Invited talk at a virtual seminar for the personnel of a large cement production group, November 2023

What can you expect me to say today?

Let me first define the situation you are in, which is the reason for you to take part in this virtual meeting.

Without having seen your coal grinding operation I know that you are here since there are safety issues in terms of **poor explosion and fire protection**. You may have some doubts already without me having said anything.

Serious fire and explosion protection issues are present in all coal grinding systems everywhere on the globe. That includes your system(s). No part of the world is excepted! Practically there exist not a single installation and no operation with correct fire and explosion protection 100 % throughout.

This we can say having inspected coal grinding systems all over the world for the evaluation of their fire and explosion safety. Whether these systems are operated by this group or another group doesn't play a role.

The aim of our virtual meeting today has to be and can only be increasing your awareness.

Most of you will be working with a coal grinding system that has been realised without your involvement or your participation in the relevant decision making. And most of you will, at best, have had the chance to become familiar with requirements of safe operation of your particular system, but not with the details of the installed technology supposed to keep your operation well protected against fire and explosion hazards.

This means that when you see an explosion vent in your system you understand that the system's realisation has somehow taken in account the hazards. But, unfortunately, having an explosion vent here and there in your plant doesn't mean that your plant's installed technology is correctly chosen and positioned. You cannot presume that! Mostly, it is not! And you cannot judge that.

Necessarily, this means that increasing your awareness will lead to some understanding of what is wrong, with the installed technology. After this virtual meeting you will not be an expert, of course.

Your group obviously wants you to contribute to safe operation of your coal grinding operations. What this means for you is that:

- You can improve the way in which your existing system is operated, possibly.
- You can, as soon as it is fully clear what is wrong with the installed technology, help with energetic tackling of problems, for which your awareness and motivation are important. But all you can do is small things, until a professional evaluation of your system has been done and a serious plan has been made. Since the corrections of the problems mostly are of a magnitude that needs substantial money, you will not be able to do things without the full support of your management.
  Members of the relevant management hopefully are present, in today's meeting.
- You can take care and ensure that the necessary maintenance (as specified by the OEMs) is taken care of.
- You can make sure that filters are not operated with leaking bags. Think of coal dust deposits in their penthouse.
- You can make sure that spillages (coal dust deposits) are taken care of without delay and that other waste laying around is removed.

- You can ensure that no unauthorised modifications are taking place, e. g., ‘stopping’ false air leakage applying kit instead of replacing the gaskets or seals by genuine OEM spare parts.

The meeting of today cannot lead to more than increased awareness. For the correction of the incorrect installed technology it is necessary to have the fire and explosion protection of each coal grinding operation evaluated. On the basis of the evaluation report the next steps can be decided upon.
The evaluation can only be done by a specialist.

And there is another aspect:

The correction of bigger technological incorrectness has to be coached by an expert. We have seen large portions of money and labour spent without good results. No corner cutting can be allowed. Misunderstandings have to be avoided. The potential for misunderstandings and ideas to cut corners to come up is tremendous.
Nothing should be done without thorough preparation and full understanding of the why.

preventive fire and explosion protection and constructional fire and explosion protection

In order to oversee the needs of fire and explosion protection it is helpful to order the various aspects in the following structure:

1) preventive fire and explosion protection

Preventive protection can be realised by:

- yard management that ensures that no coal undergoing intensified oxidation reaches the raw coal silo(s)

- reliable separation of metals, Fe and non-Fe, out of the raw coal flow to the silo(s) and remote (control room) fire alarm in all dust collectors ‘on the way’
- limiting O_2 in the process air to maximal 12 % process wise - process control that ensures that no set HIGH/HIGH limits for temperature, CO and O_2 are exceeded – Think of false air.
- emergency measures and procedures (like gaseous CO_2 or N_2 inundation = emergency inerting), with their use known by the operators and trained
- keeping the instrumentation in perfect condition

A good example of a topic about which confusion exists is emergency inerting. The solutions sold by the relevant suppliers are sold under all kind of names, often under the name fire protection system or similar. Many solutions offered are outright wrong.

2) constructional fire and explosion protection

Constructional protection is the ‘last ditch’ defence on which your safety depends when the preventive protection fails. It doesn’t prevent fires and explosions. It reduces harm to an acceptable, pre-defined degree.

Constructional protection for the air-swept indirect firing coal grinding systems of the cement industry usually is realised by:

- explosion pressure shock resistance (EPSR) withstanding unmitigated (e. g. up to 9 bar g) explosion pressure (i.e. Pfister calibration hopper and DRW rotor feeder)
- explosion venting (pressure mitigation) by means of self-reclosing explosion vents with the necessary degree of EPSR of the protected equipment in place
- explosion de-coupling with the necessary degree of EPSR in place
- explosion isolation with the necessary degree of EPSR in place

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Explosion venting releases the pressure in a vessel in which explosive combustion causes heath and with that increases the pressure at a high rate per unit of time. Explosion venting never reduces the explosion pressure to zero.

