Air Pollution Control

Flue Gas de-dusting
MSW Incinerator
&
Distillery spent wash Boiler exhaust gases

By

Clair Engineers Pvt Ltd, Hyderabad

POLLUTION SOURCE IN INDUSTRIES

INDUSTRY	EQUIPMENT	DUST LOAD (GM/M3)
Steel	Blast Furnace off gases	5 to 7
	LD convertor off gases	5
	Sinter Machine off gases	2 to 3
	Cooler off gases	2
Cement	Kiln/ Raw mill exhaust gases	50
	Clinker Cooler exhaust gases	25
	Coal mill exhaust gases	300
	Cement mill exhaust gases	300
	Cement mill Separator exhaust gases	100
	All Material transfer points	50

POLLUTION SOURCE IN INDUSTRIES

INDUSTRY	EQUIPMENT	DUST LOAD (GM/M3)
Power	Coal fired Boiler exhaust gases	70
	Biomass fired Boiler exhaust gases	20
	Coal Handling Plant	50
FerroAlloy	Furnace & Tap Fumes	5
	Dryer exhaust gases	20
Mineral & Stone Crushing units	Stone Crushers	50
	Grading screens	50
	Bagging Machines	50
	All Material Transfer points	50

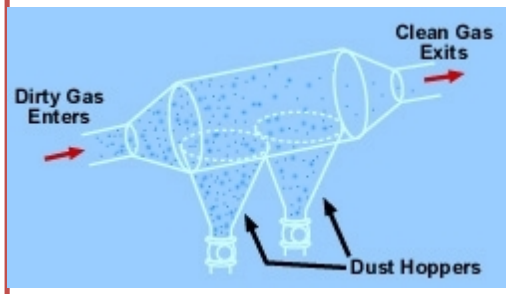
TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Equipment	Type	Collection Efficiency (%)	Industry acceptance
Settling Chambers	Dry	75 to 85	Obsolete
Cyclone Separators	Dry	80 to 90	Obsolete
Scrubbers	Wet	95 to 98	Conversion of gaseous pollution to liquid pollution
Electrostatic Precipitators	Dry	98 to 99.5	Application demand
Bag house	Dry	>99.8	Highly efficient & Most commonly used

TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Settling Chambers:

- Operation Principle: Sudden expansion of dirty gases by reduction of velocity allowing particulate matter settle out of moving stream under gravity action



- Advantages:

  - ❑ Low Initial cost
  - ❑ Simple construction
  - ❑ Low maintenance
  - ❑ Low pressure drop
  - ❑ Dry dust disposal

- Disadvantages:

  - ❑ Large space requirement
  - ❑ Only large particles with high density can be collected.

TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Cyclone Separators:

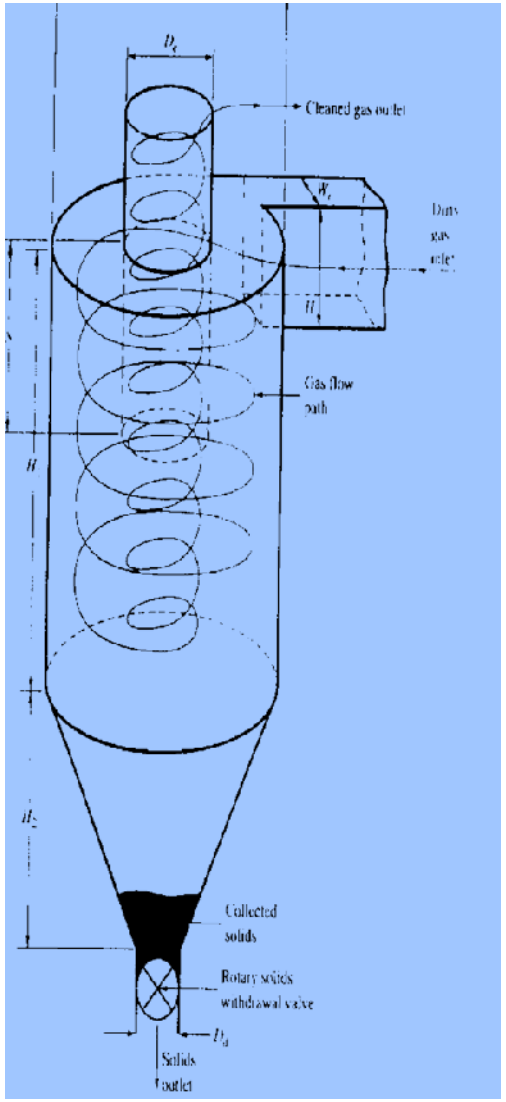
- Operation Principle: Centrifugal action in gases to separate particulate matter from dirty gas stream

- Advantages:

  - ❑ Low Initial cost
  - ❑ Simple construction
  - ❑ Low maintenance
  - ❑ Low pressure drop
  - ❑ Dry dust disposal

- Disadvantages:

