



**FINAL REPORT**

**ENVIRONMENTAL POLLUTION DUE TO**  
**THE LAKWIJAYA POWER PLANT**  
**(NOROCHCHOLAI)**

**ENVIRONMENTAL AND POLLUTION CONTROL**

**ID2010**



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## ACKNOWLEDGEMENTS

We would like to express our deepest appreciation and gratitude to everyone who have helped us in a lot of ways to complete this project successfully. A special gratitude has to be given for the subject coordinators Dr.B. Ketheesan sir whose contributions in stimulating suggestions and encouragement helped us to complete our project successfully.

We have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals. We would like to extend our sincere thanks to all of them.

Every project big or small is successful largely due to the effort of a number of wonderful people who have always given their valuable advice or lent a helping hand. We sincerely appreciate the inspiration, support and guidance of all those people who have been instrumental in making this project a success.

We would like to express our very great appreciation to Dr.B. Keetheesan sir and planning and development of this project. His willingness to give his time so generously has been very much appreciated.

And we would like to thank Norochcholai Engineers who gave us a lot of valuable information needed for our project and spent his valuable time with us for the successful completion of our project.

## INTRODUCTION

Norochcholai power plant or else Lakwijaya power plant is the very first coal fired power plant set up in Sri Lanka. The power station in Norochcholai, Puttalam on the Southern end of the Kalpitiya Peninsula. Construction of the facility began on 11 May 2006. The first unit commissioning on 22 March 2011 with 300 MWs. The name plate capacity is 900 MW and completed 2014 with total power generation.

Initial feasibility studies - 1996

Date of signing of Contract - 15th March 2006

Effective date of contract - 23rd July 2007

Date of completion of contract

- Contractual: January 2012

- Accelerated: December 2010

Main contractor for the project

China Machinery Engineering Corporation (CMEC)

(a semi government organization of People's Republic of China)

**Project funded by EXIM Bank of China**

Total project Cost

- US \$ 455 million (for stage one only)

- US \$ 891 million (for stage two only)

Project consists of three stages (3x300 MW)

First stage covers: - 300 MW (unit 01)

- Site infrastructure and auxiliary systems including the Jetty of 500m
- 220 kV double cct TX line (to Veyandgoda GSS)

Second stage covers: - 2 x 300 MW (unit 02 & unit 03)

- Site infrastructure and auxiliary systems
- 220 kV double cct TX line (to Anuradhapura GSS)

## UNDERSTANDING OF THE TOPIC

As a result of coal power generation,

The national cancer control programmer (NCCP) said that coal plant impact to the **health, safety and livelihoods** of surroundings communities and cause some damage to the environment; **both land and sea.**

### releases greenhouse gases and toxins

The burning of the coal releases greenhouse gases and toxins. Such as  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{NO}_2$  and etc.

### coal combustion produces ashes.

The coal combustion produces some residue; such as **fly ash, bottom ash (deposited in the system)** and **boiler slag**. These materials are affect to both human health and environmental sustenance as they **contain heavy metals** such as **mercury and radioactive nucleoids**

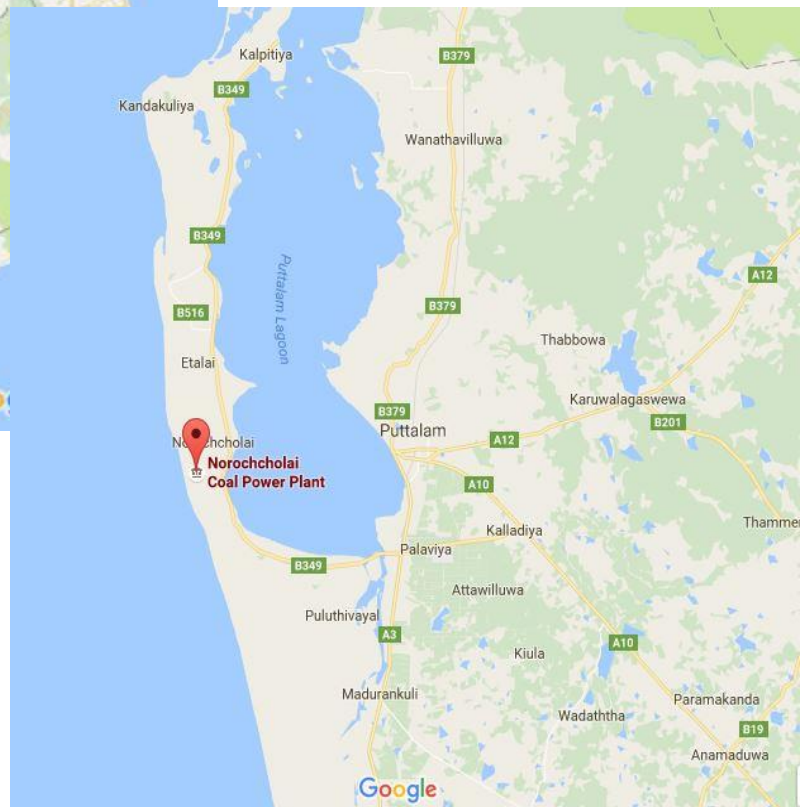
### The used heat water release to the sea

