CHEMETRON™ Fire Systems

CARDOX

CO_2

Application Bulletin

Carbon Dioxide Fire Suppression & Inerting—

Coal Grinding, Handling, & Storage Systems

Coal grinding, handling and storage systems are found in a number of industrial applications. The potential for active open-burning type fires in coal mills, ducts, cyclones and dust collectors, plus the potential for smoldering type fires in raw coal silos/bunkers, processed coal vessels, conveyors, feeders and accumulated coal in the bottom of dust collectors necessitates a concern for proper fire protection.

The use of low pressure "Cardox" type systems for fire suppression in these facilities is very popular, since the protection techniques are well established and proven in hundreds of installations.

Such a system is illustrated on the accompanying drawing. The coal is fed from the silo to the coal mill where it is ground. The powdered coal is picked up by a hot air stream and conveyed through a duct to a cyclone, where the heavier coal particles drop out, while the lighter, airborne particles are conveyed by ducts to a dust collector. Small coal particles are recovered at this point.

The coal collected from the cyclone and dust collector is held in surge bins before going to a weighing system, and then to a coal pump, which conveys it to the point of use.

Protection involves protecting against smoldering fires in accumulated coal and open fires in other parts of the system.

Protection of Coal Stored in Silos/Hoppers/Bins

Coal is subject to spontaneous heating when stored in silos, hoppers or bins. The application of carbon dioxide vapor can be used to extinguish smoldering fires that can develop in coal storage systems.

The CO_2 vapor is gently introduced into the coal from the side of containment and forced through the coal in a radial flow out from the points of application. The number of application points is determined by the size of the silo, hopper or bin. As additional CO_2 is introduced, it pushes the CO_2 vapor ahead of it between the voids of the coal pieces — some CO_2 is adsorbed by the coal — until it reaches the fire. The air space above the coal is also usually inerted.

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A World of Protection

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Branded: 06/2023 20230601SM

When the CO_2 vapor reaches the hot spot, it reduces the oxygen, which is supporting the burning, to near zero. The generation of new heat from combustion is then reduced, while heat is lost by conduction to surrounding materials, resulting in cooling of the hot spot and fire control. The coal outlet at the bottom of the silo, hopper, or bin must be closed. Otherwise, fresh air enters at this point and rises through the coal by a chimney effect, feeding the fire.

In practice, it has been found that the coal valves are never completely gas tight. Therefore, the CO_2 vapor application rate must be increased to a high enough level to overcome CO_2 loss out and air entry in through the valve at the same time. Fire control in a few hours is usually considered appropriate.

The controls used for the CO_2 vapor application must have the capability to increase or decrease the flow rate to ensure fire control with a reasonable amount of CO_2.

The control of spontaneous heating in a coal grinding, storage, and processing system by CO_2 vapor is extended to the coal accumulation in the bottoms of the cyclones and dust collectors, and in the screw conveyor enclosures.

NOTE

IT SHOULD BE NOTED THAT CO_2 LIQUID CANNOT BE DISCHARGED INTO THE COAL. WHEN THE LIQUID EXPANDS TO ATMOSPHERIC PRESSURE, SMALL PARTICLES OF DRY ICE ARE FORMED WHICH WILL PLUG ANY APPLICATION POINT BURIED IN THE COAL.

Protection Against Open Burning Fires

Portions of a coal grinding, storage, and processing system are possible sources of open burning fires. These fires must be controlled quickly by the relatively rapid introduction of CO_2. The design of this portion of the fire protection is covered by NFPA Standard No. 12 Carbon Dioxide Extinguishing Systems.

For the mill, ducts, and upper part of the cyclone, a 65% CO_2 concentration is used (see Table 2-4.2.1 of NFPA Standard No.12 on page 3), with a 30% to 34% concentration achieved in the first 1 - 2 minutes. For the dust collector, a 75% CO_2 concentration is required meeting the same application rate requirement. [Dust collector protection is covered by Industrial Facilities Bulletin #0790, Bag Houses (Bag Type Dust Collectors).]

It's not practical to apply the CO_2 as vapor at the rates required to extinguish open burning. While vapor application is practical for the lower application rates for inerting the coal storage, it is not practical for flooding the other parts of the system. At higher application rates, the CO_2 is discharged as liquid, where the dry ice particles sublime to vapor, giving the required concentration of CO_2 in air.

Mill Inerting

For some systems, it is appropriate to inert the coal mill on start up or shutdown. This is done by the application of a predetermined amount of CO_2 through a separate valve and discharge line — liquid CO_2 is used. The quantity of CO_2 for inerting, as well as the inerting procedure, is established by the mill manufacturer, the operator, and Chemetron working together.

System Controls

To protect the coal system from an open burning fire, heat operated fire detectors that initiate an automatic discharge of the required amount of CO_2 are installed. Manual releases are available to initiate a discharge in case it is detected by plant personnel before the automatic detectors have operated.

For the coal inerting, the systems are manually operated. The heat required to vaporize the CO_2 (it is stored as a liquid under pressure) is added by an external vaporizer, and the CO_2 vapor application is usually initiated by the operation of an ON pushbutton and stopped by an OFF button.