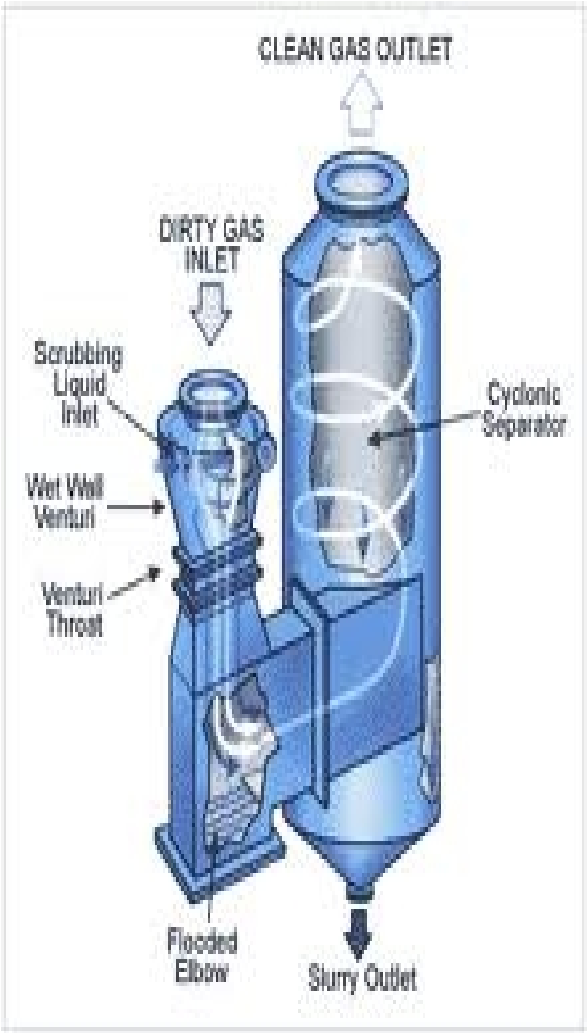
  - ❑ Low collection efficiency < 50% for 5 to 10 µ
  - ❑ Equipment subject to high abrasive deterioration.
  - ❑ Low efficiency – Low Inlet dust loads



TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Scrubbers:

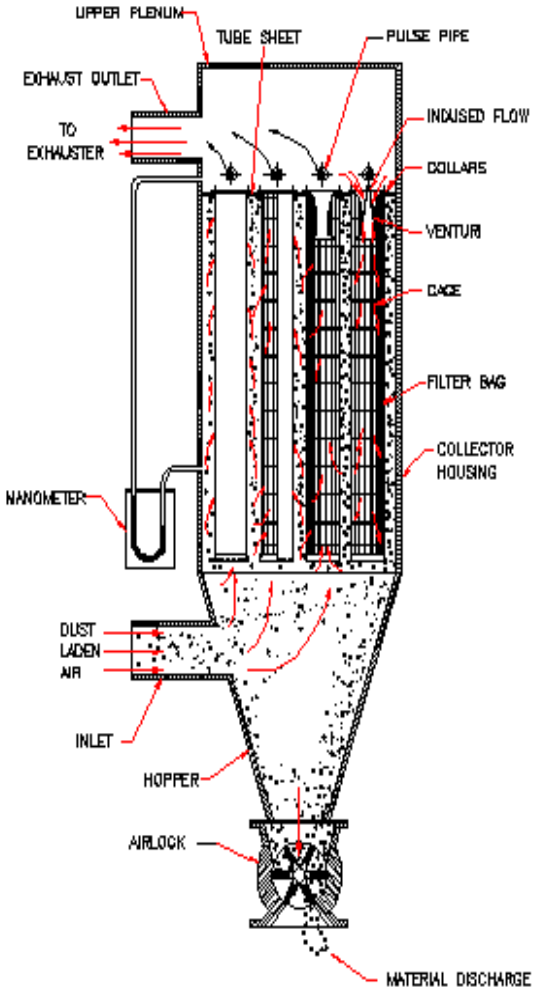
- Operation Principle: Atomised liquid spray into gases to separate particulate matter from dirty gas stream
- Advantages:
  - ❑ Low Initial cost
  - ❑ Moderately high collection efficiency even for smaller particles
  - ❑ High Temperature application
  - ❑ Simultaneous removal of particulate & gaseous pollutants
  - ❑ No particle re-entrainment
- Disadvantages:
  - ❑ High Power consumption for higher collection efficiency
  - ❑ High maintenance costs due to corrosion & abrasion.
  - ❑ Wet disposal of dust



TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Bag filters:

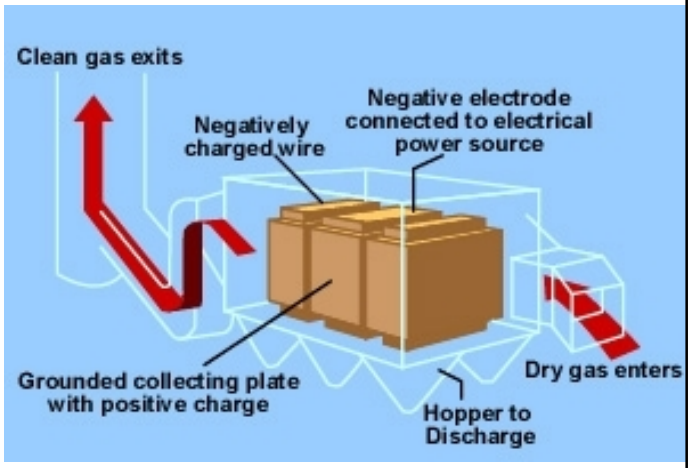
- Operation Principle: Collection of dry dust on filter fabric to separate particulate matter from dirty gas stream
- Advantages:
  - ❑ High collection efficiency (99%<0.5 μ)
  - ❑ Simple Construction & operation
  - ❑ Dry dust disposal
- Disadvantages:
  - ❑ Operating limits – High temperature, humidity.
  - ❑ High maintenance cost – bag replacement
  - ❑ Large size of equipment



TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

Electrostatic Precipitators:

- Operation Principle: Electrical forces charge dust particles (-ve) to collect on grounded collecting plates
- Advantages:
  - ❑ High collection efficiency (99%<1.0 µ)
  - ❑ Low maintenance & operation costs
  - ❑ Low pressure drop
- Disadvantages:
  - ❑ High Initial cost.
  - ❑ Large space requirement
  - ❑ Possible explosion hazards
  - ❑ Poisonous gas generation, ozone



