Dust Collectors for the Mining Industry: What Every Engineer Should Know.

By Bill Kurz, Sly Inc., Cleveland, Ohio

Wet scrubbers can be a very good alternative to baghouses or cartridge collectors for a mine: less expensive to purchase and operate. Here's what to consider when making the choice.

Wet scrubbers have been part of the mining industry since the start up of the first mine. If you think about rain, it has scrubbed the air since the beginning of time. Most modern mines utilize a form of scrubbing when they spray down stockpiles and haul roads. So, wet scrubbers can be very simple devices, and in most instances, they **are** simple devices, a real plus for air pollution control.

Today there are many issues concerning air quality, both in the workplace and emissions. This has led to the development of more sophisticated air pollution control devices. However, it is interesting to note that most of today's dust collector equipment has changed little over the last twenty years, with advances in the industry coming through the development of higher efficiency filter media, both for baghouses and cartridge filters.

Dust collectors in general are used to ventilate operations such as crushing, grinding, conveying, screening, drying, packaging and loading. Dust control in these areas look to reduce the amount of dust that escapes into the workplace, separate fines from the product, recover product and meet emission regulations. The design engineer can choose from a variety of equipment to meet each of these requirements. Sometimes there are straight forward choices but other times the decision may be more difficult. As one weighs the issues, monetary considerations such as equipment costs, installation, maintenance and energy can further complicate the decision making process.

This paper will sort through these issues and show you why wet scrubbers are often overlooked, while often times meeting or exceeding the regulatory requirements of the installation. Key factors to consider are that many mine sites are remote, water and disposal are non-issues and maintenance hours are typically at a premium.

The Big Three Variables

Many mine installations are driven by the need to control dust. It could be the need to control a hazardous dust such as silica, or the dust might be just nuisance and a housekeeping problem. In the end, it will be necessary to control the amount of dust discharged to the atmosphere. To decide whether a wet scrubber is a good fit generally requires a bit more homework from the engineer. Besides the ventilation rate (air volume in CFM), the inlet loading (given in lbs/hr or gr/cf) and the particle size distribution (given in microns) must be determined.

Categorically, wet scrubbers do not have as high a collection efficiency as dry type dust collectors. These dry type collectors, both baghouses and cartridge filters, can handle a wider range of air volume, particle size and inlet loading without affecting the outlet emissions. Scrubbers, on the other hand are sensitive to air volume, smaller particle size and the amount of dust coming to the device. For example, for an installation with a median particle size of 10 microns, which means half of the particles are larger than 10 and half are smaller than 10 microns, a baghouse or cartridge filter will have a collection efficiency of 99.99%. On the other hand, a high energy scrubber will have a collection efficiency of 99.75% and a low energy scrubber will be in the 99.26% range. Low energy scrubbers operate in the range of 3-8" wg pressure drop while high energy units have an operating pressure drop between 10" and 40" wg.

Outlet emissions will depend on the efficiency of the device and the inlet loading. The inlet loading to a dry collector will have little or no effect on the outlet emissions. Given an inlet loading of 5 gr/cf on a system handling 5000 cfm, we find that the dry collector will have an outlet loading of 0.005 gr/cf whether the inlet loading is 2 gr/cf or as much as 10 gr/cf. This occurs because of the renewable dust cake on the bag that allows it to handle various amounts of dust loadings while maintaining the same amount of dust that is allowed to pass through.

On the other hand, wet scrubbers use a different collection mechanism that is sensitive to inlet loading. Using our wet scrubber example we see that the efficiency will change as the inlet loading changes. The high efficiency scrubber will collect 99.75% of the inlet load and have an outlet loading of 0.015 gr/cf. If the inlet load is only 3 gr/cf, then the same effiency will give an outlet loading of 0.01 gr/cf. Should the inlet loading be as high as 7 gr/cf, then the outlet loading would be 0.02 gr/cf. The low energy scrubber would produce the same type of results with an outlet loading of 0.02 gr/cf with a 3 gr/cf inlet and a 0.05 gr/cf outlet loading with a 7 gr/cf inlet loading.

The particle size distribution is also critical and greatly affects the efficiencies of the collection device. Dry collectors will be more efficient over a greater range of particle size than a wet scrubber. The coarseness or fineness of the particle size range will also dictate the type of wet scrubber to be used as well as the required pressure drop.