For the working of turbines, the water is heated and made steam. After steam going through turbines waste water is released to a canal and going to the sea. That water has some heat and it is not good for the both sea plants and sea animals.

### The water which used for bubbling burning gases have included heavy metals and chemicals.

The **burning gas filtering water** include some heavy metals. Such as **hg, Pb and etc.** As well as **Sulfuric acid, Nitric acid, Sulfurous acid, Carboxylic acid** They are released to the environment

## Location





## ARTISTIC VIEW



## FRONT VIEW



## PROBLEM STATEMENT

- LAKVIJAYA power plant is Sri Lanka's first power plant. It generates electricity from burning coal and liquid fuel.
- Coal-fired power plant expose people to toxic particles, ozone and heavy metals. The most serious health impact is due to microscopic particles.
- Air pollution from coal power plants is linked with cancers, heart problems, acid rain, global warming and public health impacts.
- High noise release by pressure steam and running fans and motors.

## AIM

Protect the environment from pollutants due to the Lakwijaya power plant activities.



## OBJECTIVES

- Find the root causes for pollution in Lakwijaya power plant.
- Identify the effects of pollution.
- Find the solutions to decrease those environmental effects.

## QUESTIONNAIRE

### Questions from Engineers

- a) How the power generate procedure happen?
- b) How do you take water for making steam?
- c) What do you do for the burning ash (bottom ash)?



### Questions from villagers.

- a) What do you think about this power plant?
- b) Can you find job opportunities from this?
- c) Is there any health problem caused because of this?
- d) Are there any affects to your cultivation because of this?





## METHODOLOGY

- Discussed and finalized the topic.
- Got the permission for the topic.
- Collected information and data.
- Got the permission to visited the study area.
- Visited to power plant.
- Saw the power plant activities.
- Met the workers and neighbours (Question survey).
- Analysed of the collected information.
- Gathered more information.
- Suggested the solution.
- Finalized the project.

### DISCUSSED AND FINALIZED THE TOPIC

- This was done on the 1st week.
- We all were divided into groups and we discussed about the topic.
- Then we finalized our topic with lecturer.

### GOT THE PERMISSION FOR THE TOPIC

- This was done on 2<sup>nd</sup> week.
- After finalizing the topic, we got the permission for the project.

### COLLECTED INFORMATION AND DATA

- Collecting information and data was done on 2<sup>nd</sup>,3<sup>rd</sup>,4<sup>th</sup>,5<sup>th</sup> week.
- We collected data from the news articles and internet.

### GOT THE PERMISSION TO VISITED THE STUDY AREA

- This was done on 9<sup>th</sup> week.
- We got the permission from power plant Engineers through our faculty.

## VISITED TO POWER PLANT

- We visited to the power plant on 9<sup>th</sup> week.
- We visited to Lakwijaya power plant and saw the activities which were done there and we noticed the activities which were polluted the environment.



## MET THE WORKERS AND NEIGHBOURS

- We met them to ask about the difficulties they face due to this power plant activity.
- According that we asked some questions.

## ANALYSED THE COLLECTED INFORMATIONS AND COLLECTED MORE INFORMATION

- It was done on 10<sup>th</sup> and 11<sup>th</sup> week.
- We analysed the data that we got from power plant and newspaper articles and internet.

## SUGGESTED THE SOLUTIONS

- It was done on 12<sup>th</sup> week.
- We suggest some solutions to reduce these pollution issues.

## FINILAISED THE PROJECT

- This was done on 13-15<sup>th</sup> weeks.
- We prepared the presentation about the pollution issues and present it before our lecturer.

