Leaders in the science of making good adhesives better™

Harper/Love Adhesives Corporation
11101 Westlake Drive
P.O. Box 410408
Charlotte, NC 28241-0408
800-438-3066 • www.harperlove.com
e-mail: salestech@harperlove.com

In this issue:

- ***Starch silo maintenance and safety***
- ***Handling chemicals safely in the plant***

FEBRUARY 2013

ADVANCED ADHESIVES REPORT

Your corrugating newsletter from Harper/Love Adhesives Corporation

Starch silo maintenance and safety precautions

Keep it working. Keep it safe.

By John Kohl

One of the most frequently overlooked or ignored systems in a box plant is the cornstarch silo. In the last ten years most plants have gone away from the use of bagged starch to make corrugating adhesive because of the labor involved to lift and break bags of starch. This procedure has been eliminated with the advent of automatic starch mixers and bulk starch silos. As with any complex conveying system, there is the need for preventive maintenance and periodic service to keep the silo working efficiently and to ensure that the starch delivery to the mixer is uninterrupted. With a fully automated starch adhesive mixer, any mechanical failure with the silo can shut down the corrugator and possibly the box plant in a very short time.

Is your starch silo an explosion waiting to happen?

The silo is a large closed cylinder with a lot of starch and starch dust inside it. There is often some starch buildup in the skirt (base with the cone). Cornstarch dust is considered one of the fastest burning agricultural materials known. The US Bureau of Mines has given cornstarch an explosive index of 10, the highest rating there is. Dust explosions occur when fine particles suspended in the air ignite and burn rapidly, causing a violent increase in pressure inside the silo or other confined space.

A dust explosion needs four components to occur: fuel, oxygen, confinement and an ignition source.

The silo skirt needs to be kept clean. Lubrication of bearings inside the skirt, to prevent failure and a spark from friction, should be part of your regular preventive maintenance schedule.

A cornstarch explosion inside a silo has a pressure rise of 9000 psi per second. The force of a starch dust explosion will blow the top off of most silos if there isn't some form of pressure relief in the system. Most silos have a pressure relief cover that opens at a set psi to prevent over pressuring the tank during filling. This cover is enough of a deflagration vent for older silos, but some local building codes require the top to have a weak seam to allow it to separate from the tank in the event of an explosion. This type of cover also requires cables or chains attaching the cover to the sides of the silo to keep the cover from flying off during an explosion and injuring people on the ground. It takes only 1/8" of dust on the floor or two grams per cubic foot concentration in the air, to reach the level of an explosive hazard. Inside the silo skirt where the blower package and rotary air lock motor are housed, usually has dust buildup that can be ignited by a spark or static discharge. The silo skirt needs to be kept clean. Lubrication of bearings inside the skirt, to prevent failure and a spark from friction, should be part of your regular preventive maintenance (PM) schedule.

Ground system components to avoid static electricity

Static electricity is a concern for the inside of the silo where the starch is stored. The silo tank should be grounded and all of the delivery pipes need to have a bonded ground over each fitting to ensure a proper ground continuity to prevent static buildup during starch conveying. Bulk delivery trucks also need to be grounded to the silo with a good clamp and cable that ensures good conductivity. Often when visiting box plants, I find frayed ground cables and worn clamps. Sometimes this equipment is missing altogether. The electrical potential difference between the silo and the truck can create enough static discharge to cause an explosion and often goes overlooked even by experienced drivers. Additionally, electrical cabinets within the silo need to meet code for an explosive dust environment and the wiring needs to be rated explosion proof to prevent sparks or overheating.

next page, please

The bag house: out of sight, out of mind

The bag house on top of the silo is often forgotten about in routine PM programs since it is out of sight and not easily accessible. The bag house is exposed to rain, snow, wind and sun, which cause deterioration of all of its components, including ground wires. The bag cages, bag clamps and the bag house grounding wires need to be inspected and maintained on a regular basis to ensure the continuity of the grounding is in good working order so it can prevent static discharge. Lightning strikes are a concern since the silo is usually one of the highest structures near the plant. Proper grounding will prevent a catastrophic failure and possible explosion.

Any ignition source near a silo is a potential explosion hazard. Welding in or near a silo as well as the use of an electrical extension cord, can cause a spark or static discharge and should be avoided if possible.

Silo PM checklist

The silo needs to be maintained properly with a biweekly PM that covers the following items:

- Housekeeping: emphasis on minimizing dust and starch accumulations
- Regularly scheduled bearing maintenance including the rotary air lock at the base of the cone
- Blower lubrication
- Belt inspection and replacement
- Inspecting electrical connections
- Checking the seal and tightness of hose clamps and couplings
- Checking the PRV (pressure relief valve) or silo cap
- Ensuring silo structural integrity including finding any roof leaks
- Filter system and bag house inspection

Silo maintenance and safety

- Control ignition sources.
- Use appropriate electrical equipment and wiring.
- Control static electricity and open flames (extension cord use and welding on or near silo).
- Keep equipment maintained to prevent mechanical or electrical failure.
- Have an insurance company conduct a hazard analysis to determine if your plant is safe from a catastrophic silo mishap.
- You can use the NFPA (National Fire Protection Assoc.) guides 61, 68, 70, 77, and 654. OSHA also has electrical standards for hazardous areas in 29CFR 1910, Subpart S and 1910.307.