Scrubber Comparison – Low vs. High Energy		
	Sample A- Particle Size Distribution	**Sample B- Particle Size Distribution**
Size Range (Microns) 1 – 5 5-10 10-15 15+	 10% 30% 40% 20%	 30% 40% 20% 10%
Low Energy **Efficiency** **Pressure Drop**	 99.1% 6" wg	 Not obtainable, too fine
High Energy **Efficiency** **Pressure Drop**	 99.5% 12" wg	 99.2% 12" wg

Target is 99% collection efficiency.

Lower Purchase and Operating Costs

While dry collectors offer certain advantages for product recovery, higher collection efficiencies and no water requirements, wet scrubbers do have clear advantages. Typical scrubber systems are less expensive to purchase and operate. The following chart shows the comparison of a typical 10,000 cfm low energy scrubber and dust collector.

Cost/Energy Comparison 10,000 CFM		
Type of Device	**Baghouse**	**Scrubber**
Operating Parameter	5.5:1 air-to-cloth ratio	Single stage
Filter Media	Polyester bags	Impingement plate
Base Cost	$29,660 [1]	$24,700 [2]
Exhaust Fan Electrical Cost per Year/HP	$4,597.98/30	$3,814.17/25
Pump Electrical Cost per Year/HP	———	$695.40/5 [3]
Compressed Air Electrical Cost per Year/HP	$1,112.16/7½ [3]	———

Delta P	6" wg	4" wg

1. Includes top bag removal collector, bags, cages, bag cleaning system, hopper, slide gate valve, shipment, and full access platform with caged ladder.
2. Includes scrubber, integral mist eliminator, external recirculation tank, pump, and support structure.
3. Based on operating 2080 hours per year. Electric cost of $0.095/KW-hr.

But initial costs are only part of the consideration. A key factor in any equipment purchase is maintenance. While dust collectors have routine maintenance requirements for the bag/cartridge cleaning system such as the timer, solenoid valves and pulse valves, wet scrubbers typically have no moving parts or cleaning controls. An additional consideration is that the cleaning “zone” in a scrubber does not generally require replacement where as in a baghouse or cartridge filter, the bags or cartridges must be changed every 2-4 years.

Energy costs are an interesting comparison. First we examine the exhaust fan requirements. Low energy scrubbers will run at 3-4"wg pressure drop. A baghouse will run 4-6"wg and cartridge filter in the 3-5"wg pressure drop range. If we make the assumption that the scrubber runs at 4" and the dry collector runs at 6", the additional 2"wg in pressure drop, over the course of a typical year (2080 hours) with an energy cost of $0.095/kW-hr, the dry collector will cost $782.00 more in energy expenses per year.

The other equation in analyzing energy cost is the cleaning system. In the case of the scrubber, a pump is required to delivery water to the unit. In the case of the dry filter, compressed air is used to clean the bags or cartridges. In our previous example, we used a 10,000 cfm system. Water requirements for the scrubber will be 3 gpm/1000 cfm, or 30 gpm. Assuming the scrubber is using recirculated water and the pump is located right below the scrubber drain, a 5 HP pump is required. On the dry collector side the compressed air requirement is typically about 15 scfm. The additional energy costs to run a 7.5HP compressor for the collector compressed air supply vs a 5HP recirculation pump for the scrubber is $695.00 per year as in our previous example.

Typical applications would be to ventilate material handling equipment such as screw conveyors, belt conveyors and bucket elevators. These are generally referred to as nuisance dust control applications and generate low dust loading and coarse particle sizes. Packaging and bulk load out such as bagging machines, bulk bag filling or the loading of trucks and rail cars also generate dust loads on the low side with coarse particles. Ventilation of equipment such as screens and ball mills will produce slightly higher loadings and finer material. Finally, processes such as dryers, kilns and calciners will have medium to high dust loads with particles size distributions that reflect a high concentration of fine particulate.

In summary, wet scrubbers are a viable consideration if: water is available either from plant recycled water or recycle water specific to the scrubber, material can be recovered wet and either disposed of easily or can be placed back into the process in a wet condition. Care should be taken to fully investigate the inlet conditions of the scrubber in terms of particle size distribution and loading and determine if the scrubber will attain the desired emission level. A wet scrubber installation that will satisfy these requirements can cost less to purchase, install and maintain while providing satisfactory emission levels.

Bill Kurz is vice president at Sly, Inc. a 134 year-old manufacturer of baghouse, cartridge-style and wet scrubber air pollution control equipment. He can be reached at 800-334-2957.

www.slyinc.com

bkurz@slyinc.com