## RESULTS

After we visiting the power plant, we observed that there were many environmental ways due to the Norochchilai power plant at past. As well as, after the questionnaires form the engineers and workers at the power plant, we got a simple idea about the working process. Not only that after we met the villagers, they said that they had been faced to many problems at past.

### **They faced many difficulties due to ash dust and coal dust.**

- Ash dust and coal dust makes some health problems. Such as respiratory disorders, lung cancers, skin diseases and many health affections.
- As well as their houses, vehicles were uncleaned because of ash dust. So, they have to dedicate their valuable time to cleaning purposes every day.
- Not only that farmers have to face many problems.
- Their cultivation is destroyed and their crops are damages.

### **Noise of Norochchilai power plant make the life difficult of villagers.**

As a summery we found the results which mention below,

- Norochchilai coal plant emits CO<sub>2</sub> and generate tones of fly ash & Bottom ash
- Dust from the coal stock makes some Environmental problems & leakage in rainy season make soil pollution.
- Higher temperature (<=40 degree) chasing the marine life away while harming the breeding
- High noise release by pressure steam and running fans and motors

## Daily generation (24 hours) of Norochchilai power plant

### Fly ash - 1000 Mt

- Arsenic (As) – 45.33 kg
- lead (Pb) – 2.23 kg

### Bottom ash – 160 Mt

- Cd – 0.012 kg
- Co – 0.065 kg
- Cr – 0.254 kg
- Cu – 0.2166 kg
- Ni – 0.25 kg

### CO2 Emission - 40.8 Mt

### SO2 Emission – 2.3 Mt

### CO Emission – 0 %

There are extra oxygen particles in the flue gas. Therefore, they certificated that CO emission is **Zero**.

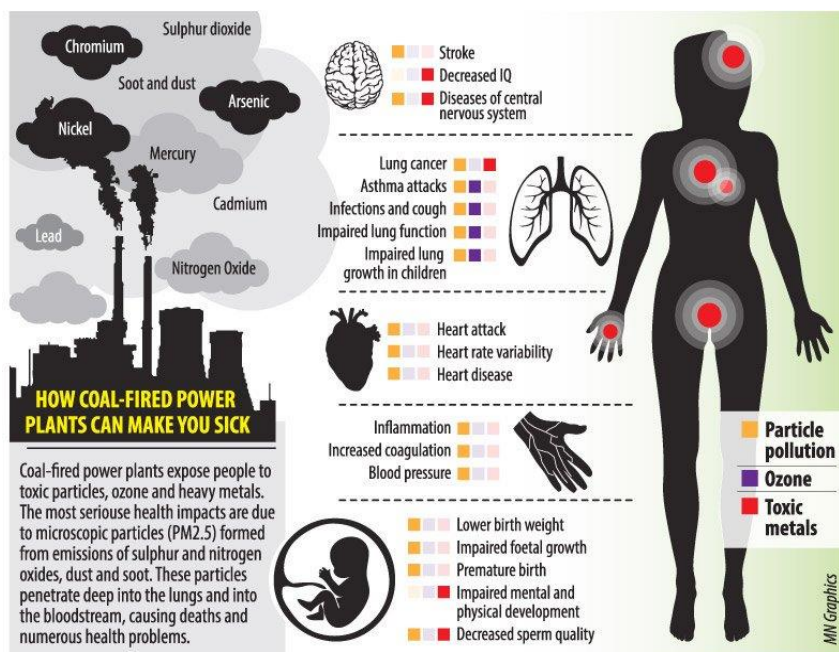
### Categorized results

#### 1. 3 main water pumps are used.

- for cooling purposes and other plant purposes.
- after cooling the steam 34 °C water released to sea.

#### 2. There is a huge coal yard.

- Coal dust are drive due to the wind.
- Coal dust affected to human, animal & environment.
- Skin diseases
- Eye infections
- Harmful effects to cultivations



### **3. 3 main boilers are used.**

- high temperature steam is generated.
- steam generating procedure make much noise & much heat.

### **4. 3 main furnaces are used.**

- High temperature is generated.
- Produces flying ash
- Produces bottom ash
- Produces SO<sub>2</sub>, CO<sub>2</sub> gases.

