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AGENDA

Electrostatic Precipitator

Cyclone separator

Absorption

ESP

Electrostatic precipitator (ESP) is a filtration device that removes fine particles, like dust and smoke, from a flowing gas by the force of an induced electrostatic charge minimally impeding the flow of gases through the unit. In contrast to wet scrubbers, which apply energy directly to the flowing fluid medium, an ESP applies energy only to the particulate matter being collected and therefore is very efficient in its consumption of energy.

TYPES OF ESP:

1. Dry type Electrostatic Precipitator

- Dry Electrostatic Precipitators (ESPs) can be used in many industries for various applications for cleaning of dust laden industrial gases. ESPs can handle any volume of gases and many types of dusts with high removal efficiencies. The continuous improvement in design & engineering of the ESPs reduce the operating costs by reducing the energy consumption, maintenance cost and lower downtime. The ESP components are well designed by using most advance technologies..

2. Wet Electrostatic Precipitator

- Tar Precipitator also termed as Wet Electrostatic Precipitator. The Wet Electrostatic Precipitator compliments our product range with an extremely versatile de- dusting system that is perfect for any process in which special dust or gas characteristics make dry separation difficult or impossible.
- The Wet ESPs are unbeatable since many years in view of operational safety, long life cycle and high collection efficiency. They are well suited for precipitation of finest dust with dust afflicted water drops of aerosols and emissions containing tar or oil. Another, positive effect is the additional bound of toxic elements (for example HCL, SO_2, NaCL & HF)

WORKING PRINCIPLE

- The dust laden gases are passed through the electrical field consisting of profiled collecting electrodes and discharge electrodes. The discharge electrodes are charged with negative high voltage and the collecting electrodes are earthed. The gas is equally distributed and made to pass through these gaps of electrodes across width and length.
- The discharged electrodes emit electrons when charged with high negative voltage. These negative electrons accumulate on dust particles and thus dust particles are charged negatively. The charged dust particles are attracted towards the profiled collecting electrodes. When the dust particles touch the collecting electrodes, it loses its charge, but due to agglomeration, they still stick to the plate. These electrodes are cleaned with the use of robust tumbling hammer type rapping system. Independent rapping systems are used to clean the collecting as well as discharge electrodes.
- Our ESPs are optimally designed, tailor-made to suit the customer operating conditions. The migration velocity is an extremely important parameter to decide the size of the ESP and helps to determine the efficiency. Apart from this, there are many parameters which affect the sizing of the ESP.

ADVANTAGES OF ESP'S

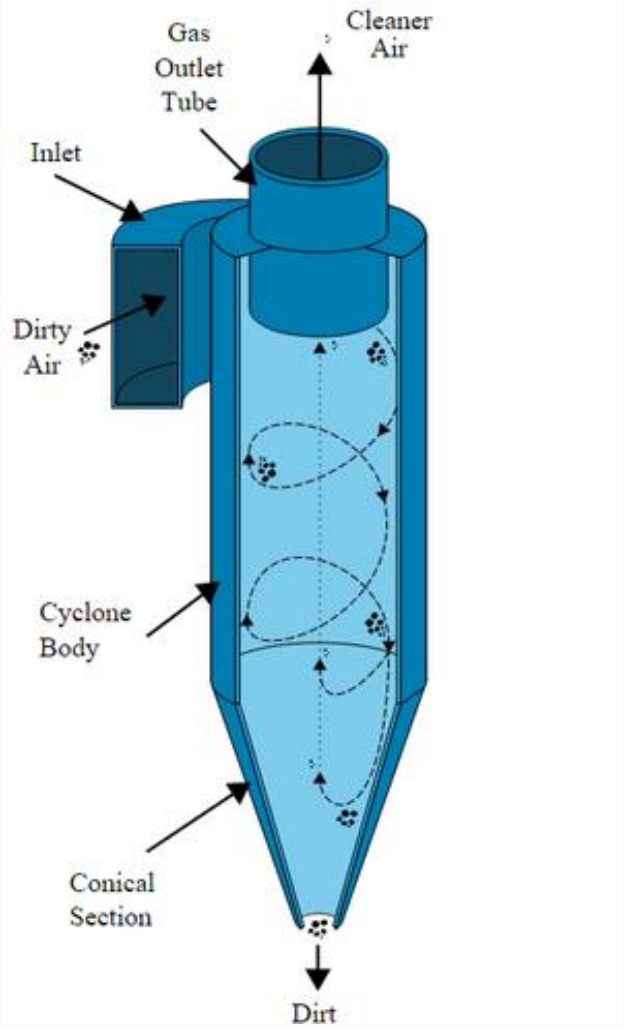
- Rigid Pipe & Spike type discharge electrodes.
- Sturdy & durable collecting electrodes for longer life.
- Separation of ultra-fine dust particles to meet the required lower emission norms.
- Continuous dust collection process.
- Low pressure drop (approx. 2.5 mbar) at high degree of separation.
- Low maintenance due to few and slowly rotating components.
- Low energy costs compared to Fabric Filter separators.
- Can handle large volume of gas flow, virtually there is no upper limit.
- Handling high gas temperatures.
- Individual solutions possible by adaptation of the standard construction to the local conditions.
- Maintenance and services ensuring continuous operation of the plant.

