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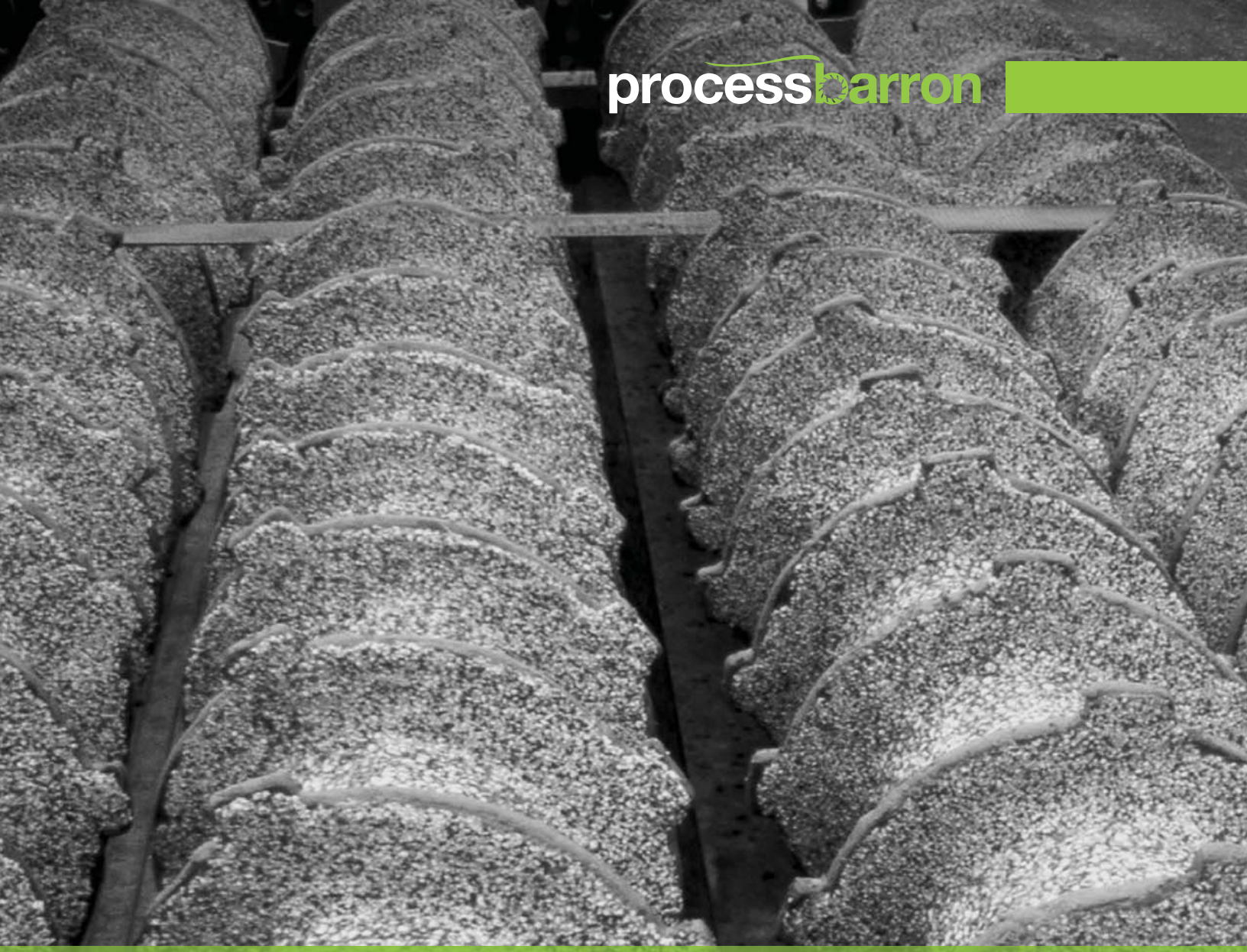


