The Backdrop

The total damage because of environmental degradation because of thermal power plants amounts to Rs 3.75 trillion (US $80 billion). This is equivalent to 5.7 per cent of the country's GDP

Emission reduction measures
Overview & experiences

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Domestic experiences feed back
units commissioned after 2003.

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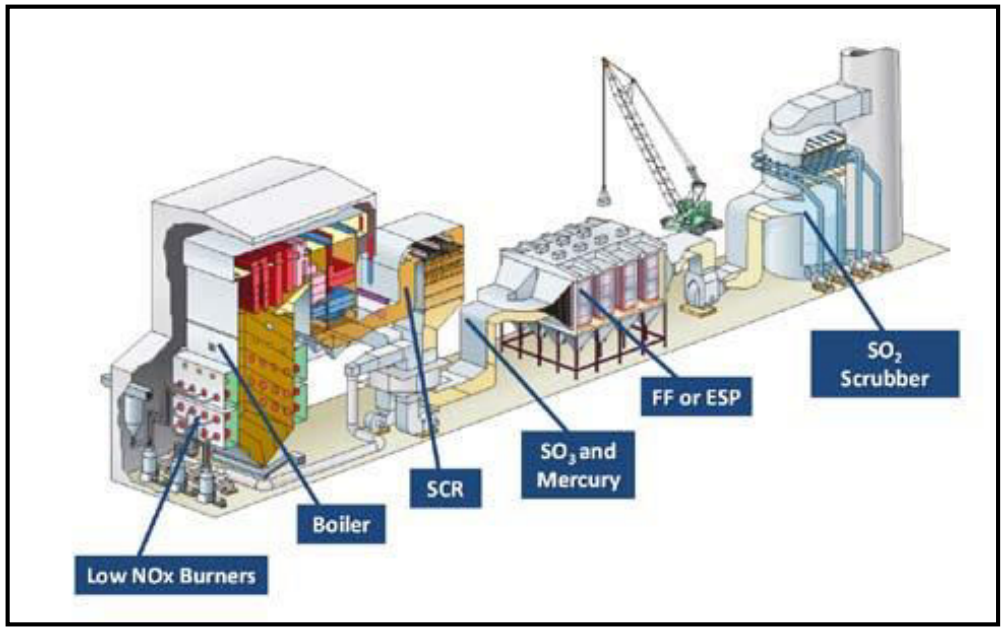
- 500 MW sized boilers installed around 2002/3 had 64 ESP fields.
- Emission levels are in the range of 100-120mg/nm3
- SOX levels are in the range 1000-1300 mg/NM3
- NOX levels are in the range 350-450mg/NM3(low NOx burners)
- Emission levels are better on sets with higher fields(80).
- When other than design coal is fed, the SPM levels are higher
- Ammonia dosing is done at few stations, but the results are not favorable.
- Corrosion was noticed on ESP discharge plates and Stack flue
- Complete ash dislodge from collecting plates is also an issue.
- Some stations are planning to increase in ESP size for SPM control.
- Auto controls are required for the dosing systems
- Fabric filters are very effective in controlling SPM 40mg/Nm3.But high maintenance

Parameter mg/Nm3	Limit		Actual
	Old	New	
SPM (at 12 %CO_2)	100	50	100-120
SOX	200	200	900-1300
NOX	600	300	350-450



Raw Coal Constituent	Combustion Result	Required Equipment
Carbon (C)	Heat, Steam, CO_2	Boilers
Nitrogen (N)	NO_X	Burners and SCR Systems
Sulfur (S)	SO_2	Wet and Dry FGD
	SO_3	Sorbent Injection, Wet ESP
Ash	Ash	Ash Handling, Sootblowers, Precipitators, Fabric Filters
Mercury (Hg)	Hg^{++}, Hg^0	Coal Additive, PAC Injection, Wet FGD Enhancement Systems

Meeting the new Environmental norms

The task cut out….

Suspended particulate matter(SPM) and its control

Electro static precipitators , Fabric (Bag) filters

Flue gas conditioning

Electro Static Precipitator(ESP)

$$\eta = 1 - \exp\left(-\frac{w_e WL}{Q}\right) = 1 - \exp\left(-\frac{w_e A}{Q}\right)$$

The ESP efficiency depends on

particle migration velocity and, the Specific Collection Area(SCA)

Resistivity of the ash particles(ideal values 5X108 to 5X10^10 ohm-cm)

Migration velocity is low for higher resistive particles.(high voltage drops cause low forces)

Resistivity varies with, So3 content, ash chemical composition and temperature.

