Interview by Peter Edwards, Global Cement Magazine

vincent.grosskopf@coalmillsafety.com
www.coalmillsafety.com

In discussion: Vincent Grosskopf, Coal Mill Safety

Vincent Grosskopf has more than 45 years of experience in bulk material handling, particularly regarding the safety of coal grinding systems. As the founder of Coal Mill Safety, he acts as a consultant to those seeking to design and build safe greenfield coal grinding systems or improve existing installations. However, since such systems are often an 'afterthought' within the cement sector, there's a lot of work to be done...

***Global Cement (GC):* Please could you introduce your experience in the cement sector to date?**

Vincent Grosskopf (VG): I started working in the bulk handling arena in the early 1970s until 1992, when I joined Thorwesten. At that point Thorwesten Vent had begun to work with explosion vents, predominantly for its own coal silos. We were then approached by others, such as Polysius and FL Smidth, which wanted to licence vents for their own designs. Learning about the use of explosion vents in collaboration with such firms led to applications in coal grinding equipment, including bag filters.

On the surface this appears to be quite simple but the situations are quite different. The inside of a silo is big and wide, which means the explosion front propogates relatively slowly. By contrast, inside the narrow ducts of a coal grinding and de-dusting system, explosions move much more rapidly and with greater pressure. At Thorwesten Vent we found solutions around these differences and other issues, gaining unrivalled experience in explosion venting.

***GC:* What led you to establish Coal Mill Safety?**

VG: I established Coal Mill Safety (CMS) as a consultancy after I 'retired' in 2011. If a cement producer wants to install a new coal grinding system, they can commission CMS to look at the supplier's design and probe it from a safety angle. If it has an existing system, it can ask CMS how it can improve it.

Current situation

***GC:* How would you characterise the state of coal mill system safety in the cement sector in 2019?**

VG: At best, coal mill safety is not well understood and, at worst, it is ignored. When it comes to coal mill systems, most cement plant operators just presume that the supplier of the equipment knows all of the standards and rules and is 100% capable of making a system that conforms to these and is therefore safe. However, this is not the case.

***GC:* Why is this not the case?**

VG: The suppliers' designs have undergone relatively little development over time from a safety standpoint. They contain 'legacy solutions.' Even some of the best European suppliers lack the necessary expertise to really maximise coal mill safety in-house.

There is no reason why an old design should be re-used just because it is convenient for the supplier and *may be* the most cost-effective solution for the user. There is too much at stake and the hidden costs, for example in excessive use of steel and concrete and poor maintenance access, quickly eat into the perceived economic advantages. Suppliers also say that a tailored solution will take longer. This is a major reason that old designs are repeated over and over again.

Above: Vincent Grosskopf, founder of Coal Mill Safety (CMS).

Below: Despite the use of oil and gas in many regions and the rapid rise of alternative fuels, coal remains the major cement production fuel. It must be safely handled when ground and fed into the kiln and, even though it is a difficult topic to broach, the onus to have the conversation is on the cement producer.

On top of this, suppliers are generally large companies that are not particularly dynamic, the designs take a lot of time and money to update and, frankly, there are more interesting projects to work on. Coal mill systems and their safety have taken a back seat for decades.

Of course, where there is not a focus on explosion protection, the supplier can create systems that are really dangerous. There are numerous suppliers all over the world, but particularly in Asia, that do not understand the safety principles and, some might say, don't particularly want to.

So... the cement producer is stuck with what they *can* buy. Plus, they are in an even worse position than the supplier to know whether or not the system is safe or not.

***GC:* What are some of the common faults?**

CG: These include: Explosion pressure shock resistance and explosion isolation issues on the inlet side of mills; Incorrectly protected vertical roller mill reject discharges; Incorrectly designed mill-to-bag house riser duct configurations; Incorrectly protected main bag houses with their downstream equipment for conveying pulverised fuel; Incorrectly designed and protected pulverised fuel silos; Incorrectly designed/installed gas analyser configurations and; Incorrectly configured emergency inerting systems. The methods and means of protection of raw coal stockpiles against fire are rarely organised and the designs of filters for the de-dusting of raw coal conveyor belt transition points are almost always wrong, from both fire and explosion protection points of view.

***GC:* Why have users not demanded improvement?**

VG: Producers do not have the expertise and very often don't have the time to ask the right questions or put their finger on the design flaws. The fact that the designs are so old lulls users into thinking that they must be safe, creating the perception that there's no need to act.

When things go wrong...