### **5. There is a huge ash yard.**

- Ash dust are drive due to the wind.
- Ash dust affected to human, animal & environment.
- Skin diseases
- Eye infections
- Harmful effects to cultivations

## **Discussions**

In this section we are discussing, the solution for above mentions problems. We got this information form engineers at Norochcholai power plant. During we visit the power plant, we could overserve these solutions. As well as, we got two great lectures throughout 2 hours which explain about,

1. Main introduction and process about Norochcholai power plant.
2. How to control environmental pollution in Norochcholai power plant.



# The Actions for Preventing environmental pollution

1. Preventing Coal Dust
2. Preventing Ash Dust
3. Cooling water releasing control
4. Ambient air quality measurement
5. Controlling SO<sub>2</sub> gas emission to atmosphere.
6. Industrial waste water management
7. Sewage releasing management
8. Fugitive dust monitoring
9. Stack Emission test
10. Noise and vibration monitoring
11. Ground water measurement

## 1. Preventing Coal Dust

- Establishment of **Wind Barrier**
- Establishment of Mist Blow (Spraying Water)
- Establishment of Mist Generating System
- Managing the yards
- Establishment of Buffer Zone
  - Coconut, Mangroves



**Buffer Zone - Coconut**

## 2. Preventing Ash Dust

- Establishment of **Electro Static Precipitator (ESP)**
- Wind Barrier
- Mix with Cream & Water
- Planting grass on the ash
- Managing the yards
- Establishment of Buffer Zone
  - Coconut, Mangroves
- When unloading ash, they keep wet condition with it
- Using sprinkle system

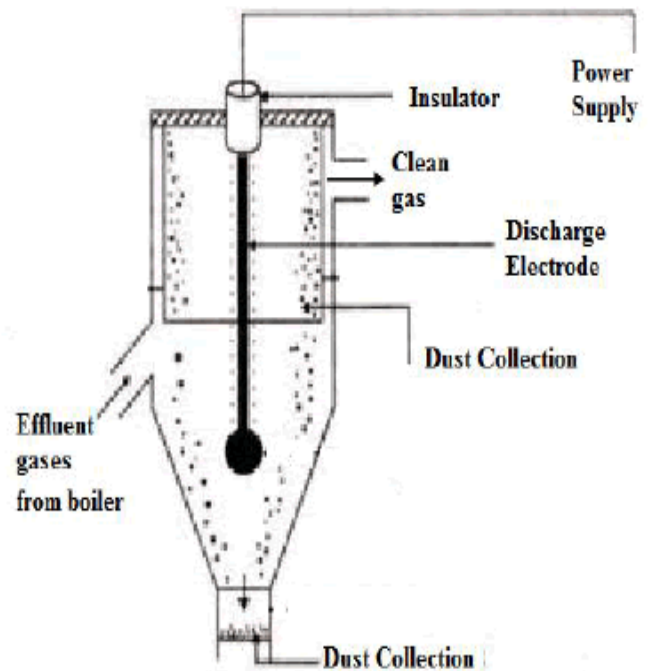


Figure 3: A schematic diagram of ESP.

**Planting grass on the ash**



**Using sprinkle system**



### 3. Cooling water releasing control

The Max releasing water temperature difference should keep according to the international environmental organizations is 7 °C

- The sea temperature of Norochcholai sea is 30 °C
- The releasing water temperature is 34 °C

The difference is 4 °C



However, the fishermen said that the fish density of this area is very low. But it not badly affects to their occupation.

### 4. Ambient air quality measurement

They checked about the air content monthly

CO<sub>2</sub>, CO, SO<sub>2</sub>, NO, NO<sub>2</sub> Getting experimental details around the power plant and compare with the maximum air amount which give by Environmental Organizations.

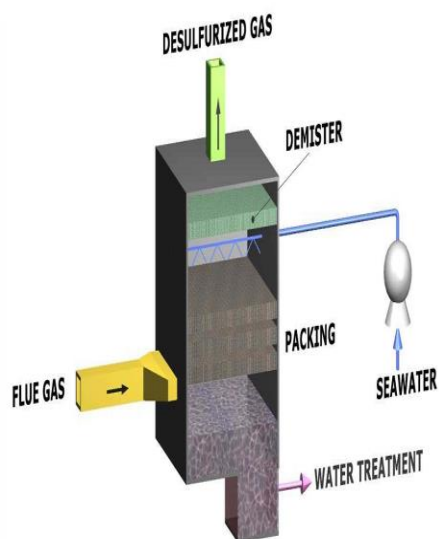


If harmful gases emitting rate is risen up, they get suitable actions for decreasing them.