COMMON SENSE SOLUTIONS TO MINIMIZE EMISSIONS

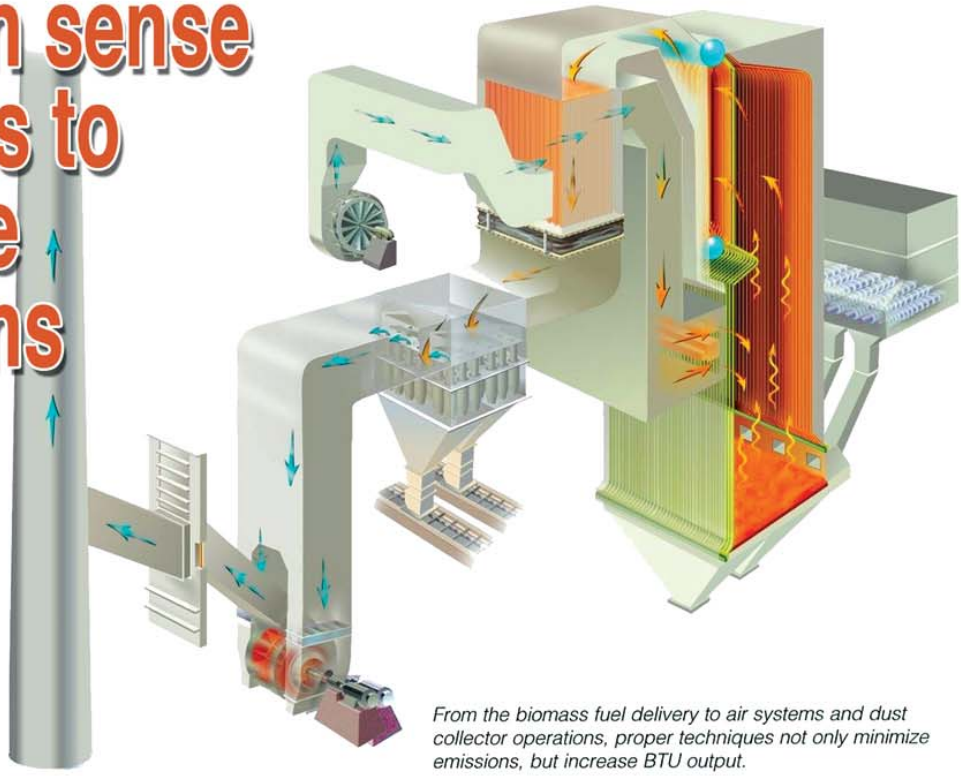
Cliff Moss, Vice President and Director of Materials Handling Division

SYNOPSIS

Every plant manager wants their plant to function at the highest level of productivity possible while complying with emissions regulations. This article documents common problems that reduce biomass systems' efficiency and offers straightforward ideas for solving them. Topics covered include biomass fuel delivery, boiler air systems, and mechanical dust collectors. By applying these principles and employing the proper equipment, plant managers will be able to maximize their plants' efficiency while minimizing emissions.

Common sense solutions to minimize emissions

BY: CLIFF MOSS

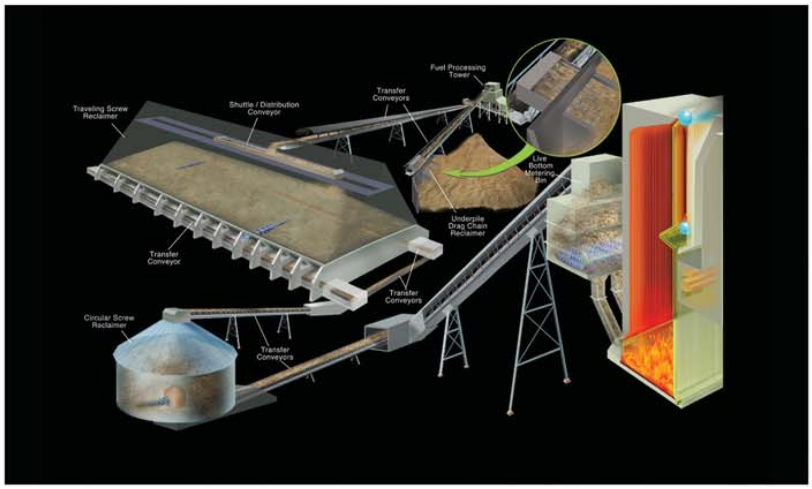


From the biomass fuel delivery to air systems and dust collector operations, proper techniques not only minimize emissions, but increase BTU output.

When emissions exceed regulatory standards, plant managers are often faced with the dilemma of cutting back production in order to maintain compliancy or incur stiff penalties. Plants that are forced to run boilers at a lower level to scale back emissions lose productivity and efficiency, which quickly becomes very costly. Fortunately, there are smart equipment options that help maximize efficiency while reducing particulate emissions. From the biomass fuel delivery mechanisms to the boiler combustion air systems to reliable mechanical dust collector operations, proper biomass air and fuel handling techniques can not only minimize emissions, but also increase BTU output from your boiler.

From the time biomass fuels arrive at the facility, there are simple steps that can keep systems running at full capacity while staying well within the bounds of emission standards. First it's critical to look at the boiler biomass feed system. Improperly functioning feed systems are the culprits of many emission overruns. If the feed system is not designed and equipped to operate smoothly, emissions issues will crop up in the later stages of the air and ash handling process.

