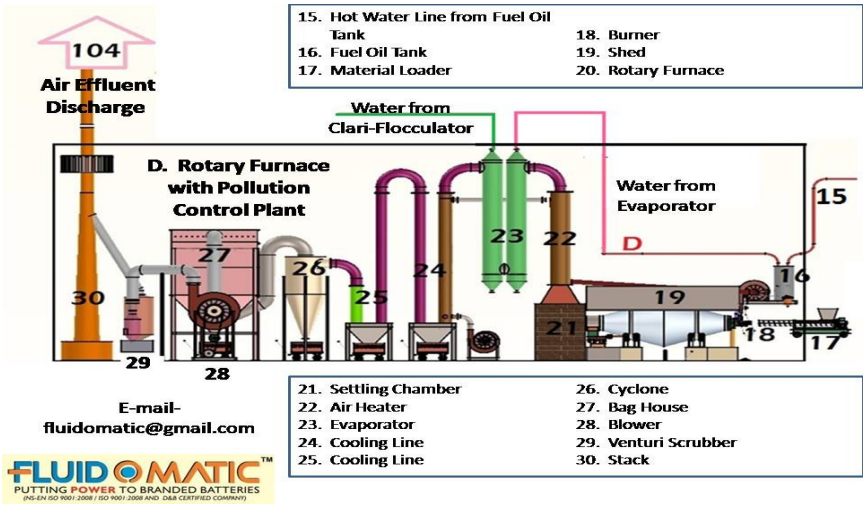


Air Pollution Control System

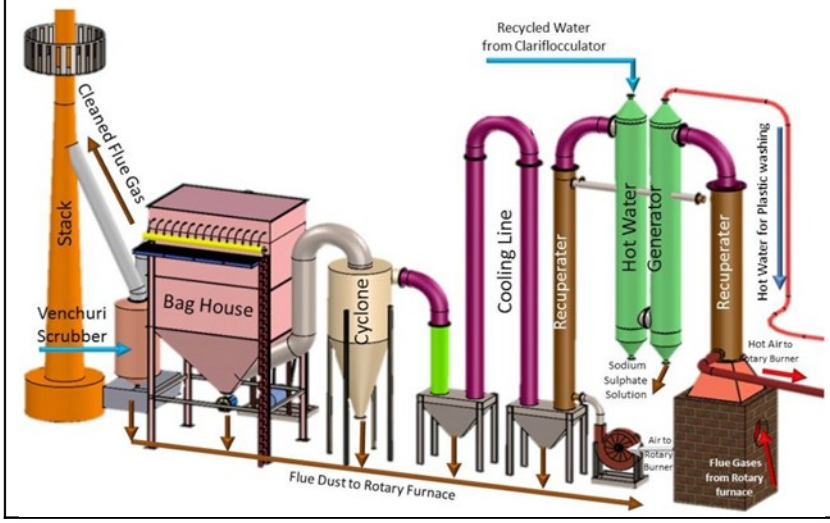
Based on the parameters and the standards mentioned, the following technology is adopted for Air Pollution ControlSystem in Rotary Furnace:

- Rotary Chamber
- Gravity Chamber
- Involutes Cyclone
- Pulse Jet based Bag House Filtration System

Apart from plates and paste of lead oxide from scrap batteries, slag from Mini Blast Furnace is charged in the Rotary Furnace.
In addition to these, certain compounds of sulphur are also present in the batteries. When this material is heated in the Presence of carbon, lead oxide is converted to lead. This conversion along with burning of fuel generates flue gases and fumes containing dust, dirt, oxides of lead, lead particles and such other impurities etc.
Hence, to meet various goals of maintaining employees' health and factory environments as well as regulatory requirements, it becomes imperative to get high end Air Pollution Control Systems to be installed with the Rotary Furnaces.

