A SQUARE HERESY

Phil Wowak, ASGCO, US, explains why the orthodoxy of round flow-control transfer chutes is not always the best solution in coal handling applications.

Optimised and engineered flow-control transfer chutes that are designed to reduce dusting and improve wear and flowability have now been around for about twenty years. There are several common designs that seem to dominate the coal handling arena, all with varying degrees of success. But the optimal design goal is to make them small and make them round!

When ASGCO first started to design and supply flow control transfer chutes, the company followed the same design path. After careful analysis, using discrete element modelling software, its designs limited the cross-sectional area to control induced and displaced airflow and incorporate a curved shape to eliminate build-up areas in the corners and maintain product velocity in the directional changes.

This type of design worked well when the product being conveyed had consistent properties that varied only a small percentage every day. However, when dealing with real world coal supplies, where moisture content and particle size can greatly vary from day-to-day, the results can potentially prove to be very difficult for today’s coal yard operators.

Living in the real world
Designers are often not made aware of the constantly changing properties or how frequently they can change. Because most
power plant coal comes from multiple sources of supply and is stored outside, exposed to the elements, flow problems can be so great that load reductions can and have occurred on a regular basis. Small variations in coals, especially moisture, particle size and hardness, can wreak havoc on a round, flow-controlled designed chute. Sometimes the coal will very easily pass through, while at other times, it will not pass through at all.

Trying to model the coal flow through a transfer chute after several days of heavy rain is extremely difficult, if not impossible. The wet coal, in addition to the reduced size and shape of the transition, can cause plugged chutes and extreme wear.

Another problem with the varying types of coal being supplied is the fluctuations in hardness. Many power plants today blend different fuel types. This presents not only a reduced flow issue but, additionally, an extreme wear problem.

There are no easy answers to what type of wear liner material will work in different types and hardness of coal. Where one type of wear liner, e.g. chromium carbide overlay, works well in sub-bituminous Powder River Basin coal, it performs poorly in eastern bituminous coal where stainless steel liners work well. Ceramic tile works well in both types but does not lend itself to applications incorporating a round design. Replacing worn curved liner and chutes is very expensive and time consuming. The chute designer/supplier often does not provide detailed fabrication drawings for the liners, forcing the end user to purchase the replacement liners from the OEM at a premium cost.

Repairing worn liners in chutes between outages has always been a challenge. On curved or round designed chutes, a repair patch using a flat piece of wear liner cannot be made. Without detailed fabrication drawings, the repair piece cannot be rolled ahead of time. In most cases, a worn spot or blow-through hole will need to be plugged using fast drying epoxy or, in some cases, cloth rags and wooden plugs. This gives less than optimal results and, in many cases, adversely affects the flow of product. It is also only temporary at best. Without the ability to quickly repair holes in chutes,
material leakage and build-up become a serious safety and environmental issue, which can turn into a citable offense.

**A square approach**

In ASCCO’s opinion, small, round flow-control chutes are not always the answer. They are a good choice when the product being handled has consistent flow properties and moisture content each and every day. But where do you find this in today’s real world coal yards? A round design seems to create a lot of issues. There is such a restrictive flow cross-sectional area that it does not appear to be conducive to routine changes in the flow characteristics seen when handling wet coal. The chutes must be designed with a larger cross-sectional area to accomplish that, as well as smooth transitions that do not funnel the coal into an increasingly smaller area.

ASCCO prefers a more open design to allow for varying coal properties, as well as easier access for inspection and repair purposes. A larger chute area that incorporates flat standard-sized wear liners, as well as eliminating 90° corners that can become problematic, greatly reduces both maintenance costs and downtime. This design provides a more controlled flow with sufficient area to allow the product to pass through, while still minimising dust. By using flat surfaces and 45° mitered corners, the design and fabrication costs are reduced. In most cases, this type of design also allows the ability to use a standardised liner system.

By designing the transfer chutes to use a standardised lining system, spare liners in only a few different sizes can be kept in stock. Using a stainless steel mounting system, liner change out can be performed easily with a minimum of downtime and expense. Also, because of the primarily flat surface area, many different types of wear lining products can be installed in the chute. This allows for any number of types of liners to be tried and installed to best suit the type of wear. Some examples would be sliding abrasion, severe impact or sticky material build up problems. Depending upon the need, the types of liner used could include: chromium carbide overlay plate, work-hardened stainless steel, ceramic tiles in either a rubber or urethane matrix,
ultra-high-molecular-weight (UHMW) polyethylene or any variety of abrasion-resistant alloys.

By designing the shell of the transfer chute to allow the installation of a standard sized lining system, the end user will now have many options available to fine tune the wear life of the coal handling system without being tied to any one manufacturer or supplier.

**Benefits for dust control**

The newer designs have a much longer skirting area with multiple dust curtains that will reduce the air velocity to knock down even more dust. A positive load zone belt support, coupled with an easy to adjust skirting seal, is a must. Belt alignment is also very important to ensure that the belt enters the load zone properly and the load is centred on the conveyor. Properly designed and installed belt cleaning systems are a key part in minimising carryback and dust control. All these components must work together as a complete system in order to conform to the strict dusting standards.

When these components are installed, provisions must be made to allow for easy access for maintenance and replacement whenever possible. The best belt cleaners in the world will quickly become ineffective if they cannot be inspected or maintained on a regular basis. Providing larger doors in many areas will help make sure that everything is appropriately adjusted and working properly.

Flow control chutes alone cannot always control dust creation at discharge points as intended, especially during start-up condition. Effective belt cleaning systems and even self-contained wash boxes are often necessary to reduce the start-up dust problems. In severe dry conditions when dealing with dry coal, a wet dust suppression system or insertable dust collectors will be necessary. There are many types of water-based systems, some that use a chemical surfactant and some that use water alone, without the need for adding chemicals. The cost for chemicals can add up, resulting in an increased yearly operating budget.

An economical alternative to a chemical-based wet suppression system is dry fog agglomerative dust suppression. Dry fogging systems produce micron-sized water particles that attach easily to the airborne dust particles so that they become heavy enough to return to the product stream by gravity. Dry fogging systems use very little water, which does not wet the process coal, only the dust particles. Also, no expensive surfactants or foaming agents are needed.

**Conclusion**

It takes more than just a round tube to meet all of the US Occupations Safety and Health Administration’s National Emphasis Program dusting regulations. The complete conveying system needs to be evaluated and then a comprehensive design analysis provided to incorporate all of the necessary goals outlined by the customer along with the changes discussed to reduce the airborne dust, while continuing to maintain full load capacity.

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