CYCLONE SEPARATOR

- **Cyclone separators** or simply **cyclones** are separation devices (dry scrubbers) that use the principle of inertia to remove particulate matter from flue gases Cyclone separators is one of many air pollution control devices known as **precleaners** since they generally remove larger pieces of particulate matter. This prevents finer filtration methods from having to deal with large, more abrasive particles later on. In addition, several cyclone separators can operate in parallel, and this system is known as a **multicyclone**.
- It is important to note that cyclones can vary drastically in their size. The size of the cyclone depends largely on how much flue gas must be filtered, thus larger operations tend to need larger cyclones. For example, several different models of one cyclone type can exist, and the sizes can range from a relatively small 1.2-1.5 meters tall (about 4-5 feet) to around 9 meters (30 feet)—which is about as tall as a three story building!

CYCLONE SEPARATOR

1.Cyclone separators work much like a centrifuge, but with a continuous feed of dirty air. In a cyclone separator, dirty flue gas is fed into a chamber. The inside of the chamber creates a spiral vortex, similar to a tornado. This spiral formation and the separation is shown in Figure



2. The lighter components of this gas have less inertia, so it is easier for them to be influenced by the vortex and travel up it. Contrarily, larger components of particulate matter have more inertia and are not as easily influenced by the vortex

Advantages	Disadvantages
• Low capital cost.	• High operating costs (due to pressure drop).
• Ability to operate at high temperatures.	• Low efficiencies (particularly for small particles).
• Can handle liquid mists or dry materials.	• Unable to process "sticky" materials.
• Low maintenance requirements (no moving parts).	
• Small footprint - requires relatively small space.	

