

FACING THE CHALLENGE

JOHN RENNOCKL, CLARCOR INDUSTRIAL AIR, USA, PROVIDES HELPFUL HINTS FOR THE DESIGN EVALUATION AND OPERATION OF COAL MILL DUST COLLECTORS.

Introduction

Today's regulatory climate has cement plants worldwide facing dual, if not conflicting challenges – how to handle tougher environmental regulations while at the same time being pressured to reduce production costs. One common strategy to decrease production costs is to reduce the cost of fuel. Over the years, this has led to a worldwide increase in petcoke usage. The advantages and disadvantages of this strategy have been thoroughly discussed within the industry. What has received less attention is the impact of this fuel change on the dust collector in the coal grinding circuit, generally referred to as the 'coal mill dust collector'. This discussion provides helpful advice for maintenance and production personnel to keep the dust collector operating efficiently.

General design practices

The increased substitution of coal with petcoke has created challenges for the dust collector that vents the coal mill. Increased material fineness and the stickier nature of petcoke can make it more difficult to clean the filter bags. Since most dust collectors in today's plants use pulse-jet cleaning systems, this article and the discussed design guidelines are limited to pulse-jet dust collectors. Compared to today's standards, many older dust collectors were delivered with marginally designed cleaning systems. Many

older collectors and even some newer ones operate at or above practical design limits because of a push for increased kiln production that has maximised airflow and material loading through the coal mill circuit. The relatively high sulfur content in petcoke also increases the likelihood of corrosion, especially in the clean air plenum of the collector and outlet ducts. The following information and design criteria will help you to evaluate if your coal mill dust collector is up to the challenge.

Airflow and filtration area

The relationship of Air Volume per Filter Area is called 'Air-to-Cloth Ratio' or 'Filtration Velocity'. To provide reliable service and acceptable filter life, the Air-to-Cloth ratio for a typical dust collector should not exceed 3.5 ACFM per 1 ft² filter area. The metric equivalent is 1.07m³/min/m². A higher Air-to-Cloth ratio typically results in short filter life, increased differential pressure, higher cleaning and compressed air consumption, potentially higher emissions and generally higher operating costs.

Cleaning system

Pulse-jet cleaning systems have evolved over the past four decades. The newer dust collectors generally provide more cleaning energy to filter bags than the earlier designs. An undersized cleaning system causes excessive buildup of combustible, fine and potentially



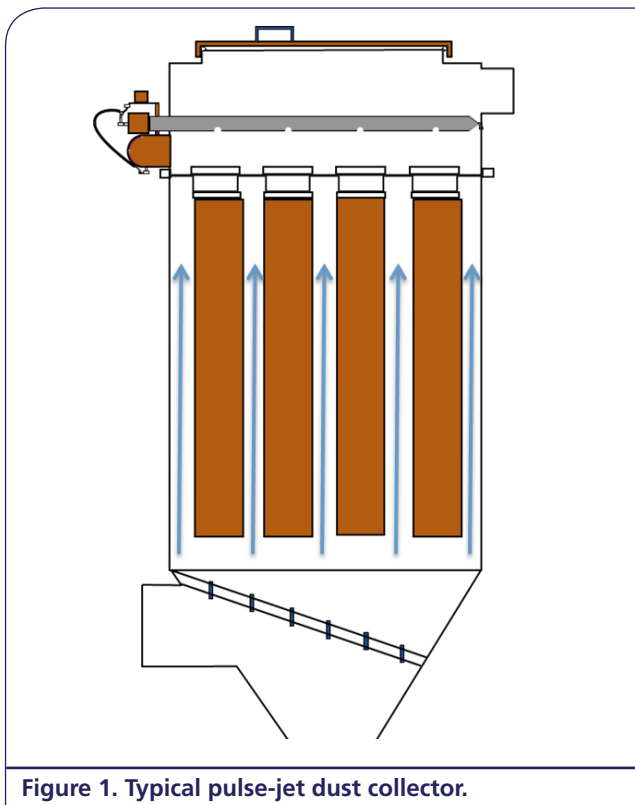


Figure 1. Typical pulse-jet dust collector.