Unlike coal, which tends to be more uniform and easier to manage with less foreign debris, biomass fuels clump in ways that often stymie conveyer system equipment like metering reclaimers, screw feed bins, chute work and boiler feed spouts. It is paramount that the biomass fuels are properly screened and sized to the boiler size specifications as soon as they arrive at the plant.



Foreign material such as rocks and metal must be removed, and the biomass fuel should be shredded or hogged to the size specification immediately after being unloaded at the plant and prior to being sent to storage or the boiler. If this is done properly and consistently, all of the equipment downstream will perform more reliably, with less power and less maintenance.

At the boiler, biomass metering feed bins that bridge often result in an uneven flow of fuel

Ensuring that equipment at each step in the boiler feed system is functioning properly helps minimize emissions issues that could occur later downstream.

Metering bins equipped with rugged screws improve efficiency and feed biomass in a uniform manner.

to the boiler. This is an early indicator that emission problems are likely to occur down the line. The irregular sizes and flow characteristics of biomass material require biomass metering bins to be designed with rugged screws that can continue to operate and feed the fuel in a uniform manner. If the bins are not equipped with the proper mechanisms to minimize bridging of the woody biomass, there will be interruptions in the fuel delivery and improper fuel distribution in the boiler. This will result in lower combustion efficiency and higher emissions at the stack.

Indications that there are problems with the fuel delivery system can easily be seen at the boiler grate on stoker type boilers. If the fuel distribution system is creating uneven mounds of fuel on the boiler grate, the combustion air system will not perform properly. Combustion air will always take a path of least resistance. In this case, the airflow will be around the pile of fuel that needs to burn and to a more open area of the stoker grate where there is no fuel. For combustion, air needs to pass through the biomass and not around it. Therefore the biomass feed system must have the ability to create an even bed of fuel over the stoker grate, and the ability to adjust the fuel levels across the grate area.

In addition to impeding efficient heat production, poor fuel delivery and distribution will entrain excessive amounts of particulate matter from the boiler grate into the exhaust gas draft system. This also will create higher levels of NO_x and CO. The net result will be increased emissions levels for particulate matter and greenhouse gases.

Properly designed metering bins and fuel distribution spouts are the solution to keep biomass fuel delivery uninterrupted and at even levels, minimizing excessive particulate matter and harmful gases from getting into the exhaust gases of the boiler. A live bottom screw metering bin located on the boiler feed side wall is an excellent way to accomplish these goals by controlling fuel feed. This is done by accurately metering fuel into the boiler inlet chutes and feed spouts, and acting as a fuel retention device for uninterrupted flow into the boiler.

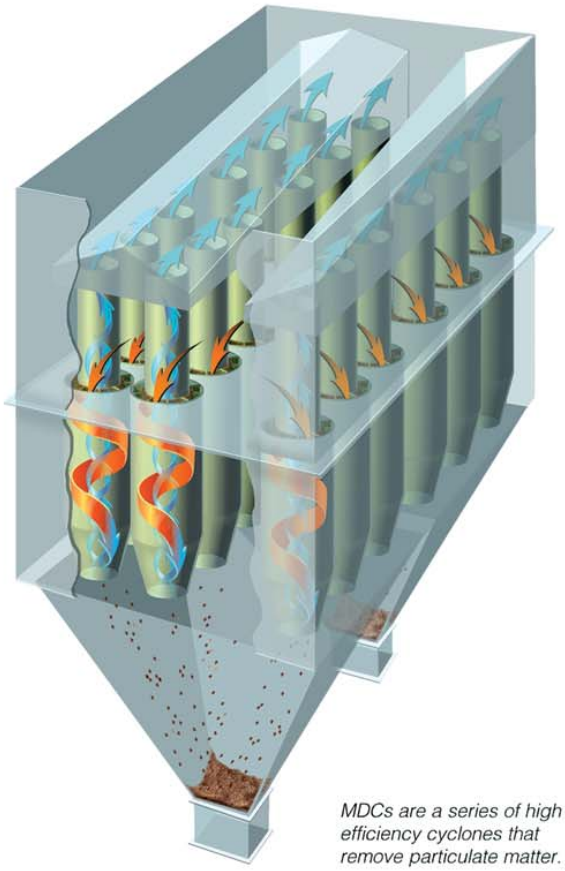
Live bottom biomass metering bins minimize excessive particulate matter from getting into exhaust gases of the boiler.

To accomplish this, multiple screws controlled by variable speed drives are located along the bottom of a retention bin. Each set of screws has a separate drive system, which allows the boiler operators to control the volume feed rate of fuel in each boiler feed chute and controls the fuel distribution across the boiler width (side to side). At the base of the boiler feed chutes, and at the entrance into the furnace, there are boiler feed spouts. These feed spouts control the fuel distribution across the depth of the boiler (front to rear).