APPLICATIONS

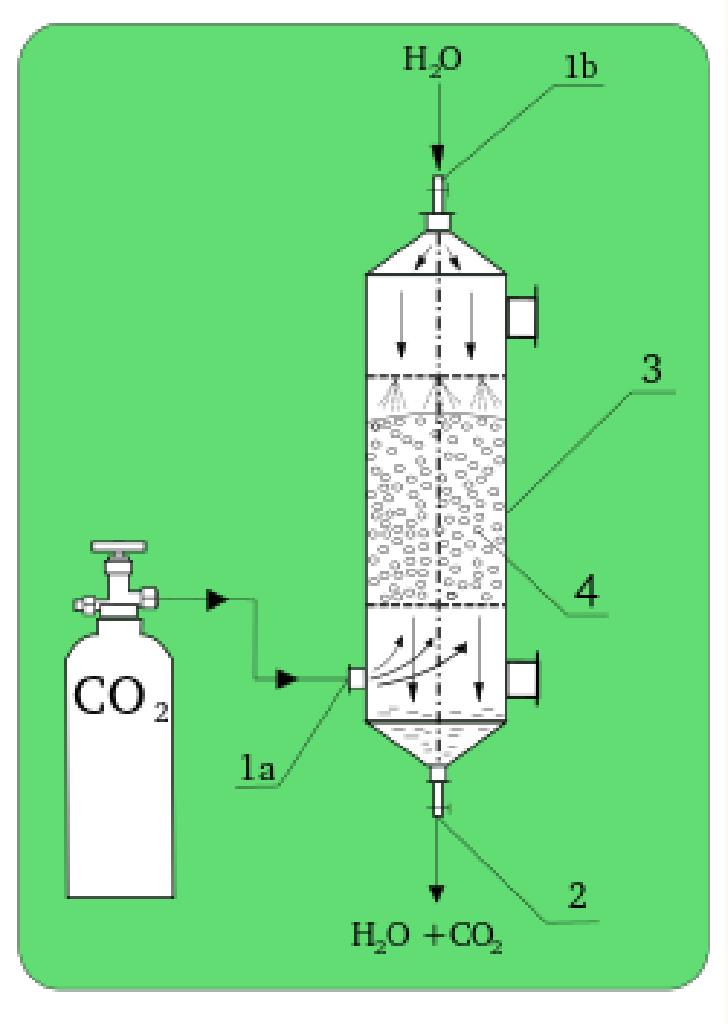
- Some cyclone models are predesigned for specific applications, while others are built for specialized environments. Among the most important application considerations is the dust and gas composition. Specific types of particulate may be corrosive, abrasive, sticky, explosive, or toxic, thus requiring special construction materials or designs in order to function properly.
- Cyclones are used for filtration in a wide variety of applications: abrasives, coolant mists, explosive media, fine powders, metalworking chips, toxic media, and various production plant exhausts.
- Sizing a cyclone involves many factors, but the most important dimensions to consider are those of the inlet and the main body chamber.
- The sizing of inlets affects the airflow capacity of a cyclone, and also influences its pressure drop at a given flow velocity. Larger openings will tend to accept greater volumes of air and also will have lower pressure drops, but at the cost of efficiency. Inlet configurations can also vary based on the type of cyclone. The four types include tangential, axial, helical, or spiral.
- Body size is important because, as mentioned above, the length of the cyclone body is an important factor in collection efficiency. Body size is also directly proportional to a cyclone’s overall capital cost, and determines the space it occupies and its height.

ABSORPTION

- **absorption** is a physical or chemical phenomenon or a process in which atoms, molecules or ions enter some bulk phase – liquid or solid material. This is a different process from adsorption, since molecules undergoing absorption are taken up by the volume, not by the surface (as in the case for adsorption).
- A more common definition is that "Absorption is a chemical or physical phenomenon in which the molecules, atoms and ions of the substance getting absorbed enter into the bulk phase (gas, liquid or solid) of the material in which it is taken up."
- A more general term is *sorption*, which covers absorption, adsorption, and ion exchange. Absorption is a condition in which something
- In many processes important in technology, the chemical absorption is used in place of the physical process, e.g., absorption of carbon dioxide by sodium hydroxide – such acid-base processes do not follow the Nernst partition law g takes in another substance

ABSORBER

1a): CO_2 inlet;
1b): H_2O inlet;
2): outlet
3): absorption column
4): packing.



