AFs drive improved fire and explosion protection

The introduction of alternative fuels (AFs) in a cement plant can often provide a good opportunity to improve fire and explosion protection systems. The availability of specialised knowledge is key to the successful completion of these projects.

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Users of coal grinding systems are often unaware that they operate equipment that is not correctly protected against fire and dust explosions (see Figure 1). During its fire and explosion protection evaluations in coal mills worldwide, Coal Mill Safety Pte Ltd has found the issue to be widespread, applying to larger and smaller cement producers, including those covered by ISO 9001 or similar QM certification. The issue spans the entire spectrum, from minor to major faults in protection, including non-existent protection. It is often the result of a lack of specialist knowledge by system suppliers, operators, certifiers and insurers, which then leads to a lack of hazard awareness. However, the number of fire or explosion-related incidents and the damage they inflict remains under the limit that would lead cement producers and their insurers to take corrective action. Therefore, this situation continues to exist.

Figure 1: example of incorrect explosion protection design: non-self-reclosing explosion vents, filter cages and bags in the way of venting blasts

Root causes

This lack of necessary specialist knowledge by both buyers and suppliers leaves the shortcomings of a protection system's design unrecognised.

In addition, requiring a supplier to adhere to standards and codes in practice leads nowhere. The existing standards do not cover all that is required to build correctly-protected coal systems. A comprehensive standard that fully covers the indirect-firing coal grinding systems of the cement industry does not exist.

Furthermore, those actually responsible for safe operation of a coal grinding system are often not involved in the purchase of the system. They also lack the specialist knowledge that would enable them to recognise the shortcomings of the design. This is exacerbated by not having serious fire or explosion incidents for a longer period as this will be erroneously understood as proof of a safe coal mill system. Therefore, the lack of specialist knowledge by system suppliers leads to a lack of motivation to get things right with new coal systems. A new coal grinding system usually is a convenient repeat of something that has been realised in the past, using drawings that were made 30 or so years ago.

Another issue is that in many cases the compulsory regular maintenance of safety-relevant equipment is not carried out.

Driving change through AF implementation

The introduction of alternative fuels (AFs) will often result in a reduction of the throughput of coal grinding systems. This lower grinding capacity may lead to necessary design changes in the grinding system, including the elimination of ineffective technology. Therefore, the AF project provides a good starting point to improve the fire and explosion protection of an existing coal grinding system.

Moreover, when the improvement of the protection system is included in the overall capital expenditure of a project, the top management may have less reason not to support it. This way, it is in place for the future. As a result, the cement company can combine working with an expert to improve the fire and explosion protection of the existing coal grinding system(s) with designing the fire and explosion protection of new AF handling and storage set-up.

In any case, the project starts with an evaluation of the coal system's current fire and explosion protection situation, and with checking the proposals for the supply of new systems in terms of effective fire and explosion protection.

Explosion and fire protection of a fuel handling and processing system is to be defined as preventive fire and explosion protection with additional constructional fire and explosion protection.

Constructional fire and explosion protections are 'the last-ditch defences' that have to prevent damage if the preventive fire and explosion protections fail.

Parameters to consider

The requirements for safe handling and processing vary with the kinds of AFs that are used, but there are some common factors that will need to be considered.

Figure 2: example of incorrect alternative fuel silo design: non-self-reclosing, inaccessible explosion vents, various explosion pressure shock resistance issues

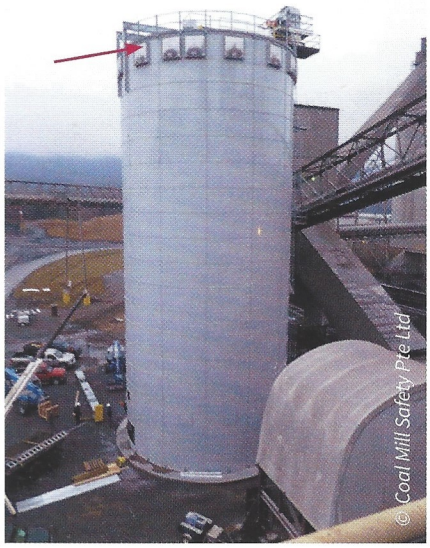

Figure 3: example of a correctly-protected dried sewage sludge silo with explosion pressure shock resistance and accessible self-reclosing explosion vents

Maximum O_2 content

For preventive explosion protection of coal grinding systems it is necessary to know the percentage of O_2 in the process air at which explosive dust combustion starts to become possible. For most types of coal this is roughly 13 per cent, so the system has to aim at a maximum O_2 content of 12 per cent.

Most coal mills can be operated with roughly three per cent O_2 in the mill's process air intake, with most of the process air originating from the precalciner, where it has participated in the pyroprocess and lost O_2.

CO content

For preventive protection it is also necessary to know the normal CO level (ppm) of the process air at various points in the system, and to have monitoring and corrective steps available in cases in which this increases to an excessive level. Usually emergency inerting, by means of inundation of the relevant system section with gaseous CO_2 or N_2, is in place.

However, emergency inerting is one of the most poorly-understood protections, with numerous incorrect implementations and executions of the technology.

Temperature

It is also necessary to monitor the temperature of the process air and the fuel stored in a silo at various points.

This ensures that corrective measurements can be triggered when the temperatures start to become too high.

Other factors

Other parts of preventive fire and explosion protection are, for example, the avoidance of tramp metal passage through the mill and housekeeping (avoiding the possibility of spilled fuel dust to be whirled up).

Furthermore, the explosion characteristics of a fuel are relevant for the definition of a grinding system's explosion pressure shock resistance and, where explosion venting is used, for the definition of the installed explosion venting capacity. These characteristics need to be known in order to be used as inputs for the definition of certain design aspects of constructional explosion protection.

AF fuel storage and handling

For AFs that are not co-processed with coal, the fire and explosion hazards of processing (if any) and storage also have to be understood.

In terms of storage, AF silos are not correctly protected in many cases. Often there are no reasons why an AF silo's protection should be different from a pulverised coal silo as normal silo design without explosion protection will be used. In these cases, fire and explosion protection will often be limited to installing some rupture panels or non-self-reclosing explosion vents (see Figure 2).

However, the use of rupture panels will make fire fighting impossible or ineffective. After having opened they will enable ingress of air (O_2) and loss of gaseous emergency inerting mediums.

As has been proven throughout the world, purchasing fuel handling systems and equipment cannot be expected to end in correct results without the necessary special know-how that so often has proven not to be available both on the supplier's and buyer's side.

Installing AF systems will not include new grinding technology. If an AF needs grinding, it possibly can be co-processed with coal, meaning that it can follow the same path as the coal through the coal grinding system. In that case, the explosion characteristics of the AF-coal mix may be different from the characteristics of the coal, petcoke or lignite that has been used before the AF was introduced and possibly be more hazardous.

But often the fuel's explosion characteristics are not known to the operators. This is not necessarily a problem. Many fuels can be categorised in classes for which credible characteristics have been defined.

Purchasing systems for AF handling without expert input may again result in incorrectly protected systems. Without the special knowledge to ask the right questions, and to specify correct demands, there is no reason to expect that the next new installation will be correctly protected.

Conclusion

The installation of technology for increased use of AFs needs planning and engineering. Combining this with the correction of the ubiquitous wrongs in the protection of coal grinding systems in many cases will make sense. Only when all handling and processing of fuels is correctly protected against fires and explosion risks, is a plant ready for the future. ■