Preamble – Waste Incineration

- **In the year 1993, mass burning of Muncipal Solid Waste (MSW) and also burning through RDF was at its lowest ebb mainly due to social concerns arising out of pollution problems related to pollutants through stack emissions and only other output product – ash, its safe handling and disposal. Subjective concerns against incineration were :**
  - ❑ **Excessive expectation from alternate methods such as composting, landfill gas recovery etc.**
  - ❑ **Inadequate technical solutions for pollution problems**
  - ❑ **Non recognition of energy benefits.**
- **In twenty years the study of emissions has matured to the following levels :**
  - ❑ **The knowledge of composition and concentrations of emission are well established.**

Air Pollution from Incinerator – Serious Concerns

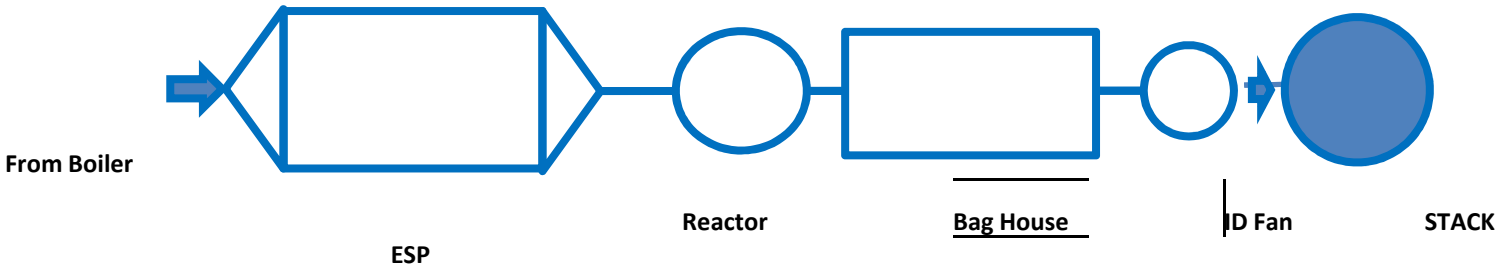
- **RDF produced from MSW after many cleaning steps, its combustion will still produce polluted emissions, though that will be of lesser degree than those from mass burning, because complete removal of all the undesired constituents of MSW is not technically possible. So the harmful emissions will always be produced. The regulatory requirements on the performance of emission control systems deployed in municipal waste incineration are now directed at the emissions of :**

* Particulate	PM 10 (less than 50 mg/Nm3)
* Heavy Metals	
* Mercury	0.01 mg/Nm3
* Acid Gases	HCl, SO_x, HF (less than 100 mg/Nm3)
* Nitrogen Oxides	200 mg/Nm3
* Dioxins And Furans	0.01 mg/Nm3

Solution to Air Pollution Control

Gas Adsorption Reactor System along with Bag filter

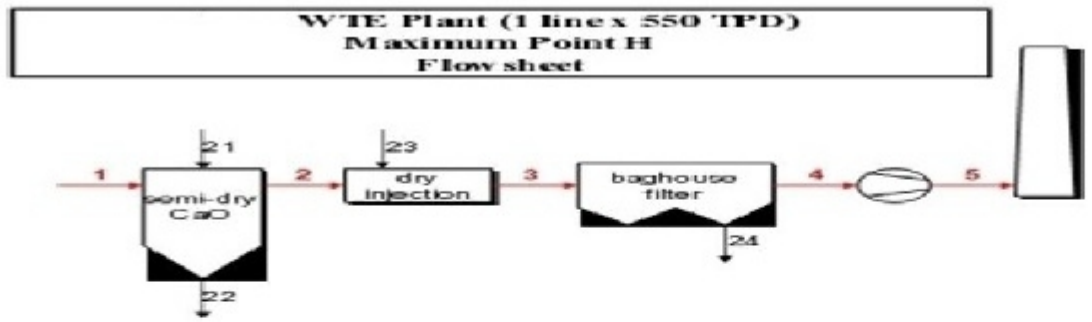
- **Flue gases can be treated in a 'Reactor' and Bag House for removal of Dioxin, Furans and also SOx.**
- **Flue gas will first pass through the Reactor where 'activated carbon, and 'lime' will be injected to remove the 'dioxin', 'furans' and SOx from the gas.**
- **The main reaction shall take place in the 'Reactor' and the balance reaction shall be over the bag filter fabric in the Bag House.**



Solution to Air Pollution Control

Gas Adsorption Reactor System along with Bag filter

Typical Mass Flow Diagram



Flow	Temp	Composition				Gas		Pollutants										Absolute Values						Total Amount of Pollutants removed					
		CO2	H2O	O2	N2	Dens	Ar	HCl	SO2	SO3	HF	NOx	dust	Cd, Tl	Hg	As,...	dioxin	Hcl	SO2	SO3	HF	dust	Total	Hcl	SO2	SO3	HF	dust	Total
Nm³/h		°C	vol%			Kg/Nm3		mg/Nm³, dry 11% O2									ng	Kg/hr						Kg/hr					
1	122723	200	7.23	18.07	8.91	64.95	1.22636	0.77	1200	297	3	10	200	2500	0,52	0,07	8,9	3,00	147.3	36.4	0.37	1.23	307	492.12						
2	127955	145	6.93	20.65	8.72	62.95	1.21349	0.75	8	32	0	0.1	200	6644	0,52	0,07	8,9	3,00	1.024	4.09	0	0.01	850	855.26						
3	128055	145	6.93	20.64	8.73	62.96	1.21367	0.75	8	32	0	0.1	200	671 9	0,42	0,00	7,1	0,10	1.024	4.1	0	0.01	860	865.54	146.2	32.4	0.37	1.21	859.75	859.70
4	129336	144	6.86	20.46	8.85	63.09	1.21419	0.75	8	32	0	0.1	200	5	0,01	0,00	0,2	0,01	1.035	4.14	0	0.01	0.65	5.83						
5	129336	146	6.86	20.46	8.85	63.09	1.21419	0.75	8	32	0	0.1	200	5	0,01	0,00	0,2	0,01	1.035	4.14	0	0.01	0.65	5.83						