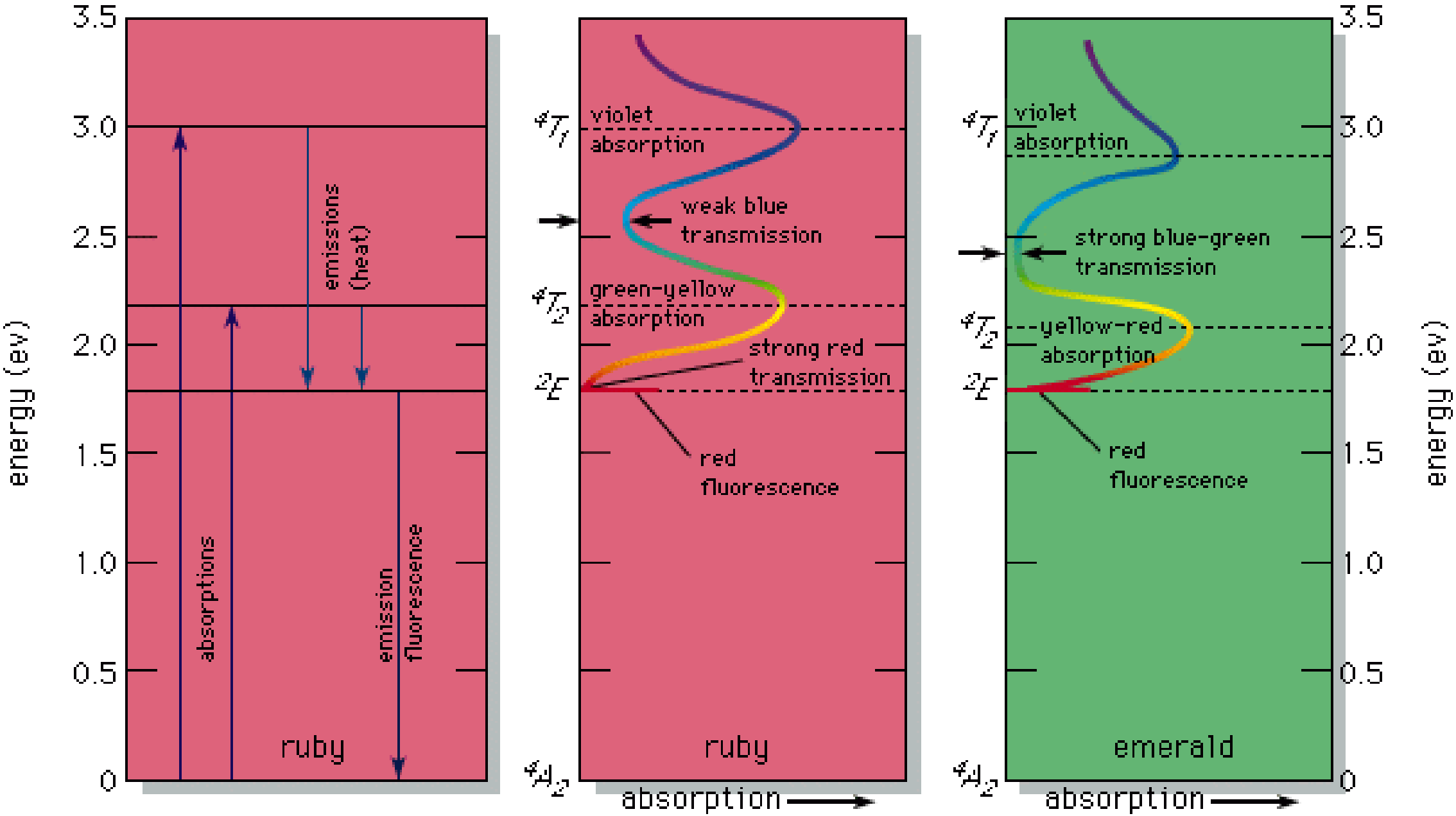
TYPES OF ABSORPTION

- **Chemical absorption**

Chemical absorption or reactive absorption is a chemical reaction between the absorbed and the absorbing substances. Sometimes it combines with physical absorption. This type of absorption depends upon the stoichiometry of the reaction and the concentration of its reactants. They may be carried out in different units, with a wide spectrum of phase flow types and interactions. In most cases, RA is carried out in plate or packed columns.

- **Physical absorption**

Hydrophilic solids, which include many solids of biological origin, can readily absorb water. Polar interactions between water and the molecules of the solid favor partition of the water into the solid, which can allow significant absorption of water vapor even in relatively low humidity.



From K. Nassau, *Physics and Chemistry of Color* (1983); John Wiley & Sons, Inc.