Dust Collector

Low Pressure Carbon Dioxide System

Introduction

Dust collectors are used in many industrial facilities to help maintain a cleaner work atmosphere, to meet environmental and pollution regulations, and to reclaim usable resources. A system of ductwork is used to pneumatically transport the debris to the dust collector. The two most common styles of dust collectors are the bag house style and the cyclone style.

In the bag house style of dust collector, the "dirty" air is forced through fabric bags that filter out the particulate. Air is either pulsed through the bags or mechanically shaken and the particulate matter (dust) is dropped into a hopper section at the bottom of the dust collector. The dust is usually removed from the hopper by a screw conveyor or rotary style gate valve. In the cyclone style dust collector, the "dirty" air is moved up a chamber that has various vanes built into the sides that force the air in a circular path and separate out the particulate. The dust is then removed from the lower section of the dust collector by a mechanical means. In both styles of dust collectors, the clean air generally exits the top of the collector housing.

NOTICE: This document is intended to provide hazard descriptions and supplementary guidelines to consider when designing a fire suppression system for a typical application. An actual system installation will require an in-depth hazard survey followed by a detailed system design and layout in accordance with the ANSUL Low Pressure Carbon Dioxide System – Design, Installation, Recharge and Maintenance Manual (Part No. 425908).

Design Considerations

CO_2 has been used for many years as a fire suppressant for dust collectors. In accordance with NFPA 12, Carbon Dioxide Extinguishing Systems, Section 5-4, a dust collector must be considered a deep-seated fire hazard. Therefore, it requires a 75% design concentration achieved within seven minutes at a rate that achieves a 30% concentration within two minutes. Due to the fact that dust collectors contain a mass of "Class A" materials in the hopper area, the 75% design concentration must be maintained for a minimum of 20 minutes.

Although dust collectors are straightforward deep-seated, total flooding hazards, there are several important design factors that must be considered.

The carbon dioxide system is designed to suppress a fire in the dust collector. It is not designed nor intended to be an explosion suppression system.

Dust collectors are susceptible to explosions especially if a combustible or volatile dust is involved, e.g. coal dust.

Dust collectors are often constructed with explosion-relief vents as part of their design. Consideration must be made for any explosion-relief vents that are provided and the pressure at which they are designed to operate. Expect pressure to build up during the CO_2 system discharge and compensate for this increased pressure (see NFPA 12, Section 2-5).

All fans, ventilation, and related process equipment must be shut down upon actuation of the CO_2 system.

All supply (dirty air) and exhaust (clean air) ductwork connected to the dust collector must be equipped with self-closing dampers that operate when CO_2 is released by electrical or mechanical means.

The lower portion (hopper area) of the dust collector contains the settled dust particles and therefore the discharge of the CO_2 system should minimize turbulence and disruption of the particulates. It is preferable that the CO_2 discharge be applied into the clean air portion of the collector using an ANSUL RSF nozzle to achieve a softer discharge pattern. The CO_2 gas will fill the entire volume of the collector.

The design of the system should assume that there would be a certain amount of leakage around the dampers in the ductwork as well as through the rotary gate valve or screw conveyor that removes the dust from the hopper. Additional CO_2 should be provided to compensate for this leakage.

The CO_2 system designer needs to determine the actual volume of the dust collector and the volume of all connected ductwork up to the dampers. According to NFPA 12, Table 5-4.2.1, the flooding factor to determine the 75% quantity of CO_2 is 0.166 lb/ft^3 (2.66 kg/m^3). To determine the rate of application to achieve 30% within two minutes, multiply the volume by .043 lb/ft^3 (.668 kg/m^3) to determine the 30% quantity of CO_2 required. Adjust this quantity by the appropriate loss factors and ambient temperature. Consideration is needed for maintaining the 75% design concentration for the minimum 20-minute hold time.

When the enclosure integrity makes it difficult to maintain the concentration for the hold time, an extended discharge arrangement is used. This involves using a second, smaller discharge valve to discharge a low rate of CO_2 into the hazard to make up for leakage and to keep the CO_2 concentration uniform throughout the enclosure. (Since CO_2 is heavier than air it will settle in the lower area of the dust collector, which could result in a lower concentration in the upper areas of the dust collector. The extended discharge helps to keep the CO_2 mixed throughout the space.)

One Stanton Street / Marinette, WI 54143-2542, USA / +1-715-735-7411 / www.ansul.com

Design Considerations (Continued)

The NFPA 12 Standard does not provide any formula for determining the flow rate of extended discharge. The actual rate required is based on the amount of leakage that is expected and the length of time the design concentration must be held. The design should also assume that any leakage would increase as the dust collector ages. One design method that has proven effective with normal leakage is to calculate the extended discharge rate at 20% of the initial discharge rate. The duration of the CO_2 extended discharge should be at least for the minimum 20-minute hold time. Some factors that could require a longer than 20-minute hold time include poor housekeeping and maintenance of the dust collection equipment, large accumulation of dust in the hopper area, accumulation of dust on the damper sealing surfaces, and faulty ancillary equipment, e.g. filter screens, spark arrestors and excessive temperature conditions.