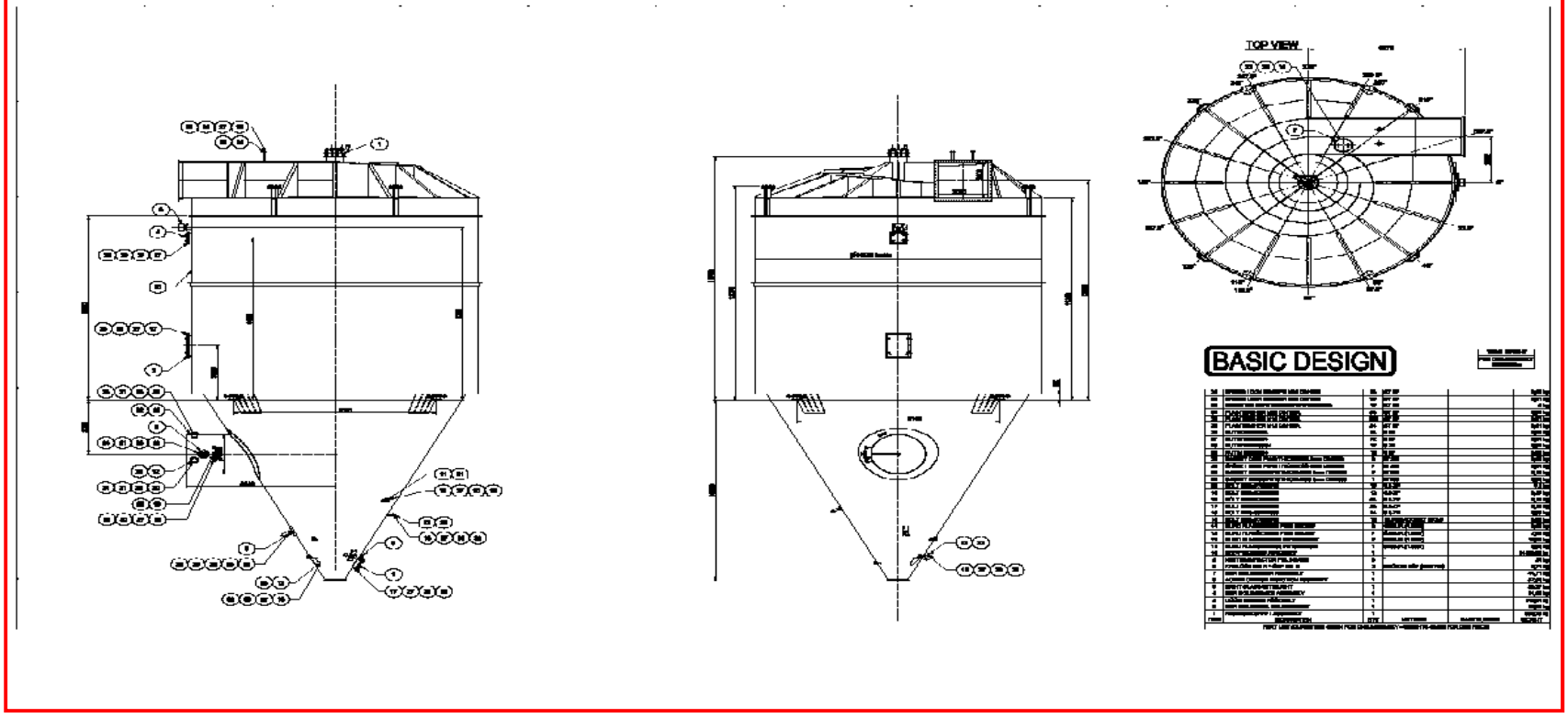
flows (for 1 line)			
	reside/reactant	water	air
	kg/h	m³/h	Nm³/h
21 CaO (100%)	273	3.6	
22 residue	75		
23 activated carbon	7.7		
24 residue	682		

Overall stechiometry for acid removal:	Total acid removal:
2,30 on removed pollutants	180.2
2,23 on incoming pollutants	273
	1.515