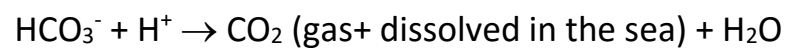
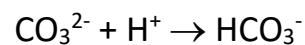
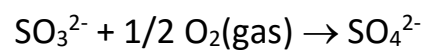
- Check the burning system air inlet.
- Expanding and repair desulfurization unit.

## 5. Controlling SO<sub>2</sub> gas emmtion to atmosphere.

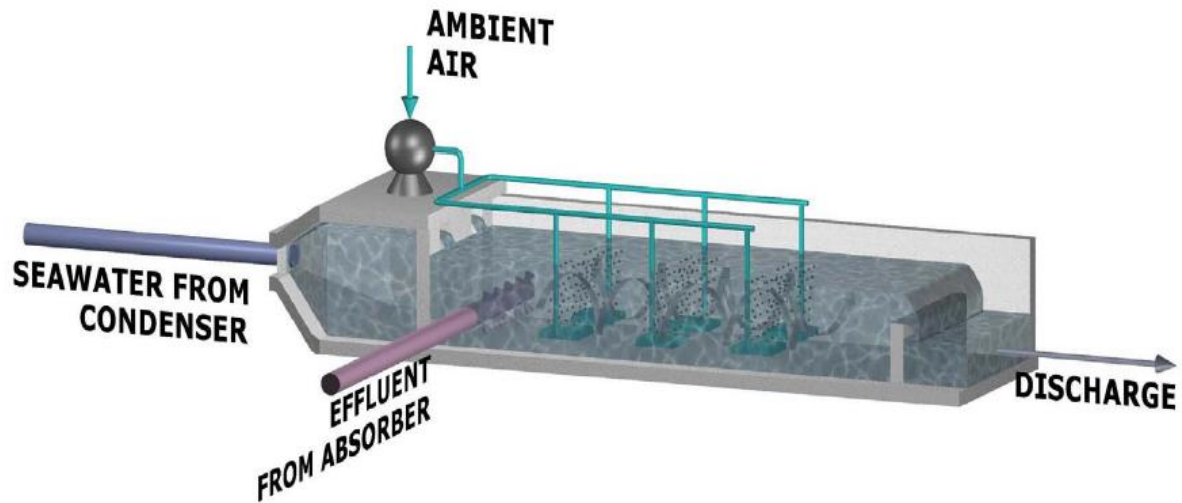
Using a Flue gas desulfurization unit



Reactions







## 6. Industrial waste water management

Waste water from kitchen, washrooms, canteen not release to the environment directly. After going through a waste water treatment, waste water used for,

- Coal yard mist generating system.
- Watering plants.
- Other cleaning purposes

## 7. Sewage releasing management

- Toilets wastages regulated by municipal council.
- Kitchen wastages used for making composts at farms around power plant.



## Sri Lanka largest RO plant situated at Norochcholai power plant

- Waste water of RO plant used for sprinkle system at ash yard.

Whole ash yard has been concreted.

- In rainy season, coal yard will cause a leachate and it will affect the water resources. Therefore, they collect coal leachate by concreting the whole yard and collect leachate in to a tank. After that, rain water released to environment.



## 8. Fugitive dust monitoring

- Coal dust monitoring
- Ash dust monitoring

Find the Cr, S, Si content of atmosphere from fugitive dust monitor and compare with the maximum value which given by CEA.

If it is trying to reach, the get suitable action for decreasing them

- Expanding the wind barrier.
- Expanding the sprinkler system.
- Increasing the mist blow



## 9. Stack Emission test

- Measure the opacity of yard and around the village twice a week and get a report. According to that, they keep the stack emission rate in correct quality.
- They have Kept stack emission test monitors at several places.



## 10. Noise and vibration monitoring

Measure the sound level

- Around the plant area
- Around several places including houses

Results are lower than permitted levels which given by government



## 11. **Ground water measurement**

### Plant Area

- water level is high
- good water quality
- hardness of ground water is low

### Around Villages

- water level is low
- bad water quality
- hardness of ground water is high

The reason for this difference is, they use wastage water to watering plants in plant area. It increases the ground water level of there.