For the inerting of the coal mill, a button is used to start the discharge, but a built-in timing cycle automatically stops the discharge when a predetermined amount of CO_2 is applied.

Special nozzles are used to introduce the CO_2 into the coal, while covered orifice nozzles are used in the balance of the system. Check valves prevent coal from entering the piping.

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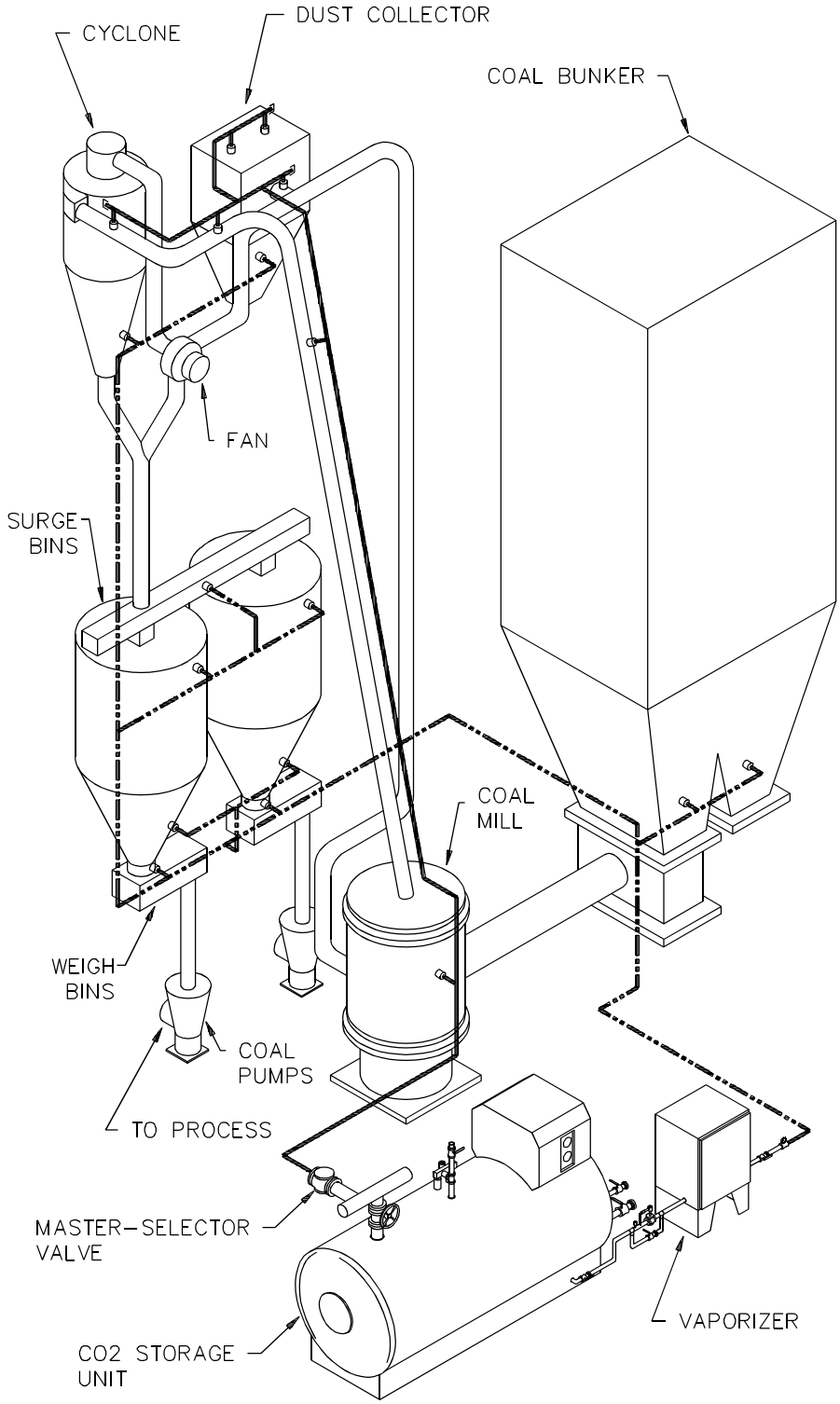
NFPA Standard No. 12 - Table 2-4.2.1

CO_2 Flooding Factors for Specific Hazards

Design Concentration %	Flooding Factors				Specified Fire Hazard
	$Ft.^3$/ Lb. CO_2	$M.^3$/ Kg. CO_2	Lb. CO_2/ $Ft.^3$	Kg. CO_2/ $M.^3$	
50	10	0.62	0.100	1.60	Dry electrical hazards in general. (Spaces 0 - 2000 cubic feet)
50	12	0.75	0.083 (200 lb. minimum)	1.33 (91 kg. minimum)	Dry electrical hazards in general. (Spaces greater than 2000 cubic feet)
65	8	0.50	0.125	2.00	Record (bulk paper) storage, ducts, and mechanically ventilated covered trenches.
75	6	0.38	0.166	2.66	Fur storage vaults, dust collectors.



Low Pressure CO_2 Protection System for Coal Grinding, Handling, & Storage Systems

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