Solution to Air Pollution Control

Gas Adsorption Reactor System along with Bag filter

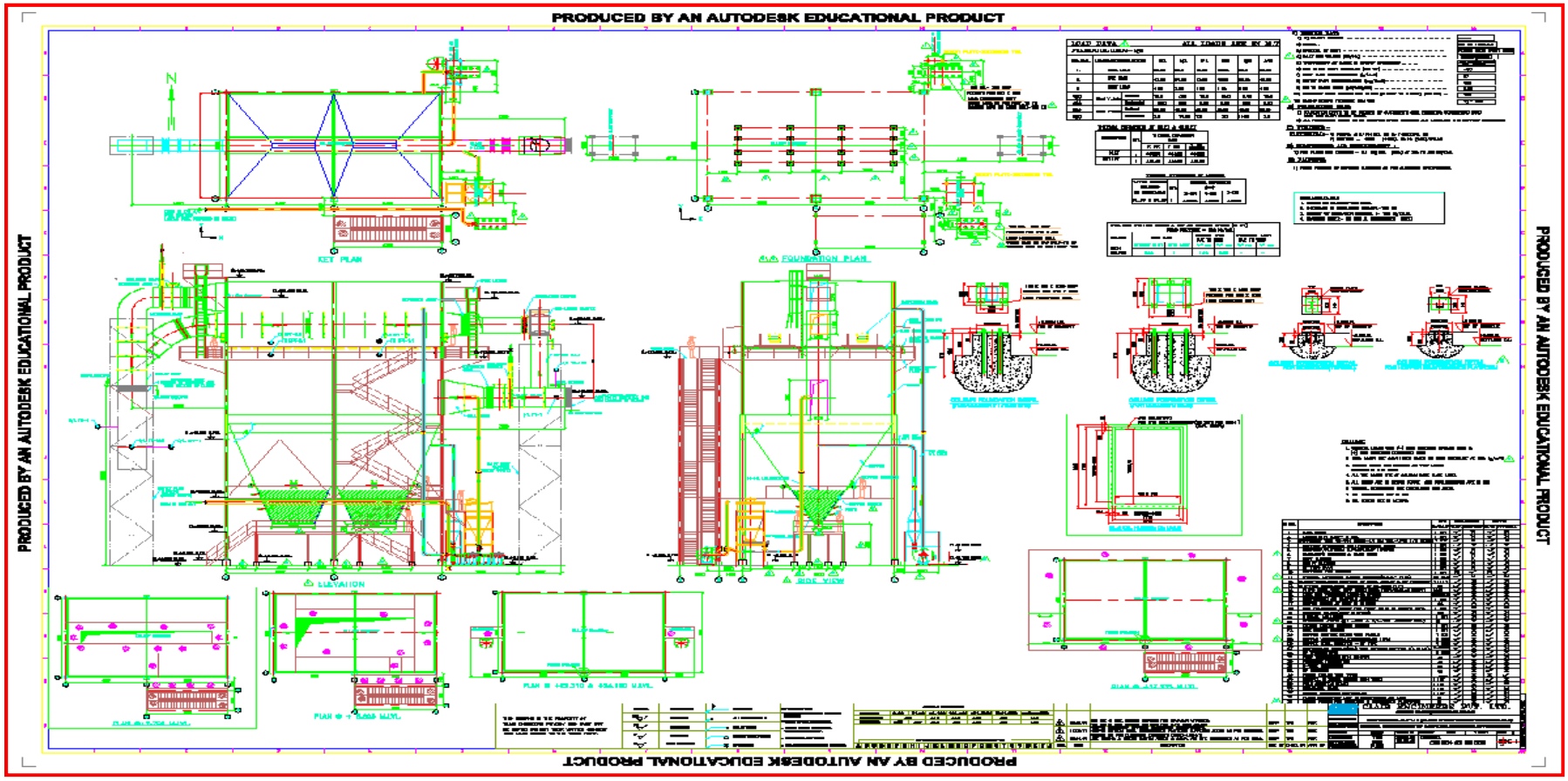
Typical Reactor GA drawing



Solution to Air Pollution Control

Gas Adsorption Reactor System along with Bag filter

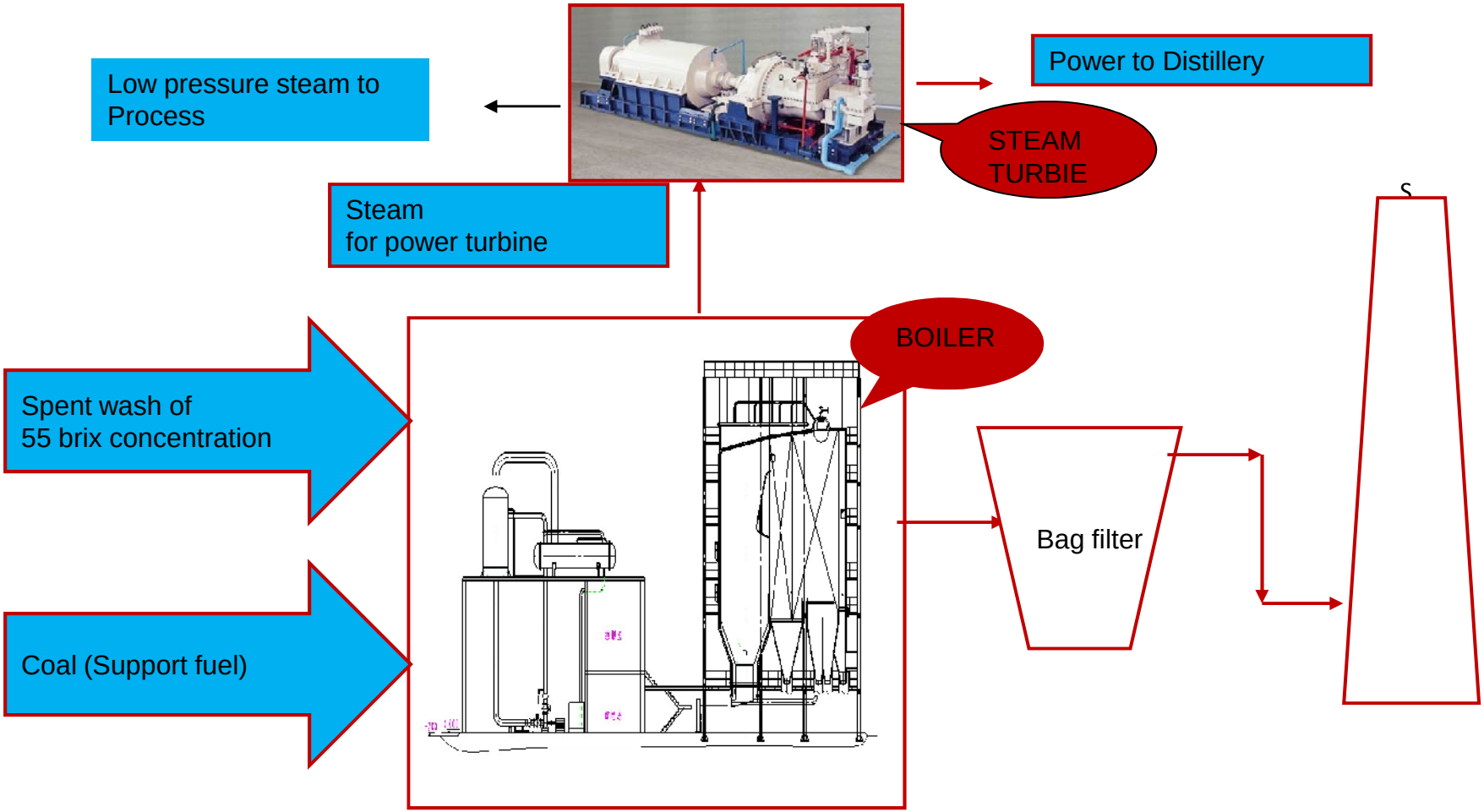
Typical Bag filter GA drawing



Distillery Spent-Wash Boiler Exhaust Gases

- **Distilleries are under pressure from government /society for the polluting effluents (spent wash/spent grain) from their core process and to sustain 'Zero effluent discharge' (ZED) norm. Since existing disposal methods – biomethanisation and biocomposting – are unable to meet the ZED norms, hence the need for an alternative solution of concentrating & firing the spent wash/spent grain in a specially designed Boilers.**
- **The benefits of this new technology are:**
  - ❑ **Disposal by burning of effluent discharge in a safe and environmentally acceptable practice (by meeting ZED norm)**