The resistivity is low at high temperatures.

The resistivity is high for low sulfur coals(low SO3)

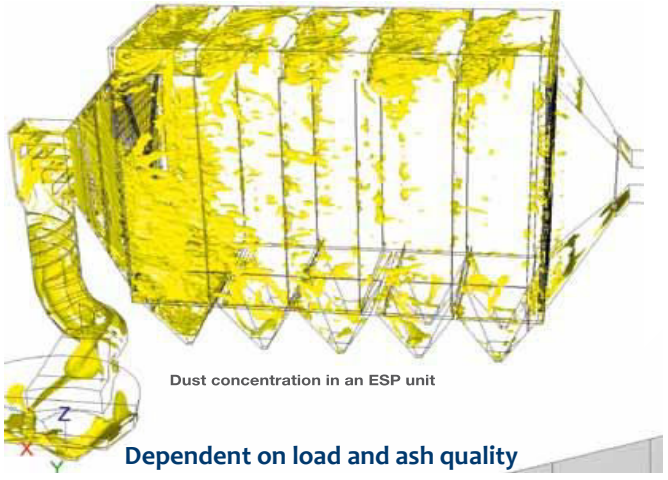
Ash Constituents: Silica and Allumina in Ash are insulators.

The SCA is calculated based on assumed migration velocity

So, the ESP's loose **effectiveness on these account.**

This necessitates

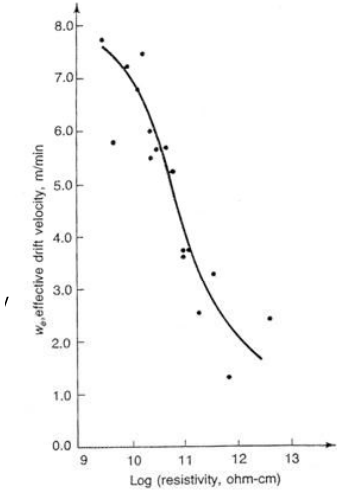
Large ESP's,Flue gas conditioning for the control of emission.



Dust concentration in an ESP unit

Dependent on load and ash quality

Less pressure drops, Low maintenance



Flue gas conditioning

Effective removal of SPM

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- Flue gas conditioning alters the resistivity reduces SCA requirement
- SO_3 is a popular conditioning agent{Sulfur on burning and oxidation gives SO_3}
- SO_3 is injected in traces at below dew point temperatures.(matured technology)
- SO_3 condenses on particulate matter, and collected in ESP, emission levels are not affected.
- NH_3 injection helps in agglomeration of PM and improves collection.
- With dual conditioning, ESP's can be 20-30% smaller.
- A wet ESP is effective for PM10 and PM 2.5(washing of electrodes against rapping)
- **Concern:** Slurry and solids after was disposal is a concerns.

Data source: Chemithon engineers

Coal Analysis (% Wt)						
Carbon	40.0	40.0	54.7	34.5	32.11	27.8
Moisture	10.0	10.0	4.90	6.7 to 6.8	0.99	21.1
Sulphur	0.5	0.5	0.38	0.4	N/A	N/A
Ash	40.0	40.0	29.8	51.4	52.94	42
Injection of SO_3(Kg/hr)	0	0	0	0	0	18
Injection of NH_3(Kg/hr)	22	15	30	30	28	14
SPM level before injection (mg/Nm^3)	120.6	350	247	800	410	400
SPM level after injection (mg/Nm^3)	80	120	49	82	74	130