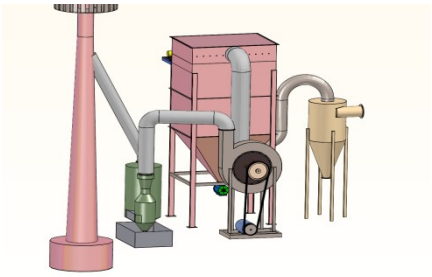
Rotary Chamber receives very hot gases from Rotary Furnace while cold gases from atmosphere are induced into chamber via specially designed profile. Thus chamber works as an equalizing chamber to reduce the temperature of gases and also where sedimentation of dust particulate matter takes place.

b. Air Pollution Control System with Waste Heat Recovery System



Waste Heat Recovery Equipment (Optional Equipment):
1. Air Heating Chamber (Radioactive Recuperators):
Preheating of combustion air is done by using heat from exhaust gases. Our recuperators are suitable for use with Lead Furnace exhaust gases. It has a negligible resistance to flow, reduces floor space of the plant. Cost incurred on land and building can be reduced by installing Energy recovery system and at the same time saves fuel consumption, It does not require any maintenance cost in turn reduces resistance to the flue gas and increases efficiency of settling chamber.
Cold air blown to its inlet and hot air is taken which is supplied to burner; it saves energy up to 10% fuel. Say if consumption of fuel is 30 liter/ hour and burner is operational for 18 hours a day then
Consumption of furnace oil = 30 liter/hour
No. of operating hours = 18 Hours
Total fuel consumed will be = 30 X 18 = 540 liter /day
2. Evaporator: This equipment is used to distillation of water as well as for hot water production, which can be used for plastic washing or plate washing for acid removal or desulphation of plate dust. This will replace cooling line for flue gas of old type Furnaces and reduce floor space too.
Main advantages of Evaporator:
Waste heat is utilized in to enhance following process:
1. Oil Heating, so Electrical Consumption is reduced.
2. Plastic Washing Plant
3. De-Suphation Plant
4. Water recycling or reclamation
5. Sodium Sulphate Lye production

c. Raw Material Drying Chamber:
Raw material to be charged to Rotary Furnace, in our case it is Battery Plates or Plate Dust, if it is preheated to the temperature, then water will vaporized so heat required in the Furnace to vaporized will be reduce, there it will be vapourised to superheated steam in comparison to ambient vapour. Superheated steam will require more energy to ambient vapour. At the same it removes sulphatevapour, and transform to Lead Oxide, reducing charged weight to furnace. This reduces sulphur dioxide emission in furnace.
It will lower smelting temperature of charged material. Slag fluidization will be better which gives more recovery of lead. It also reduce wastage of Lead content in slag.



Rotary Chamber Advantages

- Recovers 100% lead in the first operation.
- Slag produced is lead free.
- Equipment can be scaled up for higher production capacities.
- Many chemicals are required for operation.
- High power consumption.

Rotary Chamber Disadvantages

- Difficult to produce low Antimony lead suitable for soft lead purposes.
- Fugitive Emissions need to be captured in addition to flue gases.
- Need skilled operators and careful maintenance.

Fugitive Emissions Control Device
Smelting of lead in furnaces involve stages or parts where though pollution is generated, it is not handled by the main Air Pollution Control System, like charging of Rotary Furnace when it is red hot or tapping of lead from Rotary Furnace which lead to generation of fumes.
Systems put in place to capture and treat these fugitive emissions as and when they arise are called Fugitive Emission Control System. Fugitive Emissions generally lead to pollution of work atmosphere and jeopardize the maintenance of ambient air standards at the workplace. Hence, to safeguard employee health, these systems are becoming mandatory world over.

Norms of Ambient Air which the Fugitive Emissions Control System helps to meet are

Parameter Approved Range Time Period

PM (size < 2.5 micron) < 40 microgm/ Nm3 Annual Basis
PM (size < 10 micron) < 60 microgm/ Nm3 Annual Basis
Lead < 0.5 microgm/ Nm3 Annual Basis
SO2 < 50 microgm/ Nm3 Annual Basis
NO2 < 40 microgm/ Nm3 Annual Basis

- Allows large size particles to settle down
- Cools down temperature of flue gases
- Used as spark arrestor to entrap live or red hot particles.

Gravity Chamber

Cyclone is used to remove medium size particles from flue gases stream. The treated flue gases are discharged from top and dust is collected at bottom.

Following Equipments are used to guide flue gases to Stack so these can be released to atmosphere in eco-friendly way.

1. **End Block** 2. **Settling Chamber** 3. **Cooling Line**	4. **Cyclone** 5. **Bag House** 6. **Blower**	7. **Scrubber** 8. **Stack itself**

1. End Block direct flue gases to settling chamber. It is round or square shape which houses refractory bricks to minimize heat dissipation in it. It should be easily slide able so having access for cleaning in case of molten material settling on the way to settling chamber. It can be mechanically /electrically powered for shifting.