  - ❑ **Steam generation for meeting the process steam and electricity requirements of distillery.**
  - ❑ **Fly ash collected in Bag filter is rich in potash content and can be sold as fertilizer.**

Spent Wash Incineration Boiler
Typical Flow Sheet



Air Pollution from Boiler – Serious Concern

- **Flue gases from spent wash fired Boiler exhaust gases are highly corrosive and dust is very sticky in nature posing problems in proper dedusting before venting to atmosphere.**
- **Typical Process parameters:**

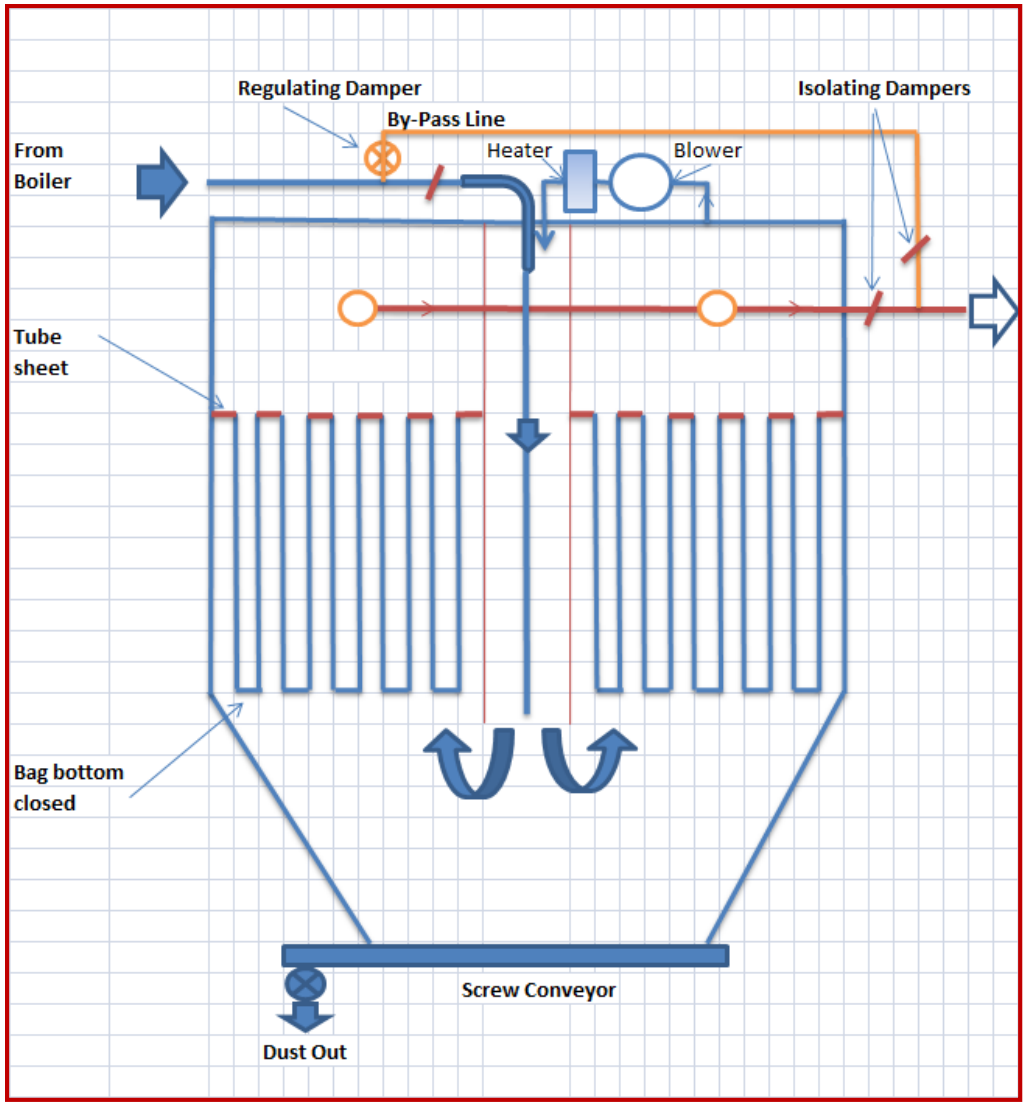
Gas temperature	**180- 220 Deg.C**
SO_2 content	**1500 ppm**
Acid dew point temp.	**165- 175 Deg.C**
High moisture in gas	**18-20 % (v/v)**
Hygroscopic dust	**K2O – 28 to 45%**
Bulk density of dust	**150 kg/m3 (coal ash 800 kg/m3)**

- **Start-up with coal & then switch to SW firing**
- **Maintaining the Diff. Pressure across the Filter**