# Conclusion

Norochcholai power plant is the first coal power plant in Sri Lanka. In Sri Lanka 39.34 GWh electricity is generated. From this 13.11 GWh is generated from coal power plants. As many environment authorities say these power plants cause more environmental pollutions.

There are three types of coal burning ways in thermal power plants. In this table 1 we can see it.

Coal type	Ignition temperature	Volatile initial release temperature
Lignite	250-450	130-170
Bituminous	400-500	200-300
Anthracite	700-800	380-400

**Table 1:** Heating characteristics of coals.

Pollutant	Anthracite	Lignite
CO <sub>2</sub> (g/GJ)	94,600	101,000
SO <sub>2</sub> (g/GJ)	765	1,361
NO <sub>x</sub> (g/GJ)	292	183
CO (g/GJ)	89.1	89.1
Organic compounds-Non methanic (g/GJ)	4.92	7.78
PM (g/GJ)	1,203	3,254
Total volume of flue gases (m <sup>3</sup> /GJ)	360	444

Note: The average emission amount of flue gases from coal fired power plants reported by European Environment Agency (EEA 2008).

**Table 2:** Average emission of flue gases from coal burning.

According to the above table we can see the amounts of coal burning  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}_x$ ,  $\text{CO}$ , organic compounds, particulate matters and flue gases releasing to the atmosphere.  $\text{CO}_2$  is the main product of coal combustion. These things cause acid rains, global warming and lung cancers.

The main particulate matter is coal fly ash. Fly ash can spread within the area of 40 km to 50 km to the direction of the wind. Because of this matter it harms plants, animals and humans. So it also has been detected even in the milk of cow. So in this power plant they use wind barriers to control spreading of fly ash. And we can use electrostatic precipitators(ESP), fiber filters(FF), mechanical collectors(MC) and VENTURI scrubbers(VS) for controlling PM.

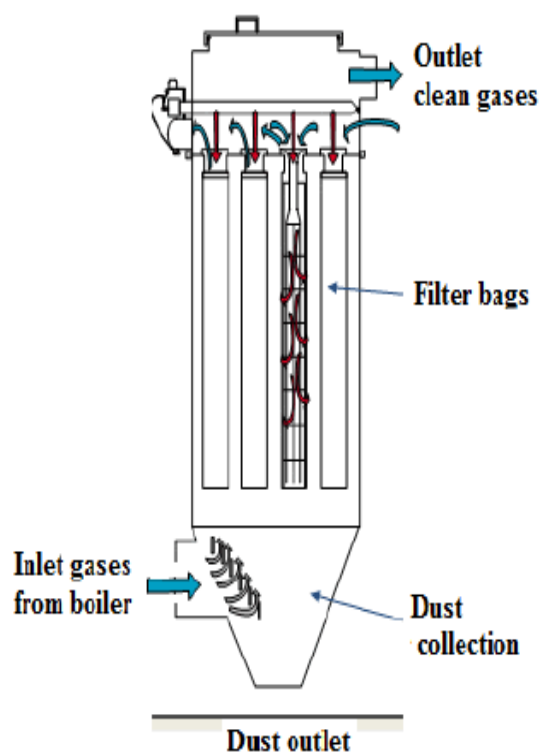


Figure 2: A schematic diagram of fabric filter.