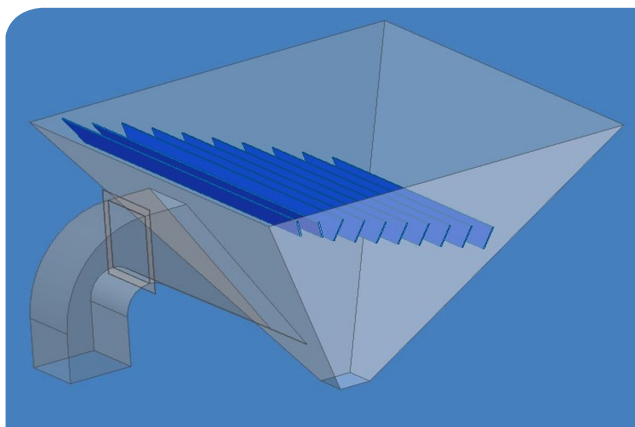


Figure 2. 'Ladder vane' inlet baffles in hopper to distribute flow and break up large dust particles.

explosive material on the filter bags. The pulse-jet system shoots a burst of compressed air into the filter bag. This pressure wave travels down the inside of the filter bag, violently shaking the bags and blowing off the accumulated dust on the outside of the bag. Most dust collectors are cleaning online, meaning that there is always airflow through the filter bags. This airflow opposes the pressure wave being injected into the filter bags by the cleaning system. The higher the gas volume through the dust collector, the more contrary gas flow the pressure

wave encounters and the less efficient the cleaning becomes.

As pressure drop increases across the filter fabric, more cleaning energy is required. Older dust collectors typically have smaller, less powerful pulse valves, therefore the cleaning systems become easily overwhelmed by increased airflows through the collector. If the dust collector uses either single diaphragm pulse valves or valves that are smaller than 1.5 in., the collector might be a candidate for an upgrade.

A reliable source of clean and dry compressed air to the pulse valves is vital to ensure a continuous operation of the cleaning system.

Can velocity

In a pulse-jet dust collector, can velocity is defined as the theoretical upward velocity of dust laden gases between the filter bags. Excessively high can velocity could prevent dust from dropping into the hopper after being blown from the filter bags during bag cleaning. The suspended dust is simply sucked back onto the filter bags once the pressure burst from the cleaning system diminishes. Finer and lighter dusts require lower can velocities. Petcoke is typically ground finer than coal, so excessive can velocity can quickly reduce the efficiency of the cleaning system and result in high pressure drop across the filter bags and excessive dust accumulation. Increasing the ventilation volume through a dust collector increases can velocity. For a coal mill dust collector, the can velocity should not exceed 240 fpm or 1.22 m/s.

Filter bags

Polyester, acrylic and aramid are the typical fabric choices for this application. Without membrane, these fabrics require a dust cake for fine particle filtration. However, a dust cake increases the risk of combustion. Fabric with ePTFE membrane does not require a dust cake.

There are engineered ePTFE membranes with properties to handle specific dust challenges. The non-stick characteristics of the ePTFE membrane, combined with a specially formulated treatment, provides the characteristics necessary to help keep the ePTFE membrane from plugging and blinding.

BHA® Preveil® membrane technology has shown promising results and enabled efficient operation with little dust cake in several test applications. To reduce static electricity and sparks, all filter bags should be grounded.

Inlet design

A good inlet design will distribute the gas flow evenly throughout the hopper and eliminate abrasion problems. Abrasion causes holes in filter bags and subsequently emissions. If abrasion problems exist

and the gas volume is as per design, one can either redesign the inlet duct, install baffles (Figure 2) to slow the dust particles and redistribute the gas stream or install filter bags with sacrificial 'abrasion' skirts or reinforced areas.

Hopper and housing design

To avoid buildup of combustible materials, hopper walls should be designed with a minimum angle of 70° from horizontal. The inside of the dust collector should be constructed so that structural steel, baffles or transitions do not form shelves or areas where combustible dust can accumulate. At least one level detector and one temperature sensor should be located in the hopper to warn the operator of either plugging or potential fire issues.