Proven Technology for Air Pollution Control

- Components Of The De-dusting System
  - **Bag Filter**
  - **Filter Pre-heating system**
  - **Dust disposal system**
  - **Lime injection system for SO_2 neutralization**

Bag Filter Schematic Drawing

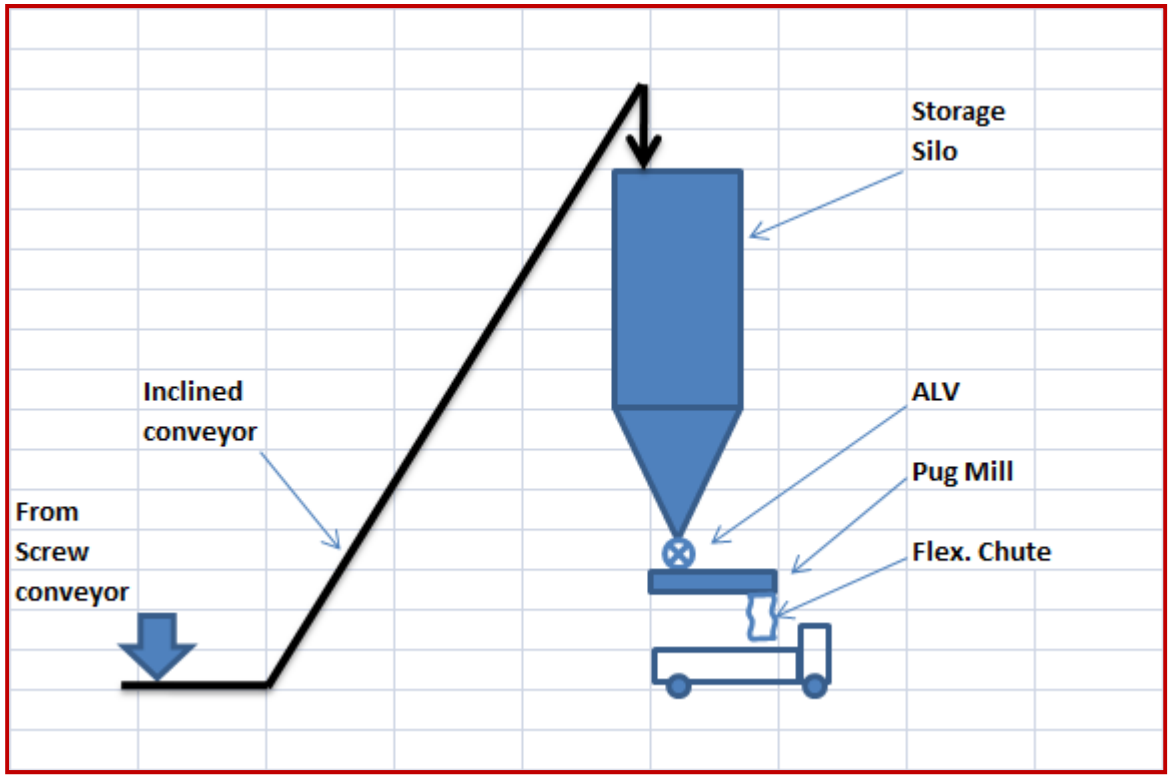


Proven Technology for Air Pollution Control

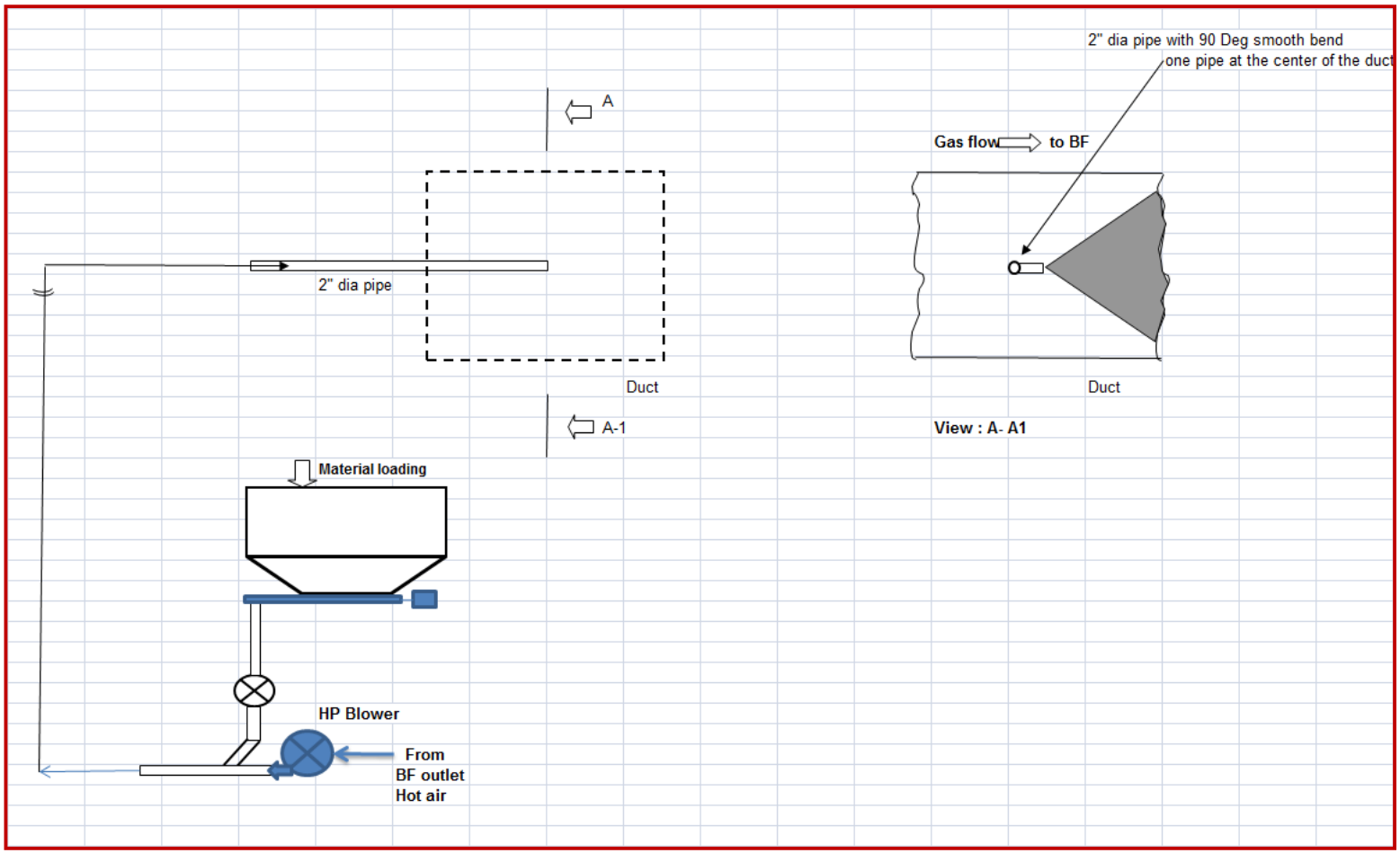
- **Unique Specifications:**

Cages 20 wires (min.)-	**MOC suiting corrosive atmosphere**
Venturies -	**Aluminium die-cast**
