Shabreena Vincent

212222230141

SA2 Assignment

Part 1 – Create a comparison chart of particulate control equipment (gravity, cyclone, fabric filter).

Industrial processes such as power generation, cement manufacture, chemical production, and mining release a mixture of gases and tiny solid particles known as *particulate matter* (PM). These particles, if not controlled, contribute to air pollution, respiratory diseases, and environmental degradation. To limit emissions, a range of particulate control devices is used. Three major types are **Gravity Settling Chambers**, **Cyclone Separators**, and **Fabric Filters (Baghouses)**.

Gravity Settling Chamber

A gravity chamber is a large, rectangular enclosure where dusty gas slows down, allowing the force of gravity to pull heavy particles to the bottom.

- **Operating Principle:** When the gas velocity decreases, the inertia of large dust particles causes them to fall out of the gas stream.
- **Design:** Simple construction with an inlet, settling zone, and dust hopper for collection.
- **Efficiency:** Best for coarse particles larger than about 50 micrometers.
- **Advantages:** Extremely low cost, no moving parts, minimal maintenance, and can handle high-temperature gases.
- **Limitations:** Cannot capture fine smoke or light ash, so it is typically used as a pre-cleaner before advanced equipment.
- **Examples of Use:** Boiler houses, grain-handling facilities, and woodworking shops.

Cyclone Separator

The cyclone separator relies on centrifugal force to separate particles from the gas stream.

- **Operating Principle:** Gas enters tangentially at high speed, creating a powerful vortex. Heavier particles are flung outward toward the chamber wall, lose momentum, and slide into a collection hopper while the cleaned gas exits through a central pipe.

- **Design:** Usually a conical cylinder made of steel, capable of handling large gas volumes.
- **Efficiency:** Removes medium-sized particles (roughly 5–20 micrometers) with 70–90% efficiency.
- **Advantages:** Low maintenance, can operate at high temperatures and humidity, compact and robust.
- **Limitations:** Less effective for submicron particles and sticky dust.
- **Examples of Use:** Cement plants, metal grinding, grain mills, sawmills, and foundries.

Fabric Filter (Baghouse)

Fabric filters provide the highest efficiency for fine dust collection.

- **Operating Principle:** Polluted air is drawn through long fabric bags made of woven or felted materials. Dust clings to the fabric surface, and a dust "cake" forms, which further enhances filtration. Periodic cleaning—via shaking, reverse airflow, or pulse-jet bursts—removes the collected material.
- **Design:** Housed in a steel casing with hundreds of filter bags, dust hoppers, and an automated cleaning system.
- **Efficiency:** Over 99% removal efficiency, capturing particles as small as 0.1 micrometer.
- **Advantages:** Handles a wide range of particle sizes and concentrations, produces very clean exhaust gas.
- **Limitations:** Higher capital and maintenance costs; fabric bags require regular inspection and replacement.
- **Examples of Use:** Power plants, steel mills, chemical factories, food-processing units, and pharmaceutical production.

Combined Use:
In many industries, these devices are used in sequence. A gravity chamber or cyclone first removes larger particles, reducing the load on the baghouse. This layered approach lowers operating costs and extends equipment life while ensuring that emission standards are met.

Part 2 – Identify indoor air pollutants in a classroom and propose simple mitigation strategies.

Even in a school setting, indoor air can contain pollutants that impact health, comfort, and learning performance. A classroom is an enclosed space where many people spend hours together, so contaminants can accumulate.

Sources and Pollutants

1. **Dust and Chalk Particles:** Generated during cleaning, from chalkboards, and from the movement of students and furniture.
2. **Carbon Dioxide (CO_2):** Buildup occurs when students and teachers breathe in a poorly ventilated room, leading to headaches and drowsiness.
3. **Volatile Organic Compounds (VOCs):** Emitted from whiteboard markers, cleaning sprays, paints, adhesives, and some furniture materials.
4. **Mold and Mildew Spores:** Thrive in damp corners, under leaking roofs, or near air-conditioning units.
5. **Microbes and Allergens:** Bacteria, viruses, and dust mites from books, curtains, and carpets.
6. **Outdoor Pollutants:** Fine dust, pollen, and vehicle exhaust can enter through open windows and doors.
7. **Noise and Odor:** Though not always categorized as "pollutants," persistent noise and unpleasant odors also affect indoor comfort.

Health and Learning Impacts

- Respiratory irritation, coughing, sneezing, and aggravated asthma
- Eye and throat discomfort, headaches, and fatigue
- Reduced concentration and slower cognitive response due to high CO_2 levels
- Allergic reactions or infections from mold and microbes

Mitigation Strategies

1. **Frequent Cleaning:** Daily sweeping and damp mopping to trap dust; weekly vacuuming of carpets and curtains with HEPA filters.
2. **Ventilation Improvements:** Cross-ventilation by opening windows on opposite walls; ceiling or exhaust fans to keep air moving; installing mechanical ventilation with proper filters where natural airflow is limited.
3. **Moisture Control:** Immediate repair of leaking pipes or roofs, drying of wet surfaces, and dehumidifiers in humid seasons to prevent mold.
4. **Low-Emission Materials:** Use low-VOC markers, paints, and cleaning agents. Avoid strong chemical sprays during class hours.
5. **Regular Equipment Maintenance:** Clean and replace air-conditioner and fan filters to prevent dust recirculation.
6. **Greenery Indoors:** Plants like spider plant, peace lily, areca palm, and snake plant can absorb certain pollutants and help maintain oxygen levels.
7. **Health Education:** Teach students to avoid littering, report leaks, and keep personal items clean to reduce microbial growth.
8. **Monitoring:** Periodically measure CO_2 levels or use simple air-quality sensors to identify ventilation needs.

Implementing these measures creates a cleaner, healthier learning environment. Good indoor air quality helps reduce absenteeism, improves attention spans, and supports overall well-being of students and staff.