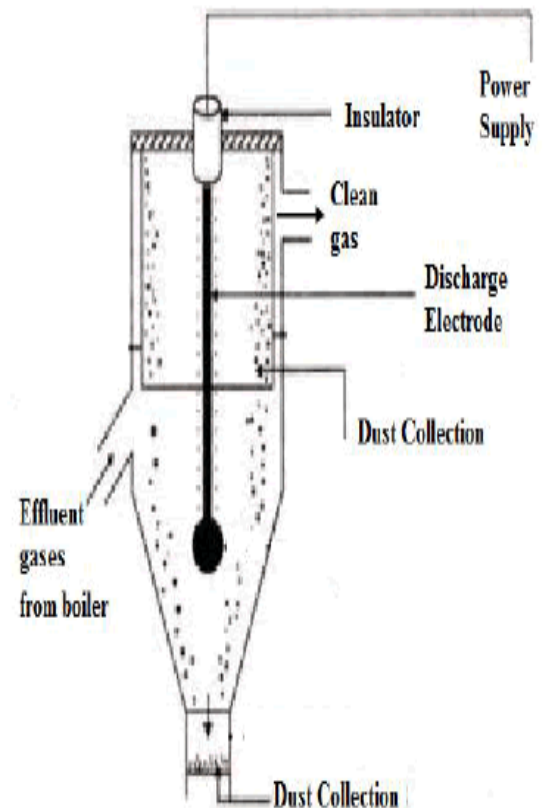
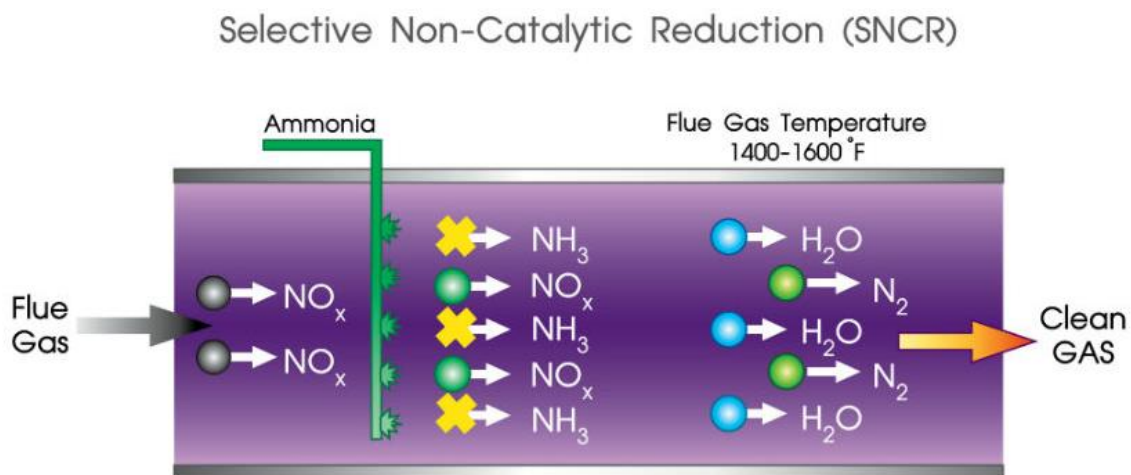


Figure 3: A schematic diagram of ESP.



There are 78% percentage of C in the coal. So from burning coal, it releases  $\text{CO}_2$  to the atmosphere.

To control  $\text{NO}_x$ , we can replace original coal burner with new low  $\text{NO}_x$  burners. The low  $\text{NO}_x$  burner apply advance fluid dynamics and flame thermodynamics techniques to reduce flame temperature, hence less  $\text{NO}_x$ . And also  $\text{NO}_x$  can control by using Selective Catalytic Reduction(SRC) systems and Non Catalytic Reduction(SNCR) systems.



$\text{SO}_2$  can be controlled by using three approaches. Blending of fuel, switching fuel, with a fuel having lower sulfur contents or removing the  $\text{SO}_2$  from the flue gases.

We can use FGD and DSI option in power plants.

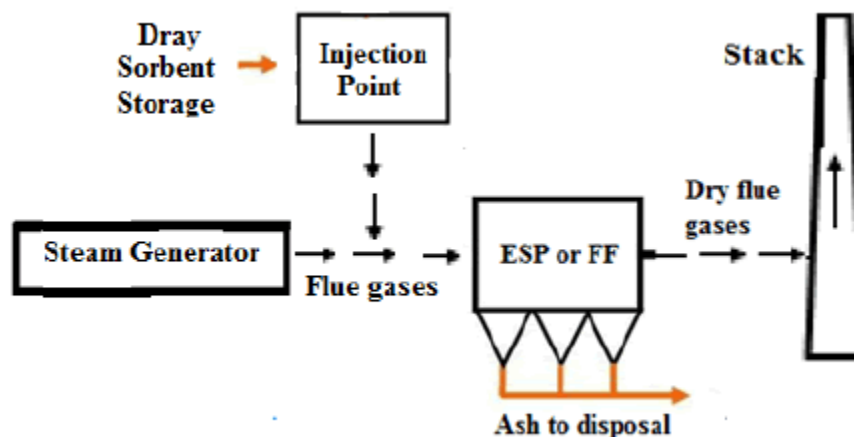


Figure 7: The locations of the DSI option in plant.

