

### 3.4 CENTRIFUGAL SEPARATORS

#### Working Principle / Operational Considerations:

A cyclone separator consists of a cylindrical shell, conical base, dust hopper and an inlet where the dust-laden gas enters tangentially. Under the influence of the centrifugal force generated by the spinning gas, the solid particles are thrown to the wall of the cyclone as the gas spirals upward at the inside of the cone. The particles slide down the walls of the cone and into the hopper. The operating efficiency of a cyclone depends on the magnitude of the centrifugal force exerted on the particles. The greater the centrifugal force, the greater the spreading efficiency. The magnitude of the centrifugal force generated depends on particle mass, gas velocity within the cyclone, and cyclone diameter.

$$F_c = M_p \frac{v_i^2}{R}$$

Where,

$F_c$  = Centrifugal force, N

$M_p$  = Particulate mass, Kg

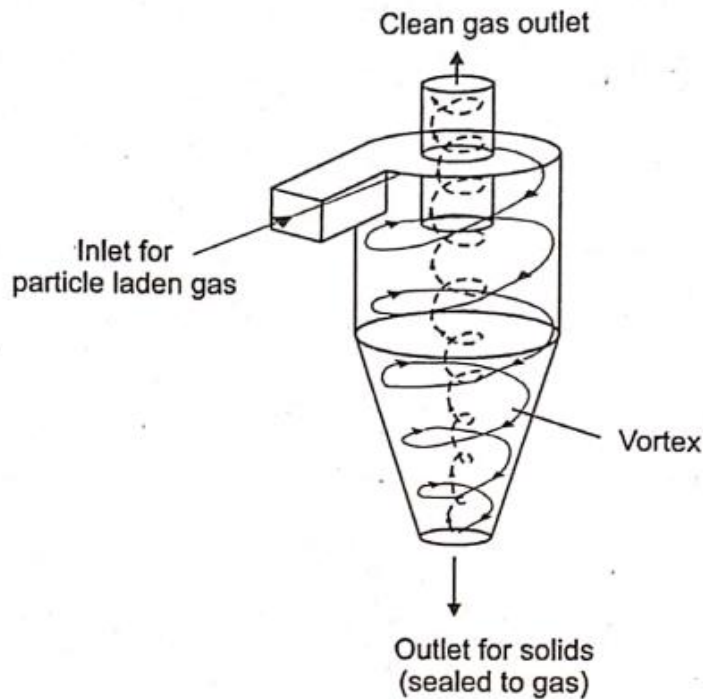
$V_i$  = Equals particle velocity

$R$  = Equals radius of the cyclone, m/s.

From this equation, it can be seen that the centrifugal force on the particles, and thus the collection efficiency of the cyclone collector can be increased by decreased  $R$ . Large-diameter cyclone have good collection efficiencies for particles 40 to 50 $\mu$ m in diameter.

#### Mechanism of Action

The dust laden gas enters tangentially, receives a rotating motion and generates a centrifugal force due to which the particulates are thrown to the cyclone walls as the gas spirals upwards inside the cone. The particulates slide down the walls of the cone and are discharged from the out let.



**Figure 3.4.1 Cyclone Separator**

[Source: [https://www.degruyter.com/document/doi/10.1515/psr-2016-0122/asset/graphic/j\\_psr-2016-0122\\_figure7.jpg](https://www.degruyter.com/document/doi/10.1515/psr-2016-0122/asset/graphic/j_psr-2016-0122_figure7.jpg)]

- Centrifugal force is utilized to separate the particulate matter.
- It can remove 10 to 50 $\mu\text{m}$  particle size.
- Used mostly in industries.

#### **Advantages:**

- Low initial cost.
- Require less floor area.
- Simple construction and maintenance.
- Can handle large volume of gas at high temperature.

#### **Disadvantages:**

- Requires large head room.
- Less efficiency for smaller particles (<10 $\mu\text{m}$ ).
- Sensitive to variable dust load and flow rate.