Verify silo contents before opening access hatch

Suffocation by entrapment is a danger to personnel servicing your starch silo. Starch will flow like water if a hatch is opened and the starch can knock down and cover a person in seconds. Don't open man ways or access hatches until the silo is verified empty. Don't trust inventory records; measure it.

Dust hazards in the plant

Dust control also applies to other areas of the plant. Minimize dust escaping the starch transfer system, clean air filters regularly and don't neglect housekeeping. Don't forget settled paper dust on top of overhead beams. Once it accumulates to about 0.25" deep, it becomes a fire hazard. If it is in an enclosed section of the building, it is an explosion hazard. This also applies to the paper dust buildup inside the box plant over time. Periodically clean structural cross beams to eliminate dust buildup.

Provisions for downtime of the silo should be considered. A manual starch mixing formula should be in place and personnel properly trained on how to make the adhesive manually are necessary. A few pallets of bag starch for backup in the advent of a silo failure should be on hand for the manual batches. A pallet of OBM™ (One Bag Mix) can be used as a stopgap for silo and starch mixer failures, to keep the corrugator up and running.

Handling chemicals safely in the box plant.

By Rex Woodville-Price

There are several chemical products used in the typical box plant that require careful handling. Using common sense and wearing the appropriate personal protection equipment (PPE) are the two best things you can do when dealing with these products. It is also a good idea to read the MSDS. Yes, they are dry and technical but there is valuable information in them. The information is conveniently organized into sections that deal with subjects such as how dangerous the product is (i.e., is it toxic or corrosive), and how to handle spills, disposal or even, fire.

The right equipment and procedures will protect your production team from the potential hazards of chemicals you need for production

Caustic Soda

Caustic soda is arguably the most dangerous chemical in the box plant. Although it is not toxic (theoretically you could drink a very diluted solution) it is highly corrosive. It can cause severe burns on contact and will easily blind you if it gets in your eyes.

The chemical name for caustic soda is sodium hydroxide. It has a very high pH, which is why it is useful in starch-based adhesives. We use its chemical energy to lower the gel temperature of the adhesive. It will neutralize acids and is often used in the water treatment system to adjust pH.

Liquid caustic soda (solution) must be stored in a container that has a containment wall around it that will act as a secondary tank in case the primary vessel were to leak or rupture, ensuring that none gets out.

Dry caustic soda comes in several presentations such as beads, pellets or the more commonplace flakes. Liquid caustic is merely sodium hydroxide (a salt) that has been dissolved in water. In the USA it is typically used at a concentration of 50 percent whereas in Europe the tendency is to use concentrations of 30 percent to 35 percent. A 50 percent caustic solution will crystallize at 54° F (12° C) so steps must be taken to keep it warm during cold weather. This usually entails some sort of heating element or heat exchanger. A caustic storage tank should not be installed near an open window or door.

Liquid caustic easier, safer to handle

In the US and Europe, the use of liquid caustic has become the norm because automatic starch mixing equipment can meter liquid caustic more readily than dry caustic. Machines that automatically convey dry caustic, use pellet and bead caustic soda presentations, since they flow more readily than flakes, which tend to clump. Also, flake caustic tends to release airborne particles, which will cause burns upon contact, particularly on sweaty skin. Having the machine automatically weigh and pump liquid caustic solution is the safest way to handle caustic addition, since it precludes human contact.

In Latin America it is still common practice to use flake caustic and dilute it with water before adding it to the mixer. This is a potentially dangerous task and should be handled by someone with experience and using all the necessary PPE. One good rule to follow is to always add powder to liquid and not the other way around to avoid dangerous splashing.

Some municipalities in the USA restrict the use of caustic soda in manufacturing facilities. For these facilities we have developed alternatives such as OBM™ and SafetyMix™ which make corrugating adhesive without using caustic soda.

Borax

Borax, or sodium metaborate is another commonly used chemical used in the preparation of corrugating adhesive. It is commonly used in granular forms and is found in three variations: decahydrate (10 mol), pentahydrate (5 mol) and boric acid. Chemically, the three are very similar and vary only in concentration and speed of reaction. Even though human contact with granular borax in the box plant is limited to breaking bags and refilling the hopper in the starch kitchen, it is still important to follow PPE protocol. The dust that emanates from this operation is a breathing hazard, so an approved mask should be used.

Other chemicals

Although these products are not dangerous, they are used in small quantities and therefore dosage accuracy is very important to achieve satisfactory results. Use the recommended amounts and be sure to not confuse the products because the prescribed amount for each is different.

- Defoamer: Too much defoamer will lower tack and affect adhesive transfer.
- Biocide is offered in preweighed soluble bags to facilitate adding the correct amount.
- Liquid biocide is corrosive and should be handled with care.
- Calcium Inhibitors: Excess Calciban™ will increase viscosity.
- Penetrant: Too much penetrant will cause wet, soft board. One exception is when trying to retain moisture in the board without increasing adhesive application rate in a very dry or cold climate.

Coatings

Although these products are generally not dangerous in and of themselves, it is the way we use them on the corrugator that can present the greatest hazard. I often see large spills on the floor in the application area where the operators have to walk to access the machine. Coatings can be very slippery. This is a safety hazard; take care when connecting the coating source (such as a drum or tote); correct any leaks and clean up all spills promptly.