The housing and hopper should be airtight to avoid entry of cold, moist and oxygen-rich air. Explosion vents if installed, are notorious for leaks. Since coal is capable of spontaneous combustion at certain moisture levels, air leaks that provide moisture and oxygen are to be avoided at all cost.

Insulation

Many dust collectors filtering petcoke suffer from severe corrosion. The sulfur content of petcoke and the cyclical operation of the coal mill circuit promote the formation of sulfuric acid which then corrodes exposed metal inside the dust collector and ductwork. Keeping the metal and filtered gases above the dew point is critical to avoid acid formation. Although most dust collectors are insulated, one frequently encounters corrosion problems.

Many dust collectors are installed outside and exposed to rain, wind and varying temperatures. Eventually water will leak through caulked joints in the cladding and then wet the insulation underneath. A lack of insulation around structural steel that is welded to the outside of the dust collector, including lifting lugs, frequently creates heat sinks and 'cold spots' inside the collector. Heat sinks as well as wet insulation typically cause condensation and acid formation on the inside of the dust collector. Injection ports for fire suppression systems and the pipes from the pulse valves into the dust collector are other troublesome heat sinks if not properly insulated.

A lack of insulation in the hopper walls often results in wet surfaces on the inside of the hopper, triggering accumulation of combustible dust.

Material handling system

Material handling systems typically contain a type of airlock and sometimes a feeder. It is essential that material handling equipment is sized adequately to handle material surges; e.g. if a rotary airlock at the discharge of a collector receives material from a collection screw inside a trough hopper, the airlock should be sized to convey the amount of material

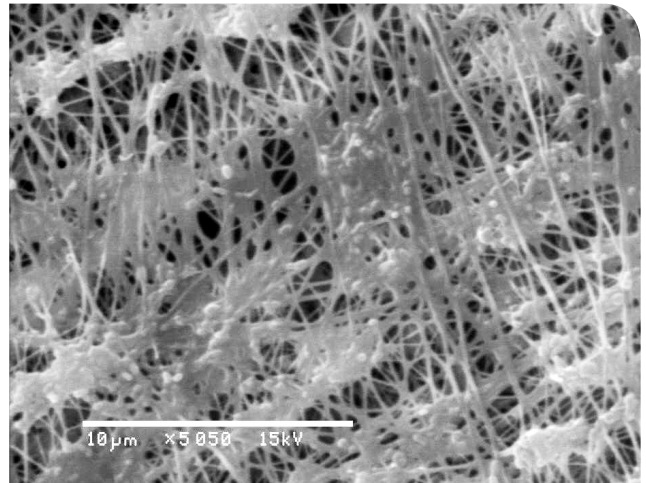


Figure 3. ePTFE membrane allows increased airflow with higher efficiency particulate capture.

delivered by a completely full screw conveyor, even if that screw conveyor typically only operates at 25% material loading. All moving material handling equipment should be equipped with motion sensors to detect failures.

Dust collector operational practices

Once it is established that the design of the dust collector is correct, the following operational practices can further improve its operation. Keep in mind that, although the topics of explosion venting and fire prevention exceed the scope of this article, they should be thoroughly examined with regards to design and operation.

- Establish guidelines for startup and shutdown such as evacuating all the dust from the hopper after the fan has stopped.
- Inspect the dust collector once per shift. This check should include pressure drop across the filter bags, visible emissions, the cleaning system, material withdrawal equipment, damper settings and fan operation. Verify that the order in which the pulse valves of the cleaning system actuate is a staggered and not a sequential sequence.
- A staggered sequence reduces dust recirculation inside the collector and pressure drop across the filter bags.
- Operate your cleaning system and the material withdrawal equipment continuously while the fan is in operation. Do not allow excessive dust accumulation on the filter bags or in the hopper.

A reliable and safe operation of the dust collector starts with a proper design. Operating the collector within its design parameters and maintaining the equipment in excellent condition will further reduce unscheduled downtime, emissions and hazardous conditions. 🌍



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