***GC:* What are some of the common ways that people get injured?**

VG: Many people are killed and maimed as a result of a coal dust explosions but often you won't hear about it. Even if you do hear about it, you won't get any details, which makes analysis of wider trends really difficult. A very common incident is when people open the system in, for example, a baghouse, with the expectation of fighting a fire that's inside. Oxygen enters the relatively oxygen-poor environment inside the system, there is a backdraft and anyone in the way is killed, or at least very badly burned.

Right: A coal grinding system with a mill-to-bag house riser duct (marked with red line) that is very long. Through it, unmitigated flame front propagation could reach a velocity too high for the installed protection to effectively protect the bag house. This is a typical situation and it needs to be corrected.

***GC:* What data exists on the number of injuries and/or deaths caused by these systems?**

VG: There is pretty much no centralised data on this subject, which means we don't really know how bad things actually are. What we do know is that in many places around the world there are fatalities and maimings with alarming regularity. Some might reach the local news but there are many more that don't.

Even in developed markets, there are injuries and deaths as the result of explosions. They will be reported to local safety authorities but it's very hard to get a picture of the scale of the situation beyond that.

***GC:* It's not possible to say how much improving safety would reduce harm then, is it?**

VG: Even if there was a good set of data, I still think it would be hard to act on, especially in regions where safety is not a major concern. Perhaps a major association could collate the data, but there are many other jobs, monitoring environmental performance for example, that demand their attention. I am pessimistic that this situation will change soon.

***GC:* Do those with first-hand experience of coal explosions take them more seriously afterwards?**

VG: When things go wrong with coal grinding systems, consultants like CMS will get called. On day one after the explosion, the plant staff will be very concerned and ask, '*What happened?*, '*How do we stop it happening again?*' and so on... By day three, the plant manager's 'downtime clock' is ticking louder and louder and the onus returns to production. The

plant then carries on, with many of the same flaws in place and a possible repeat of the incident on the cards.

***GC:* Where is coal mill safety the best in the world?**

VG: This is not a question that can be answered geographically. There is no 'best' or 'worst' country at the moment, even when you look at litigious markets like Europe and the US. I'd even go so far as to say that there isn't one completely safe cement sector coal mill system, anywhere in the world.

Right: A cyclone of an indirect firing coal mill system that hardly could have been laid out worse. The cyclone has been installed inside a building, which disallows protection by means of explosion venting. Equipping it with explosion vents has been aborted, as evidenced by the blind covers that have been installed in place of explosion vents. The explosion pressure shock resistance will be very low, if present at all.

Flame front propagation would run into the cyclone completely unmitigated, since no explosion de-coupling upstream of the cyclone's dirty inlet is installed.

The configuration shown here is disastrous, since disintegration of the cyclone could cause a dust cloud inside the building, which, if ignited, could blow up the building itself.

There may be some marginal improvements coming in Germany, where some inspections are now finally taking place, after ATEX Directives were transposed into national law. In Egypt, the ATEX Directives will have to be complied with by all coal-using industries very soon. This will be a very interesting process to observe.

Looking for improvements

***GC:* Can a coal mill system actually ever be safe?**

VG: Absolutely! If you combine all of the knowledge available to properly design and engineer your system, operate it correctly and maintain it, there is no reason why the system cannot be completely safe. This is why it is such a shame that the reality is so far from the situation we *could* have. If an explosion were to happen in such a system, there would be no loss of life, no injury and no major system damage.

***GC:* What can be done to improve the situation?**

VG: It starts with the cement plant operator asking the right questions during the design phase. To do that they may need the help of a consultant like CMS. Whoever is asking the questions, they need to have the power to actually demand changes to the design. Otherwise there is no point.

Once, a major European cement multinational asked me to help negotiate the purchase of a coal system from a Chinese supplier. However, I was not given authority by the purchaser in that situation and the result of my efforts were negligable. The cement producer needs to understand that being the customer means they should be knowledgeable enough to not accidentally get the somewhat flawed 40 year old design the supplier wants to sell!

You also need to operate the system safely and know how it needs to be used. It needs to be maintained properly too. Otherwise the system will become unsafe within three or four years.

Even if the plant staff are really 'on the ball' there will still be a place for experts. I was once at a plant in the Philippines where an explosion had occurred during the night before I visited. The plant staff were poring over their computers and control systems to try and find out about the incident. They could, for example, work out where the temperature rose too far and where there was too much oxygen in the system, but, looking at the damage quickly proved that their efforts to understand the effects of the explosion and why their protection had failed went nowhere. 45 years' experience allows you to understand that part, without computers.