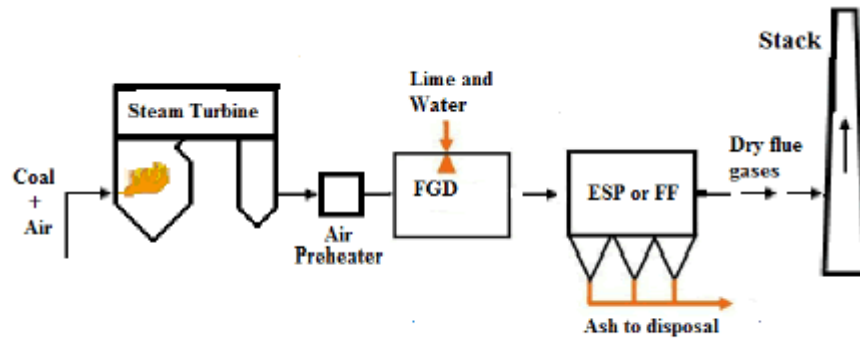


Figure 6: FGD in a coal fired power generation plant.

And also we can use some adsorptions. Here we can see some adsorbent.

Adsorbent	SO <sub>2</sub> removed
Linestone	30%
Dolomite Lime	58%
Calcitic Lime	62%
Ligno Lime	68%

Mercury emission also can be controlled by using DSI and FDG techniques.

## RECOMMENDATIONS

- The importing coal should fulfill the required standards Proper frequent monitoring system should be established.
- More priority should be given for alternatives.
- More studies should be conducted about the long term impacts.
- Fly ash could be used as a raw material for other industries.
- EIA reports should reveal the real situation of the impacts Mass scale projects should establish with good quality workmanship.
- To Establish the hydro power plants in Sri Lanka.
- To establish only environment -friendly high efficient coal power plants using “clean coal technology “.
- planting trees in the buffer zone was impractical due to sheer scale of carbon emissions from coal power plants
- Improve the technology to generate the power by using Natural gas.
- Fly ash use to: Making cement  
Making asbestos sheet
- Bottom ash use to: Making cement block stone  
Making some Building apparatus



## TIME FRAMEWORK – week 1- week 15

	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13-15	
Discuss with group members and select a topic														
Getting the permission for the topic														
Search details on the selected topic														
Plan the project														
Presenting the project proposal														
To get the permission to visit Noraichchulai														
Visit the Noraichchulai														
Visit the surrounding area and talk with people														
Collecting data from Internet														
To discuss about final sample project														
Analysis the all data														
Implementing the solutions														
Finalizing and presenting the project report														

## WORK DISTRIBUTION

Time	Activities	Responsible person
Week 6 -7	Fact finding /data collection. <ul style="list-style-type: none"> <li>• location</li> <li>• Get some knowledge about our project</li> </ul>	- Sisila(2018/E/110) - shajee
Week 8-9	Field Visit. <ul style="list-style-type: none"> <li>• How is it working and get some knowledge</li> <li>• Ask to workers about the working process</li> <li>• Ask to nearest family to work about the power plant</li> </ul>	- Sisila(2018/E/110) - Sathurjan(2018/E/108)  - Rumeszni(2018/E/109)  - kethiga(2018/E/112) - Shajeef(2018/E/111)
Week 9	Preparations of recommendations and Proposal Preparation for presentation <ul style="list-style-type: none"> <li>• Divided the task and gave to our group members and they did that task</li> </ul>	- shajeef(2018/E/111)

Time	Activities	Responsible person
Week 10	Starting the project in certain ways that we are going to search internet and talking related people Read some article and news papers.	Sathurjan Saarugesh Shajeef
Week 11-12	Going to discuss about how are the calculations and reports are going to be prepared.	Kethiga Rumeszni
Week 13-14	Meeting with group members to finalize the all data and divide the topic	all members
Week 15-16	Create a report and submit. Final presentation	Shajeefpiranath(2018/E/111)



# REFERENCES

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- <http://www.sundaytimes.lk/180603/news/explosive-report-on-hazards-of-Norochcholai-coal-power-plant-296923.html>
- [Effects of Norochcholai coal power project, http://www.scribd.com/doc/31536194/EFFECTS-OF-NOROCHCHOLAI-COAL-POWER-PLANT-PROJECT](http://www.scribd.com/doc/31536194/EFFECTS-OF-NOROCHCHOLAI-COAL-POWER-PLANT-PROJECT)
- Lakvijaya power plant official website
- Public and workers Review



# ATTACHMENTS

Some important parts photos:

**Turbines and Pumps**



**Temporary coal bunker storage**



**Jetty**