2. Settling Chamber is a Compartment made with Red bricks lined with Refractory bricks to pass flue gases which give stability of temperature and reduces radiation losses of furnace. It slow down velocity of flue gases so larger particles settles due to gravity. Its efficiency depends upon residence time with lowering velocity of flue gas stream. It lowers velocity of flue gases, this helps to drop larger particles (SPM) with the help of gravitational force, which gives residence time to flue gas more residence time, more droppage of SPM, lowers velocity, lowers volume of flue gases.

Advantages of Settling Chamber:

- Low capital Cost
- No visible energy cost but very low energy cost in term of loading of I/D Fan.
- No moving Parts, practically very low maintenance cost
- Excellent reliability
- Low pressure drop
- Provide cooling of Flue gases
- Temperature Limitation is dependent on type of construction material
- Base area and height of chamber depends upon what temperature drop, SPM drop required with minimum pressure drop
- Heat Recovery equipment can be installed or connected to it
- It can have vertical partition to drop more SPM so load on other equipment can be reduced.
- There are two models in this Settling chamber or gravity settling chamber.
- If Temperature is dropped rapidly, it will also increase its efficiency

3. Cyclone is an equipment to separate any particle suspended in the stream of fluid it may be water or gases with any filter. It does this by exerting centrifugal force with the help of pressure difference. Size of particle depends upon its design parameter whether it is dust particle or liquid mist. The polluted gas stream is forced into a vortex.

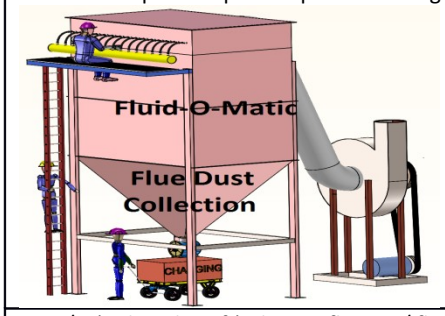
Principle of operation:

The motion of the gas exerts a centrifugal force on the particles, and this force depends upon size and mass of particles. There particles go to outer periphery and get deposited on the inner surface of the cyclones, Here these are dropped due to gravitational force. The movement of particles is in spiral path so once stream of fluid leaves and proceeds towards outlet through the vortex cleaner stream of fluid proceeds towards outlet and heavy particles remain at the bottom and ultimately fall out.

Efficiency Improvement Depends: upon Density of Fluid, Particle sizes, Fluid flow Rate, Fluid Viscosity, Dust Loading. Efficiency of cyclone increases with increases in Fluid flow rate, Particle sizes, Density and decrease in fluid viscosity.

4. Bag House or Bag Filter House is equipment which houses filter bags. It has two compartments separated by filter bags in such a manner that any of air stream passes through one compartment to another, that has to pass through Fabric Bag. One compartment is connected to in stream of flue gases and another to the inlet of Blower. Energy on the particles is exerted by pressure difference of both the compartments and flow of gases is created by Blower. Pressure drop in Bag House will depend upon Dust particle accumulated on the surface of bag fabric and no. of we have Bag House in cyclonic shape as well Rectangular Shape. Cyclonic Shape gives added advantage of filtration through fabric filters as well cyclonic separation. It reduces loading on Fabric Filter Bags.

- Type of fabric depends upon particle and temperature. The filters retain particles larger than the mesh size. Air and most of the smaller particles flow through. Some of the smaller particles are retained due to interception and diffusion. The retained particles cause a reduction in the mesh size. The primary collection is on the layer of previously deposited particles. Pressure drop will depends upon no. of bags. Higher no. of bags higher the filtration area, so lesser pressure drop is exerted.



5. I/D (Induced Draft) Blower: flow air/ flue gases out of Furnace to Stack. So some force is required to move flue gases through the Settling Chamber, Cyclones, Cooling Lines and bag house. This force is induced by the Blower on flue gases. Blowers/ Fans exert a pressure to move air (or gases) against a resistance caused by ducts, dampers, or other system components in a gas flow system. The fan/blower rotor/impeller receives torque from a rotating shaft of electric motor or some other driver. Impeller of fan/blower forces gases through the system.