***GC:* Does it surprise you that after 45 years, an expert such as yourself is still needed at the plant?**

VG: No, I'm not surprised. Plant staff in the cement industry need to focus on producing cement. Fire and explosion protection for coal grinding is a highly specialised field. You cannot expect that plant staff recognise flaws in the system that has been put in front of them, normally with no or very little input from their end.

***GC:* Will there be a 'brain drain' in this area as consultants like yourself leave the field?**

VG: That's a risk, yes. I just have to pass on as much information as I can in the remaining time that I can have in the sector.

***GC:* Are attitudes gradually changing?**

VG: Overall, no. Nothing is really changing at this point. Some producers are making sporadic efforts to understand this area and improve, but such large companies move so slowly. Many suppliers are listening to Thorwesten Vent, which is good. However, Thorwesten Vent can only influence certain aspects of fire and explosion protection of coal grinding systems, not everything.

***GC:* Could the standards be improved?**

VG: The standards and codes are very complicated

and difficult to follow. They are always referred to but not understood. In some cases the standards leave a lot of room for interpretation. So, you see, you cannot even blame the engineers for misinterpreting the situation - they are doing their best!

The information from ATEX or the EN codes tell you all kinds of interesting information but they are not, and cannot, be exhaustive in terms of engineering solutions. You won't find answers to all the workarounds you need, most probably because it hasn't been needed before. There may be warnings at best.

I've already mentioned flame front propagation through a duct. That is something that the standards speak of, but they don't say how to deal with it.

***GC:* Is that because those writing the standards also don't know?**

VG: It's not that this is unknowable, but there are no standards with a focus on indirect firing coal grinding systems, which typically have some special conditions. NFPA 85, in spite of its pro-forma applicability to the indirect firing coal grinding systems of the cement industry, in reality only covers direct firing for the power generation industry, almost completely neglecting the elements that would form the basis of correct fire and explosion protection of indirect firing grinding systems.

***GC:* Would you advocate that a cement group standardise its coal mill safety solutions?**

VG: Yes. It would be good to issue a 'group guideline' covering both design specifications/requirements and best practices. Compliance needs to be part of each plant's quality management, with strong monitoring by the group's management. However, such an approach has become more difficult in the past decade or so, with the closures and downsizings of some groups' technical centres. Lafarge, Holcim, HeidelbergCement and others used to have several of their own technical centres that would have some degree of in-house know-how and responsibilities, which certainly improved situations in the group. They would look at selected new and existing situations, but were not able to support, let alone control the safety of all the systems of their large groups.

Now the big groups have closed or downsized several of their technical centres and delegated responsibilities to their plants' management, where the necessary know-how will definitely be insufficient.

***GC:* What kinds of producers are most proactive in coal mill safety?**

VG: The multinationals are starting to move in the right direction on paper, but it's really slow. They don't help themselves with constant personnel changes. I have been in a situation where I've been training say 8-10 individuals across a group. Everything goes well and then, six months later, I try to reconnect with them to see their progress. The problem is, they're almost certainly in a different role by then! They've most likely forgotten everything they ever knew about coal mill safety and probably didn't transfer knowledge to the next person in their old role.

***GC:* What is the one easiest thing to do to improve an existing system with poor safety?**

VG: Sometimes the best solution is to rip it out and start again. That way you have a clean slate and can avoid so many of the common mistakes. When that's not possible, there is no 'easy win.' It's all hard work! All situations are different in any case.

***GC:* It seems that your final answer sums up the whole issue...**

VG: Indeed. Improving coal mill safety in the cement sector is a continuous and varied challenge. I hope that by highlighting some of the most common problems and failings in these pages - in terms of systems, attitudes and regulations - I can make others aware of how they can influence this area for the better. This will help the suppliers, cement producers and, most importantly, the men and women that risk their lives working with these unsafe systems.

***GC:* Vincent Grosskopf - Thank you for your insights today.**

VG: I'm glad to be of assistance!

Left: An awkwardly designed and installed explosion vent on a pulverised coal silo. The silo has been installed in a building, which disallows explosion venting without special measures that control the blast's exit from the building. These are not present. The explosion vent is of a design that will not reclose, due to design faults that will cause its hinged lid to deform and not to fall back after the explosion, leaving it open to ingress of O_2 and uncontrolled losses of inerting medium that will make firefighting impossible.

Explosion pressure shock resistance of the silo and the explosion vent are lacking. The explosion effects will affect the silo's in-feed drop chutes.

When venting, the blast will hit the concrete ceiling, which is far too close to prevent the flame body's dangerous deflection, spread and expansion into the building.