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DUST CONTROL TECHNOLOGIES FOR MINERAL PROCESSING PLANTS

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ABSTRACT: There is number of dust control problems in mineral processing plants. The principal plant sources of dust emissions are either from process or open sources as example; dumping and material transfer operations, bulk loading and unloading facility, crushing and grinding and product, row materials and waste piles. In industry, many alternative control systems are commonly applied to contain dust. The selection of the most appropriate system for a given process is a function of its efficacy to control dust, the capital investment, the operating cost involved and ease of use. The paper discuses most common technologies in use today. As case study, dust control system designed for crushing and screening plant at BRIK surface coal operation is presented.

INTRODUCTION

More than ever our society is promoting the concept for using "clean" technologies in order to lessen the impact of industrial processing of row materials on our environment.

The ore handling, crushing, screening and milling processes are very dusty. What is even worse, at most of mineral processing plants fugitive dust account 50-80% of total dust emission. Fugitive dust refers to particles have become airborne by wind or physical movement (impact) or some combination of two, in a relatively unconfined space. In contrast to dust from point source emission, such as stacks and vents, fugitive dust is not confined to a specific area or generated from specific piece of equipment, thus making it even more difficult to control.

These dust emissions can cause a variety of problems including material loss, hazards to employs health, equipment explosions, high maintenance costs and regulatory concerns.

These emissions can be controlled mechanically, chemically or by both means. This paper presents both alternatives for fugitive dust control and decisions making process to select best treatment approach for specific plant. In addition, the theory behind chemical application and case history are also presented.

DUST CONTROL ALTERNATIVES

This section discuses most common technologies used for dust control which include:

Confinement

Building a roof and walls around the contaminated are is a valid method to control dust where human intervention in the confined space is not required or is limited. This method has proven to be very effective in controlling emissions in protected area; however, the main drawbacks are usually;

- High capital costs required to build the confined area
- No provisions to control dust if the dusty material leaves confined space

Mechanical dust collection

The use of a baghouse or an electric precipitator may provide high dust abatement exceeding 95 % efficiency. Mechanical methods are often only practical alternative for hot flue gases. When dusting is associated with material at or near the room temperature, the following implications my be carefully weighted;

- high capital costs required to purchase and install equipment
- Each transfer point requires a dust collection system
- Each conveyor should be shrouded
- Operating and maintenance costs of 0.10 to 1.00 $ per ton must be budgeted, depending on the number of transfer points and extent of the collection system
- Heating costs for air losses from heated building
- Provision to handle dust removed by the dust collector

Wet suppression

Water is known to be good dust suppressor. It has been used extensively in controlling road dust because it is inexpensive and readily available almost everywhere. Surfactants can be added to increase wettability of the dusty material with water. Thus, it is possible to achieve the same dust control performance using surfactants with 70% less water than by using water alone. Wet technologies are not often use because:

- Many materials are difficult to wet, with no or marginal dust control efficiency
- Water freezes during the cold season, causing production problems
- Water cannot be added in large quantities to certain processes
- Spray systems are required and must be properly maintained

Foam suppression

Foam has become a leading treatment method in dust control management applications. It significantly reduces water and energy consumption. It can be the most effective method for reducing breathable dust. Dust control efficiency with foam may exceed 95 %, performing well as or better the mechanical collectors.

As opposed to wet suppression foam do not freeze. Treated material retains its ability to be non-dusty for several hours, which can be increased to several days with the addition of the binder to the foam. Treatment costs are comparable to the operation of dust collector and capital expenses are minimal.

Sprayed binding/agglomeration agents

Binding agents provide intermediate control to long term dust control compared to the wet suppression or foam. As such binding/ agglomeration agents are usually applied to active or short-term piles.

Stock pile crusting agents

The use of various chemical-crusting agents has proven to be effective way to protect stagnant piles, not only against fugitive dust, but also against water intrusion into such piles. Treatment costs vary with the type of crusting agents applied; however, costs are less expensive than the investment requires for mechanical confinement.

CASE HISTORY

An automated foam application was designed for coal crushing and screening plant at surface cola mine BIK-Berovo.

Several objectives are usually considered when addressing dust control, including; preventing material loss, reducing employ health hazards, reducing explosion potential, reducing maintenance costs and eliminating regulatory pressure.