For indirect firing coal grinding systems (and for many other systems) it is important that self-reclosing explosion vents are used. If, after the explosion venting has taken place, the explosion venting orifices remain open, a subsequent fire is supported by the O_2 of the ambient air and the use of CO_2 or N_2 will be ineffective, since the gas will dissipate into the atmosphere.

Since, unfortunately, all explosion venting standards and codes were developed without looking into fire protection, you will find no indication of the need to use self-reclosing explosion vents in the standards.

Explosion de-coupling ensures that explosion effects as the result of a deflagration in one component of a system only reach connected components with sufficiently mitigated violence.

Explosion isolation ensures that explosion effects in one component of a system are not felt in other components.

In case of VRM systems the interconnected vessels normally are: VRM – DC – PF silo(s) and possibly (a) burner feeder system(s) or (a) pump(s).

In case of HBM systems the interconnected vessels normally are: HBM – separator – DC – PF silo(s) and possibly (a) burner feeder system(s) or (a) pump(s).

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According to the rules for constructional explosion protection, interconnected vessels have to be explosion isolated or explosion de-coupled, depending on location, shape and possible exposure to violence.

compromised explosion pressure shock resistance

There are 2 causes for compromised explosion pressure shock resistance:

- incorrect design (incorrectly chosen equipment)
- modifications after unqualified decision making – This includes leaving bolts away or unfastened, e. g., the bolts for the fixation of an inspection cover.

An example:

When you see a ‘fat’ (thick) flange on robust equipment connected with a flange of ‘kitchen ventilator grade’ (thin) you must become suspicious. Very suspicious!
Such situations will often be found!

alternative solid fuels

Many alternative solid fuels come with a dust content that will form an explosive atmosphere. Some alternative fuels can develop intensified oxidation (heating up) during silo storage. Here we have to look into silo storage and understand that the same protection as for silos flor coal, lignite and petcoke has to be in place.

A problem often is that silos supplied for the storage of alternative fuels come from companies with an agricultural background. The designs then are incorrect in aspects like explosion pressure shock resistance and explosion venting, e. g. non-self-reclosing explosion

vents are installed, which makes effective firefighting impossible. Such silos simply are the wrong equipment and their correction can be difficult or impossible.

zoning

Often, when an initiative to improve the fire and explosion protection of an operation is taken, people start with zoning. Zoning for dust explosion risk classification according to USAmerican and very similar European rules in our case is defining if sections of a system are Zone 20, Zone 21 or Zone 22.

What then often can be seen in the coal mill area of a cement plant is that warning texts are fixed to walls or railings in the relevant areas.

This information sometimes comes with additional information, like indication of the relevant zone.

The zones classify the share of operation time during which an explosive atmosphere exists in them. In Zone 20 the explosive atmosphere exists more or less continuously. In Zones 21 and 22 the explosive atmosphere is less often present.

Zoning is only good for the selection of safety-relevant equipment. Nothing speaks against indicating the relevant zoning in a plant. But don't expect improved safety from such indications.
To install signs saying something about being careful in the vicinity of a coal mill doesn't help. People have to do their job. The environment in which they do that has to be safe. Exactly that is the responsibility of the plant's management.

What makes sense is that the operation and the installed technology is correct.

If anything at all, such signs will remind people working in the vicinity are reminded that a coal mill system is something that needs to be operated and maintained well.

It is the supplier of the equipment who has to select qualifying equipment to be operated in the zones.

What people operating a coal grinding plant should know and do, apart from what has been said already about safe operation, is:

- Do maintenance on the equipment as per the OEMs' instructions.

- Never, never ever, compromise the explosion pressure shock resistance of equipment, e. g. by leaving bolts unfixed and unfastened.
- Never, never ever, open an inspection cover when the system has an increased temperature or CO level inside. Allowing O_2 to enter into the system may cause you to be blown away with fatal burnings.

standards and codes

A number of relevant USAmerican standards and codes exist. Here and now NFPA 85, NFPA 68 and NFPA 69 can be mentioned.

NFPA 85 is a code that deals with the safety of coal grinding. Although it pretends to also cover indirect firing systems, the document almost solely deals with the direct firing grinding systems for power generation.
NFPA 85 isn’t helpful at all.

NFPA 68 deals with explosion venting.

NFPA 69 is a standard on explosion prevention. Emergency inerting is dealt with by NFPA 69, but other NFPA documents are to be complied with in addition to this.

The available EN (European Norm) standards comprise standards on all relevant topics and they cover the various matters more completely than NFPA.
ATEX conformity relates to complying with these standards.