Ensuring that your combustion air handling system also is properly sized is critical to maximizing efficiency and minimizing emissions. Biomass combustion air handling systems should have larger over fire air systems than traditional fossil fuel systems. The high moisture and varying size nature of biomass fuels often results in larger ash and char particles, which can easily be pulled into the exhaust gas system. Properly designed OFA systems will minimize char particles from entering the exhaust gas system and bring down combustion efficiency, as well as provide the necessary mixing of fuel and oxygen to further burn out the char particles, releasing more BTUs to power the system and minimize particulate carryover.

In addition to incinerating char particles, OFA systems also provide the mixing and necessary oxygen to properly combust the volatile gases that are released from the biomass fuel during combustion. It is common today for the designers of OFA systems to use Computational Fluid Dynamic modeling to determine the exact amount and location of OFA needed to maximize the effect on combustion. This can be very complicated with the varying types of fuels, such as biomass. However, an increase by just a few percentage points of combustion efficiency can result in big dollars and emissions compliance without expensive backend equipment on the boiler.

While they've been around for decades, the benefits of Mechanical Dust Collectors can be easily overlooked. Properly sized MDCs can be a workhorse for reducing emissions levels and keeping the air pollution control equipment working reliably with minimal energy input. The MDC makes the pollution control equipment more reliable by taking out a large percentage of the



MDCs are a series of high efficiency cyclones that remove particulate matter.

equipment more reliable by taking out a large percentage of the particulate, minimizing the load on the downstream equipment, such as the ID fans, scrubbers and precipitators. MDCs also protect this equipment from excessive erosion problems and possible fires commonly associated with biomass boilers. These problems can lead to long, unexpected downtime, further reducing the plants operating efficiency.

A mechanical dust collector is sometimes referred to as a "multi-clone" because it is a series of multiple high efficiency cyclones operating in a parallel arrangement using a common inlet and outlet plenum to remove particulate matter from the boiler exhaust gases. Years ago they were used as the final air pollution control equipment, but today's standards require more particulate removal efficiency than can be met with just an MDC. However, the MDC still plays a vital role in most biomass boiler exhaust gas particulate removal systems.

The MDC is a low cost method of removing more than 85 percent of the boiler exhaust particulates. It typically operates with 3" w.g. differential pressure and can handle large amounts of gas volumes. It is commonly used as the main collection device on the char re-injection systems commonly found on most stoker type boilers. The MDC also acts as a pre-cleaner to the downstream equipment to minimize equipment erosion and downtime.

The design of older MDCs made them less effective and difficult to maintain.

The combustion of biomass means a lot of foreign matter, like sand and dirt that is typically entrained in biomass fuels, collects in the exhaust gases. The MDC is a very efficient device to remove this debris before it reaches the ID Fan, where it can cause severe erosion and possible catastrophic failure to the rotating assembling and/or housing, resulting in long downtimes on the boiler.

Older dust collectors were installed with tubes that were very small in diameter and could only handle small amounts of volume per tube (600-750 ACFM), requiring many of them operating in parallel to achieve the entire boiler exit gas volume throughput. This setup resulted in minimal emissions reductions and made maintenance of individual components very difficult.

Today, MDC are designed to be much more heavy duty, rugged and reliable. Unlike their predecessors, modern MDCs have larger diameter tubes that reliably get the particles that are more than 15 microns with minimal energy. They also are able to run an entire year efficiently and reliably without plugging up and developing holes in key components. In today's MDCs you'll find they take up the least amount of total space with the fewest number of components, typically 1/6 the number of 9" tubes. They retrofit well with smaller tube collectors on existing boilers and have a no plugging potential with larger tubes.

Some of the other benefits of MDCs include open air passages, allowing the best potential for even air distribution of gases to all tubes; heavy duty wall tubes and turning vane construction, allowing longer reliable operation before replacement; total accessible design for minimum maintenance requirements and easy access to compartments.

Ensuring that fuel and air handling systems are functioning correctly are a few common sense solutions to minimizing biomass boiler emissions without adding on costly back-end equipment. In addition to reducing emissions, these steps also enhance other important aspects of boiler operation, improving combustion efficiency and uptime of the boiler, which creates greater annual BTU output and minimal cost per megawatt.

About the author:
Cliff Moss is the vice president and director of Materials Handling Division at Process Barron Pelham, Ala. With more than 20 years in the biomass field, Process Barron designs, installs, manufactures, installs and maintains air, fuel and ash handling equipment for biomass systems.

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