Reduced particulate emissions
Bag Filters

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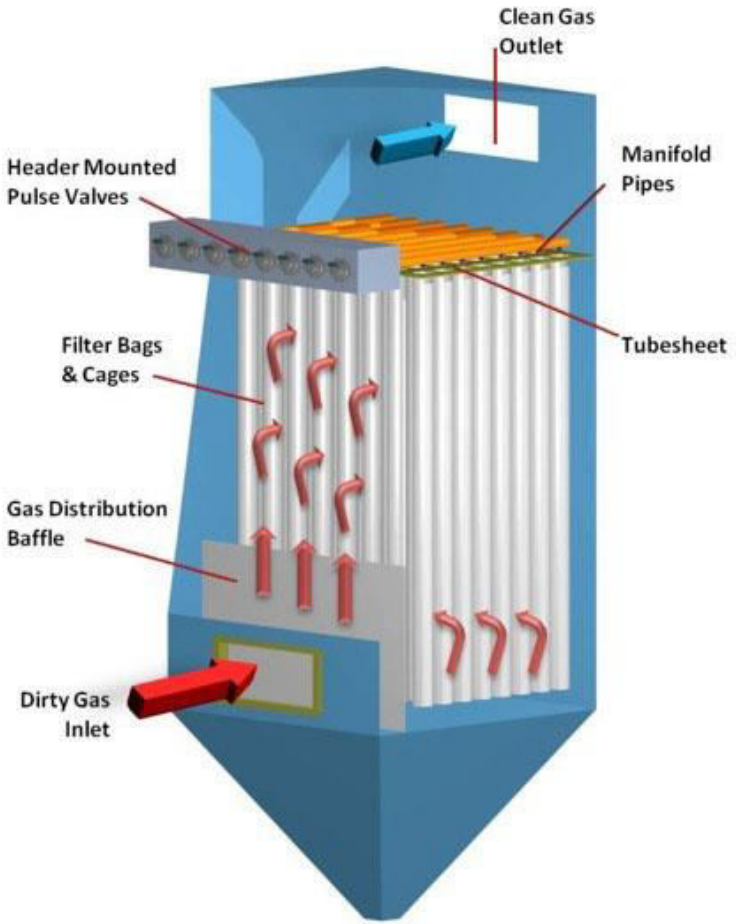
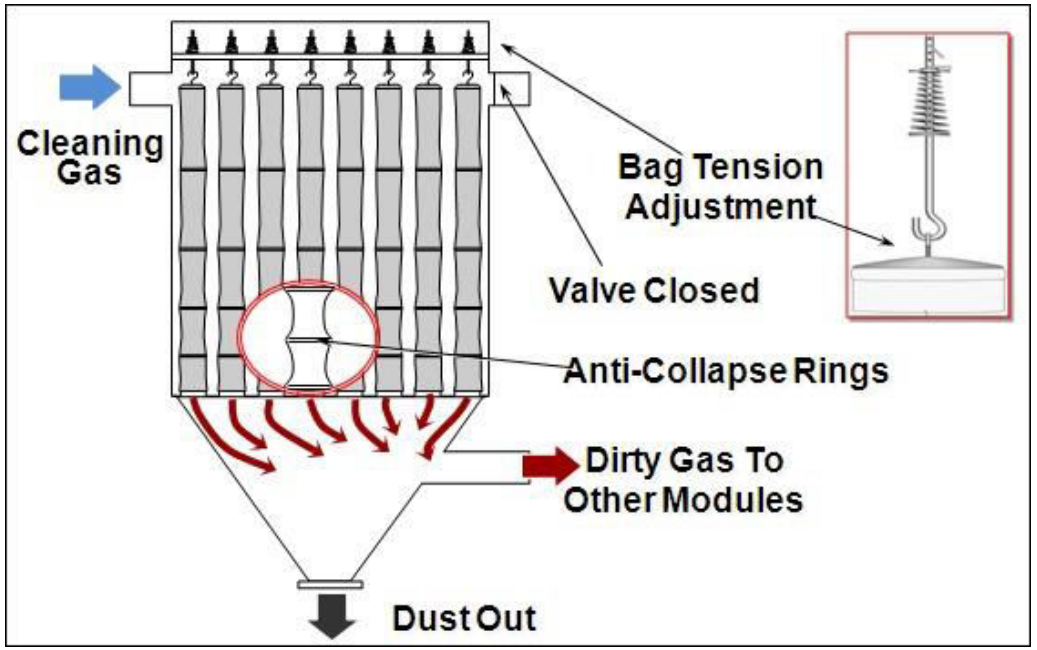
Pulse jet type (economic & site layout)



reverse air type

(reverse gas fans, offline compartment cleaning)



Steag's experiences

Consistent emission levels irrespective of ash quality or load

Higher pressure drops(higher energy)

Higher maintenance(bags replacement)