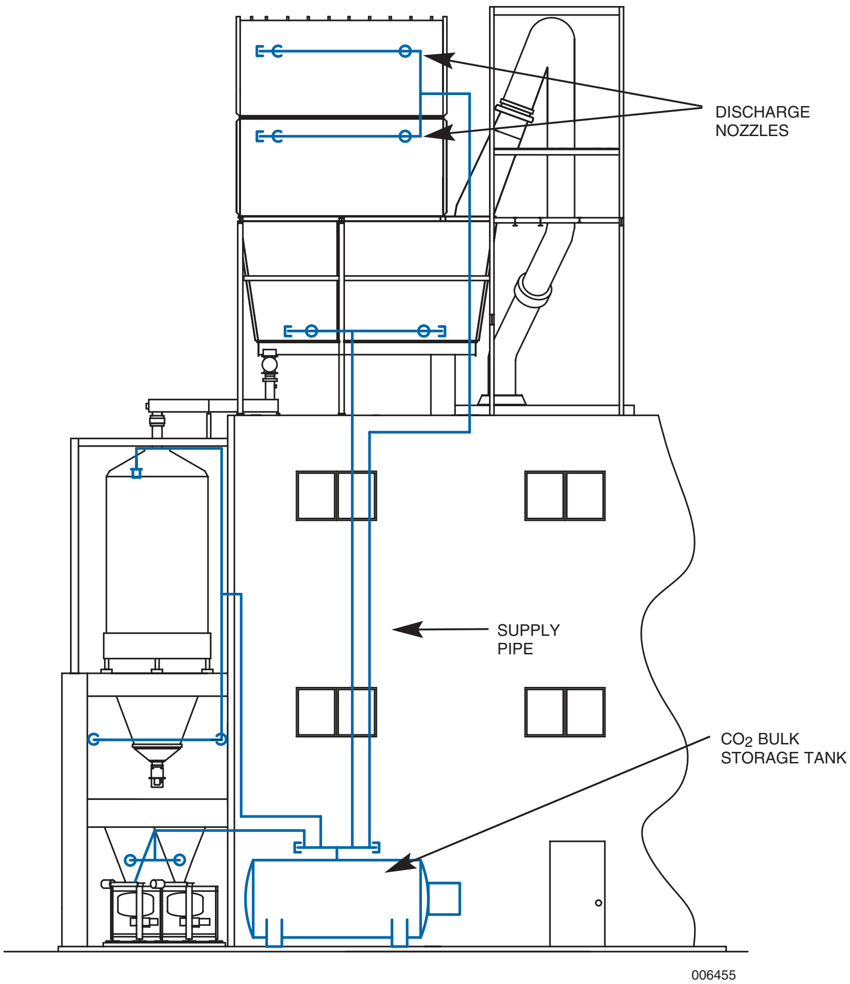
The amount of CO_2 storage required for dust collector protection is the sum of the initial 75% concentration with loss and temperature considerations, plus the quantity needed during the extended period.

When systems are initially designed for an extended discharge in excess of the minimum 20 minutes, this allows for greater flexibility at the time of the acceptance test to adapt to actual field conditions. By simply changing the nozzle orifices of the extended discharge nozzles, you can increase or decrease the flow based on actual testing. If leakage past the supply dampers is greater than initially anticipated, there are two corrective actions that can be taken. The enclosure could be repaired to modify or replace the dampers, or the extended discharge nozzle orifices could be increased to allow additional CO_2 to enter the collector. However, based on the amount of CO_2 storage, the increased flow rate may lessen the length of the extended discharge. Therefore, it is best to start out with more CO_2 than what would be required for the minimum discharge time.

The exhaust system ductwork associated with the dust collector should also be protected with CO_2. This can be a portion of the dust collector hazard or it may also be a separate hazard that is designed to discharge simultaneously with the dust collector system.

Detection for dust collectors can be accomplished using a fixed temperature, rate compensated, hermitically sealed heat detector. Products of combustion and flame detection are not suitable for the harsh and dirty environment found in dust collectors. Another source of detection is monitoring equipment that is part of the dust collector controls. Often the control equipment will monitor certain gas concentrations (carbon monoxide, methane, etc.) and air temperatures of the dust collector. If there is a rise in these levels, it may be an indication of a fire in the dust collector and manual activation of the CO_2 system may be warranted.

Drawing of a Typical Installation



NOTE: This drawing represents an elevation view of a typical low pressure CO_2 system protecting a dust collector. For clarity, the detection system is not shown.