As RPM is increased for more flow, power is increased cubically whereas if diameter is increased then power is only doubled, so bigger size of blower is more useful at lesser RPM than smaller size blower at more RPM.

Basic requirement for blower are following:

1. Air Volume, this depends upon fuel consumption in the system and required pressure in the furnace.
2. Drive type, Direct driven / indirect driven / Direct coupled.
3. Operating Temperature.
4. Blower RPM will make less/ more Motor H.P.
5. Construction material, depends upon flue gas

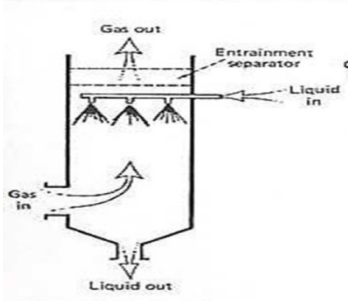
6.Wet Scrubber

- This equipment is used to remove SPM of finer sizes those have passed through Fabric Filters by spraying fine liquid droplets. This equipment can also treat flue gas stream for its chemically contamination by adding some chemical in liquid so chemically charged liquid can react with the stream gases and making some other compound which can also precipitate with SPM. It reduces toxicity of stream within permissible limit. Liquid is subsequently removed for treatment.

- Advantages of Wet Scrubbers
  - Wet Scrubbers can handle incoming streams at high temperature, thus removing the need for temperature control equipment.
  - Wet scrubbers can handle high particle loading.
  - Loading fluctuations do not affect the removal efficiency.
  - They can handle explosive gases with little risk.
  - Gas adsorption and dust collection are handled in one unit.
  - Corrosive gases and dusts are neutralized.
- Disadvantages of Wet Scrubbers
  - High potential for corrosive problems
  - Effluent scrubbing liquid poses a water pollution problem.
  - It loads flue gases with fine liquid droplets which corrodes Chimney/Stack.

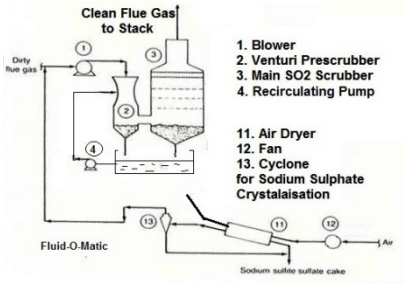
Major types of Wet scrubbers used in Lead recycling process are mention below:

- Orifice Wet Scrubbers: A cylindrical shaped spray tower which liquid spray on flue gas stream



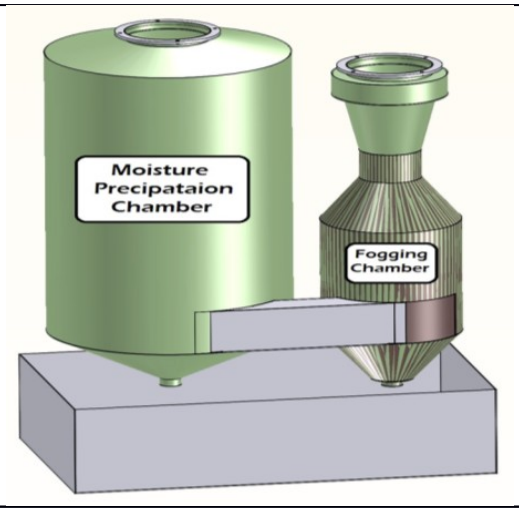
Venturi Scrubbers : This process consists of the following sub-processes:

- Flue gas pre-treatment.
- Sulfur dioxide absorption by Sodium Carbonate/ Limstone
- Purge treatment
- Sodium sulfite regeneration.
- The concentrated sulfur dioxide stream is processed to a marketable product.
- It is double compartment Scrubber first one used for pretreatment and second for precipitation of water droplets. Reducing Corrosion of Stack.



Water Recovery System

The Venturi scrubber has a built-in water cleaning system allowing it to circulate the same water. Dried sediments from the first collecting tank are sent to the charging unit of rotary furnace.



7. Stack (Chimney): Stack is a vertical pipe, which guides flow of Flue gase to upper layer. Required Height is as per CPCB.

Stack has foundation strong enough to support the structure in case of wind flow, stress created by nature including minor tremors, cyclones etc.

It has higher ambient pressure at the bottom and lower pressure at top which creates draftinside the stack, this assist to flow flue gases to the atmosphere.