At this plant preventing material loss, reducing equipment maintenance costs and regulatory pressure were the most important objectives. In addition the plant management wanted to control dusts with method that added minimal moisture to the material.

The crushing and screening plants consists of truck unloading station, vibratory feeders, conveyance to screens and to stock piles (see fig. 1). The plant runs 5 days per week (200 days per year) with variable capacity of 250 – 400 tons per day.

Survey

The project was started by surveying the system and ensuring all mechanical components were in good working order. Once mechanical checks are completed, base line dust conditions were measured. All measurements were taken using a MINIRAM Model PDM 3 and expressed in milligrams dust/cubic meter. The data for both base line and treated conditions are complied averages over several days.

Program selection

After baseline measurements and general system survey was completed, selection of a dust management approach was considered. Primary

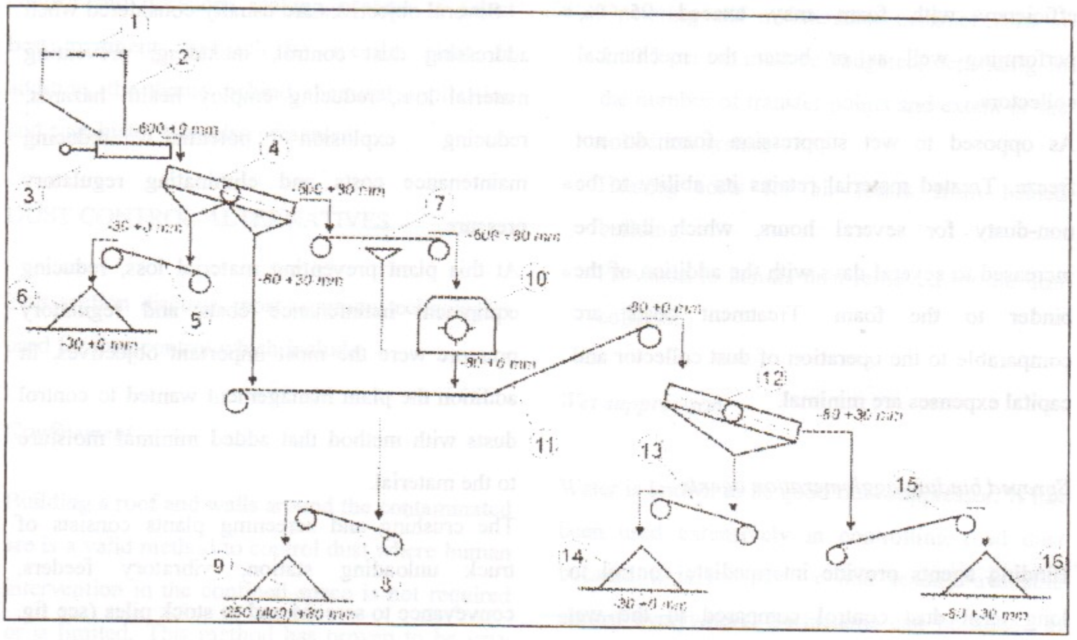

Fig. 1. Schematic view of coal crushing plant

sources of dust were vibratory feeders, conveyor belts transfer points and coal piles.

Both wet suppression and mechanical collection was ruled out, because of excessive moisture addition for wet suppression and high investment costs, maintenance problems and problems connected with handling dust collected with the system, for mechanical collection system.

Treatment choices included foam and foam with binding agents. The addition of binding agent was deemed necessary, as the foam alone cant provide adequate dust control in this particular operation.

Addition points

The next step was to locate application point(s) that would achieve maximum dust elimination.

Foam should be applied into the material at a point of free fall to ensure adequate mixing of material and foam before impact dusting occurs. In this case, the first point of the free fall was from the vibratory feeders to the belt conveyor. As the foam often has residual effect that will carry through and control dust, in this particular case one fed was found to be sufficient to controlling dust throughout the system (even through the crusher operation).

Foam generating equipment

For foam generating/feed proposes was used original equipment by agents manufacturer. The foam making process begin in FPA (Flow proportioning assembly) where water and chemical was mixed in appropriate amounts. This solution is then carried to the RMM (Remote

Metering Module) where solution is mixed with the air in the foam-generating cell. Foam is the discharged through one hose to the foam application point.

