppm) shows its interference in changing to black colour.

Finding The Result On Dead Fish

Disinfection may be achieved in various ways, but chlorination is relatively easy to the holder and cost-effective; hence it is almost universal use. Chlorine reacts with water to form hypochlorous acid (HOCl) and hydrochloric acid (HCl). [6]

According to interpretation and standard by environmental protection agency, chlorine is a poisonous gas for freshwater fish if over 0.005 ppm HOCl. Thus, fishes have died in water containing chlorine in the extent of 0.02- 0.64 ppm.

BOD and COD are more amounts and cause the reduction of oxygen required for aquatic fishes. A more level of nickel is also hazardous to fish.

High chlorine concentration causes the death of fish and leads to skin problems meant for humans, such as inflammation, skin rash, and itching.

Detection On Water For Drinking Purpose

Coliform microbes are slightly infectious and found in soil, the intestinal tract of warm-blooded mammals, together with man. They can be detected by the whirl- pak bag of coli test. This bag is made of special barrier film and shows colour-changing if presence.

When water from Nyet Pyaw Taw surface well is filled in the bag, the blue colour forms showing the presence of E.coli. Thus water from tested well is not suitable for drinking.

CONCLUSION

Since coal is low-cost and locally available in Myanmar, coal is selected alternatively to be fuel for the growing demand for power generation. Coal has both beneficial factors and adverse effects.

After using coal as fuel, water pollution occurs within one year. Moreover, soil and airborne pollution will emerge, and those areas may face various impacts without using appropriate technology.

Myanmar, a developing country, needs a power supply for present and future development activities. Hydropower, natural gas, and renewables, like solar and wind, should be chosen as the prime priority for a long time of environmental conservation.

Coal utilization should be adopted as a second stage since coal demonstrates various pollutions and huge impacts on our society. Its adverse effects would continue to coming generations and actively harmful to our nation.

Significant clean technology is appropriate for coal utilization, and it must be eventually employed if power plants of coal switch on anymore. Policies, Rules, and regulations should be arranged to balance and manage economic growth and environmental protection.

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