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

<table>
<thead>
<tr>
<th>Industry</th>
<th>Equipment</th>
<th>Dust Load (GM/M³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Blast Furnace off gases</td>
<td>5 to 7</td>
</tr>
<tr>
<td></td>
<td>LD convertor off gases</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sinter Machine off gases</td>
<td>2 to 3</td>
</tr>
<tr>
<td></td>
<td>Cooler off gases</td>
<td>2</td>
</tr>
<tr>
<td>Cement</td>
<td>Kiln/ Raw mill exhaust gases</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Clinker Cooler exhaust gases</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Coal mill exhaust gases</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Cement mill exhaust gases</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Cement mill Separator exhaust gases</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>All Material transfer points</td>
<td>50</td>
</tr>
</tbody>
</table>
## POLLUTION SOURCE IN INDUSTRIES

<table>
<thead>
<tr>
<th>INDUSTRY</th>
<th>EQUIPMENT</th>
<th>DUST LOAD (GM/M3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Coal fired Boiler exhaust gases</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Biomass fired Boiler exhaust gases</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Coal Handling Plant</td>
<td>50</td>
</tr>
<tr>
<td>FerroAlloy</td>
<td>Furnace &amp; Tap Fumes</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Dryer exhaust gases</td>
<td>20</td>
</tr>
<tr>
<td>Mineral &amp; Stone Crushing units</td>
<td>Stone Crushers</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Grading screens</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Bagging Machines</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>All Material Transfer points</td>
<td>50</td>
</tr>
</tbody>
</table>
## TYPES OF AIR POLLUTION CONTROL EQUIPMENTS (SPM)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Type</th>
<th>Collection Efficiency (%)</th>
<th>Industry acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Chambers</td>
<td>Dry</td>
<td>75 to 85</td>
<td>Obsolete</td>
</tr>
<tr>
<td>Cyclone Separators</td>
<td>Dry</td>
<td>80 to 90</td>
<td>Obsolete</td>
</tr>
<tr>
<td>Scrubbers</td>
<td>Wet</td>
<td>95 to 98</td>
<td>Conversion of gaseous pollution to liquid pollution</td>
</tr>
<tr>
<td>Electrostatic Precipitators</td>
<td>Dry</td>
<td>98 to 99.5</td>
<td>Application demand</td>
</tr>
<tr>
<td>Bag house</td>
<td>Dry</td>
<td>&gt;99.8</td>
<td>Highly efficient &amp; Most commonly used</td>
</tr>
</tbody>
</table>
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
**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 Municipal 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, SOₓ, 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
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

- Spent wash of 55 brix concentration
- Coal (Support fuel)
- Low pressure steam to Process
- Steam for power turbine
- Power to Distillery
- STEAM TURBIE
- Bag filter

BOILER
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/m$^3$ (coal ash 800 kg/m$^3$)
  - 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 SO₂ 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

- Inclined conveyor
- Storage silo
- ALV
- Pug Mill
- Flex. Chute
- From Screw conveyor

[Diagram of 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