Pulse pipes -	**Upgraded MOC**
Isolating dampers	**+98 % leak proof**
Filter Bags	**Special Fabric**
BF Outlet chamber	**Walk-in Plenum**
Cleaning	**On-line**

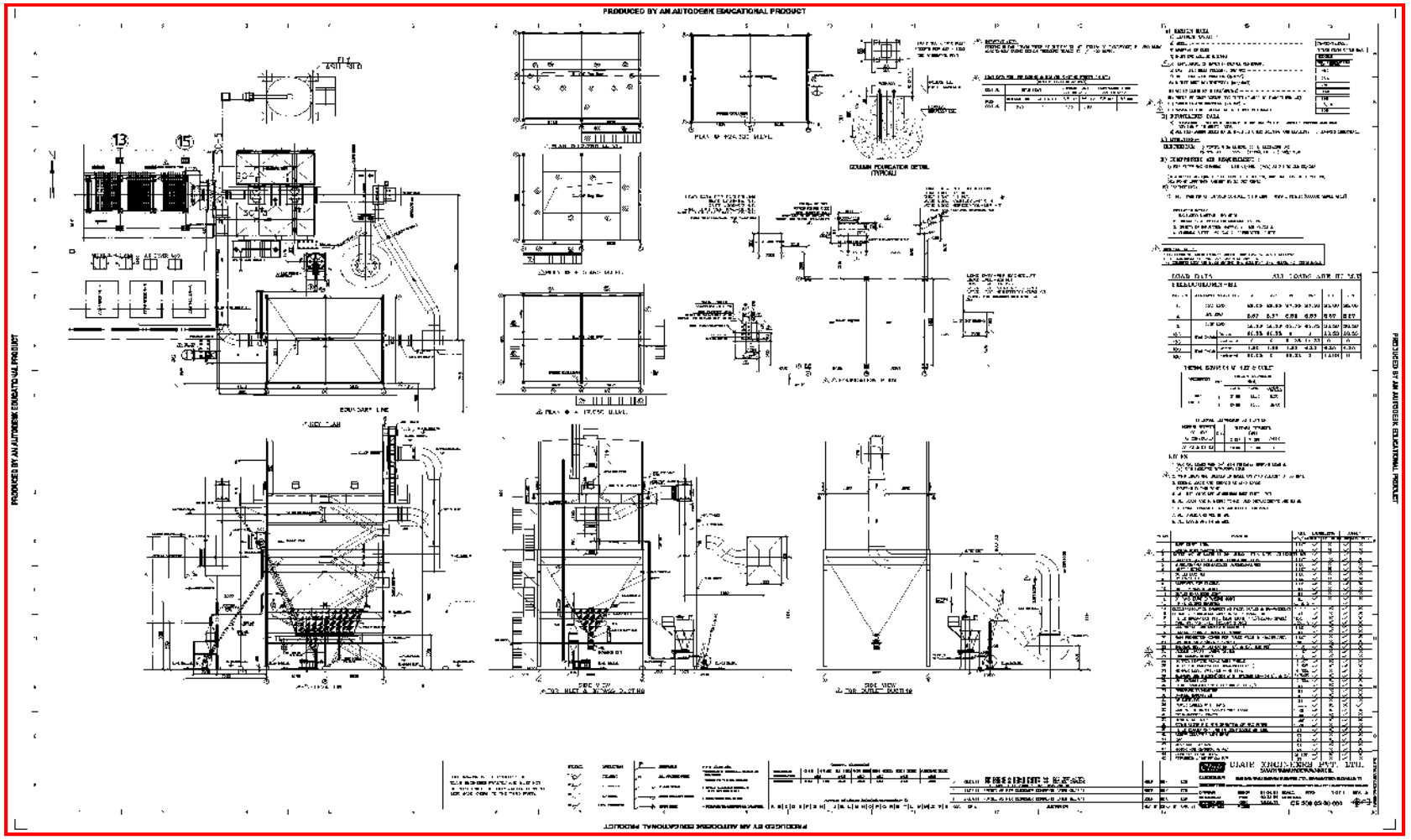
Dust disposal system



Lime Injection System



Bag filter Re-build for 23.4 TPH Boiler at BASL, Nanjangud



Bag Filter Installed At EID Parry, Sivaganga

Bag Filter Installed At GMR Sugar, Haliyal

Bag Filter Installed At Rajashree Sugars

Bag Filter Installed At Bannari Amman Sugars, Nanjangud

Lime Injection System

THANK YOU