What is spray drying?

Spray drying is a process which transforms a liquid to a powder. The liquid is pumped, and a liquid mist is created through nozzles or atomizers. The mist is then dried by hot gas (mainly air in the Food and Beverage industry).

A spray dryer is a very large and expensive piece of equipment that typically operates 24/7. It is an assembly of a drying chamber, fluidized bed, and separation devices such as cyclonic equipment or bag house dust collectors.

Why are Allianz Risk Consulting and their clients focusing on spray dryers?

Spray dryers present explosion and fire hazards due to the processing of combustible dust. Loss of this type of equipment could result in a long period of business interruption and the replacement cost of the equipment is high.

The use of spray dryers has increased significantly over the last ten years in the food industry, especially in the dairy sector.
CIRCUMSTANCES

On a Saturday, around 9pm the amperage increases for a pump motor used to rotate the atomizer that transforms the liquid into water mist. As the amperage is surveyed and reported in the control room, the operator received the information. The control room operator observes that the amperage increases from 129 A to 139 A in a short period of time.

Some moments after this observation, a fire and an explosion are reported by the alarms and the deluge sprinkler system is manually activated by the operator. The fire brigade is called and arrives on site 20 minutes later. Since the call to the fire brigade, the fire has spread into the building and has generated significant smoke. The fire has also spread to the cyclonic equipment.

During the following six hours, the fire brigade fought a relatively small fire but with many difficulties due to:

• The height of the building (more than 30 meters with several catwalks, mezzanines and intermediate floors)
• The electrical shutdown
• The night time

EXTENT OF THE DAMAGES:

• The building is damaged, including the foundation, intermediate catwalks/mezzanines, metal structure and roof.

• After the cleaning and replacement of some equipment, such as electrical cabinets and ducts, replacement of the roof and wall siding begins. The process is restarted but quality controls are not adequate. The client and AGCS chose to replace most of the spray dryer equipment, including the atomizer, the heating devices, the drying chamber, the fire protection system and two cyclonic separators. The work on site takes more than eight months and the spray dryer starts to produce 12 months after the event.

CAUSE OF THE LOSS

After the loss investigation, it was confirmed that the atomizer was not secured well, which caused metal friction and then sparks. An explosion occurred and generated flames that started a fire involving the combustible powder located in the bottom of the drying chamber.

It was confirmed that the explosion also created a fire inside the premises as the vents were not ducted outside.

The conditions needed to create an explosion are:

• Combustible load – explosive dust, in this case the milk powder
• Containment – confined area, in this case the drying chamber
• Dust suspended in air
• Oxidant – Oxygen
• Ignition source
• The ignition source was the only condition that was missing within the drying chamber to generate an explosion.
WHAT HAS WORSENED
THE LOSS?

• The fire brigade had an adequate water supply for
  fight the fire but had difficulties to fight the fire.
• The first emergency team has responded the fire
  and explosion events with effectiveness as the
  monitoring of the amperage of the pump and other
  equipment has correctly informed the operator that
  something wrong was happening. On the other hand,
  the process has not been stopped.

WHAT HAS LIMITED THE LOSS?

Property Damage:
• The deluge sprinkler system installed reduced the
  damage and prevented collapse of the equipment.
• The presence of vents, even if not ducted outside has
  avoided the blast of the equipment, which could have
  created even more damage.

Business Interruption
• The management of the plant has been very proactive.
• The client has a very strong network of plants in the
  country and has immediately planned the transfer of
  the raw materials to back-up plants.
• At the same time the client has immediately reactivated
  an old spray dryer to produce a similar powder even if
  at reduced capacity.
• For these reasons, the Business Interruption has been
  limited to approximately a one year period even if
  some additional costs have been incurred to restart
  some equipment.

COMMENTS AND LEARNINGS

• Keep in mind that explosion are often followed by fire
  in spray dryer processes. Explosion is not the only
  hazard to take into account when you plan to protect
  your assets. Some loss prevention rules and protection
  systems may limit the severity of a fire or an explosion
  at a spray dryer location.

Process
• Duct adequately designed vents outside of the
  building. If not possible, install flameless explosion
  venting or chemical suppression.

• Whatever information is used to monitor the safety of
  the process, keep in mind that three levels of alarms
  are needed:
  – First level: The operator must immediately check
    the effected equipment (i.e. presence of smoldering
    powder, vibration of the atomizer or the bearing of
    the fans, etc.). The operator should have enough
    time to perform inspections and proceed with a
    normal shutdown when necessary.
  – Second level: The operator must immediately stop
    the process according to the normal shutdown
    procedure (e.g. water on the feed). After shut down,
    the effected equipment must be inspected.
  – Third level: The process must be automatically shut
    down by the emergency procedure, and if the
    deluge sprinkler system has not already operated
    automatically, the system should be activated
    manually by the operator.
• Install a fire protection system that can be
  automatically and manually activated with an
  adequate and reliable water supply.

A good way to avoid the spreading of the fire or the
explosion from one piece of equipment to another is to
install a rotary feed valve which acts as a stop point,
preventing an explosion or a fire from propagating
backwards into the spray drier or vice-versa.

Emergency and organization
• Write an emergency response plan and update on an
  annual basis with an adequate organization and
  establishment of the leadership.
• A fire drill should be conducted annually to identify
  difficulties on site.
• Ensure the effectiveness of the emergency team
  through a well-organized and well-documented
  training program. Keep in mind that it is too late to
  develop skills at the time of an emergency.

QUESTIONS OR COMMENTS?

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