The unit was set to function in the automatic mode. This was accomplished by installing material flow paddle switches at the discharge end of the vibratory feeders. The signal from the switches was input to the FPA module. In this configuration, foam was applied when a signal is sent from the switches indicating material flow. At the end of material flow cycle the unit is shut down and an air purge begins to clear the lien of residual solution and foam.

Results

Baseline measurements were taken prior the activation of the foam generating system. Measurements were collected in three different zones and are summarized in the Table 1.

Table 1. Baseline measurements

Zone	Average dust level (mg/m^3)
Vibratory feeder	9.4
Crusher	13.5
Coal piles	12.3

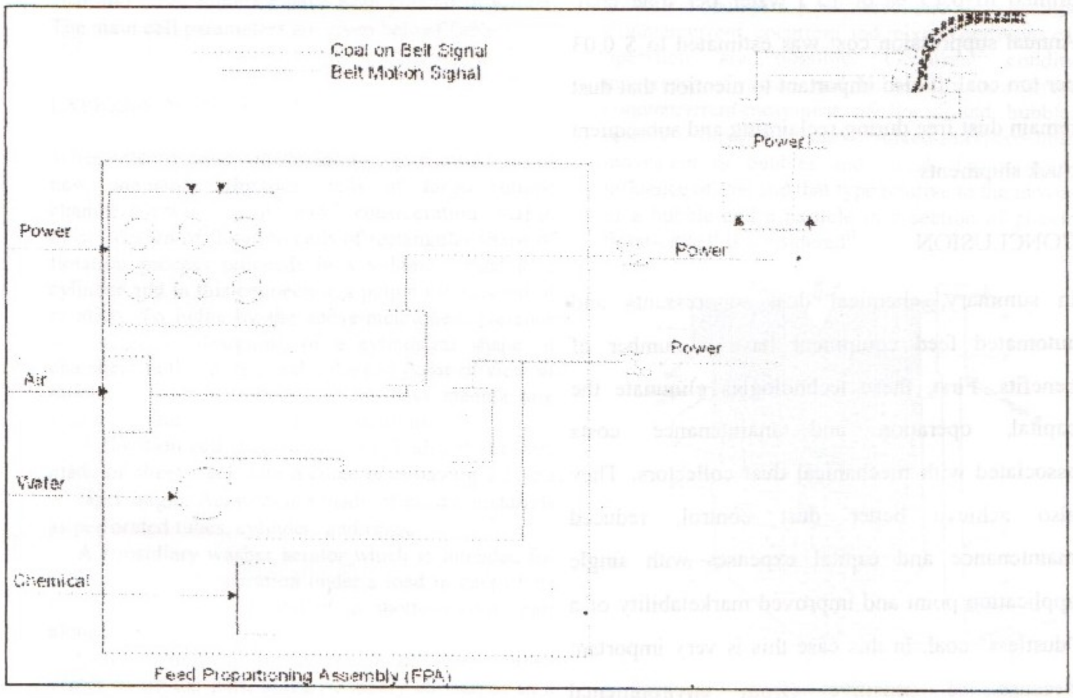

Fig 2. Schematic view of foam generating/feeding equipment.

After the system was turned on and continued for several days, the measurements are taken at the same three zones (see table 2).

Table 2. Dust measurements with foam suppression

Zone	Average dust level (mg/m^3)	Percent reduction
Vibratory feeder	1.7	82
Crusher	1.5	89
Coal piles	1.1	91

Successful dust reduction was accomplished in all three zones with one foam feed point. The average reduction was 87 %. Moisture addition was limited to 0.15 % or 15 l water per tone coal. Annual suppression cost was estimated to $ 0.03 per ton coal. It also important to mention that dust remain dust free during reclaiming and subsequent truck shipments.

CONCLUSION

In summary, chemical dust suppressants and automated feed equipment have a number of benefits. First, these technologies eliminate the capital, operation and maintenance costs associated with mechanical dust collectors. They also achieve better dust control, reduced maintenance and capital expenses with single application point and improved marketability of a "dustless" coal. In this case this is very important because of sensitive (from environmental standpoint) location of the mine and his transportation routes.

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