A Quarterly Loss Prevention Digest

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IN-SIGHT

Lead Article:

Loss Prevention in Sugar Industries

bharti AXA

redefining / general insurance

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CEO & MD

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Message from CEO and MD

The financial year that has gone by has been an encouraging one both for the insured and the insurers. There were lower number of claims and losses that were reported during the year and this was mainly possible due to the fact that there were no major natural calamities or flooding incidents during this period. As far as natural calamities are concerned there were no major incidents in this part of the globe if Asia and Australia were to be considered. However, the scenario is quite different when we consider the remaining part of the globe. Swiss Re reports say that natural catastrophes and man-made disasters in 2012 resulted in insured losses of USD 77 bn and economic losses of USD 186 bn with approximately 14000 lives being lost. This makes 2012 the third-highest year in losses on record. Hurricane Sandy was the most expensive event for the year both in terms of economic and insured losses and the second most damaging hurricane after Katrina in 2005. Nat Cat events are now becoming more frequent and severe. Trends indicate that a USD 20 bn insured loss event previously expected once in 250 years would now have to be expected once in 140 years. Hence there arises a need for industry and community to enter into partnership to close the protection gap and also to better manage post-disaster relief operations.

While we look forward to the emergence of this partnership, we at Bharti AXA General Insurance Company Limited are committed to deliver products which meet the requirements of the people and are affordable at the same time.

Subrahmanyam B.

Sr. VP & Head, Health and Commercial Lines

Bharti AXA General Insurance Company Limited

From the Editor's Desk

Sugar industry is one of the largest sectors of the Indian economy with India being the largest producer and consumer of sugar in the world. There are over 642 sugar factories in the country producing around 250 lakh tons of sugar. Maharashtra (36 %), Uttar Pradesh (25 %), Tamil Nadu and Karnataka are our major sugar-producing states. Besides sugar, bagasse and molasses generated as wastes during sugar production are very productively used. Bagasse is used as fuel for boilers in co-generation plants of sugar mills which besides meeting their own captive electrical power requirements are also able to export power to the grid. Molasses is used in distilleries for manufacture of alcohol (rectified spirit). The 5% mandatory ethanol blending with petrol which is to be shortly implemented across the country is bound to further increase the importance of sugar industry to the Indian economy. With this background, the focus on lead article for this issue is on hazards and loss mitigation measures pertaining to the sugar industry.

The issue also includes a safety quiz and an analysis of major loss incidents in sugar industry that has taken place in the recent past.

Wishing all our readers a happy and informative reading experience.

1.0. Lead Article : Loss Prevention in Sugar Industries

1.0 INTRODUCTION

Sugar is produced in 121 countries and the annual global production now exceeds 168 mn tons. Of this, approx. 70% is produced from sugar cane and the remaining 30% is produced from sugar beet. Brazil, India, the European Union, China and Thailand are the five largest sugar producers in the world.

In India, sugar is primarily produced from sugar cane and it is indeed interesting to note that India is described as the original home of sugar & sugarcane *(There are references of sugarcane cultivation, its crushing and preparation of Gur in Atharva Veda and in Kautaliya's Arthasastra)*. Although sugarcane was being grown in India from time immemorial and sugar produced in lumps during 4th century, there was no sugar industry in India. It is said that the 1st sugar plant in India was established by the French at Aska, Orissa in 1824. Not much is known about this factory except that it was maintained by Late James Fredrick Vivian Minchin and that its operation stopped around 1940. The 1st vacuum pan process sugar plant was set up at Saran in Marhowrah in Bihar in 1904 and by 1931-32 there were 31 sugar factories in India all of which were in the private sector. The total production of sugar at that time was 1.5 L tonnes, whereas the consumption was about 12 L tonnes. To meet the domestic demand of sugar, India had to import; and this was mainly from Java (Indonesia). The passing of the Sugar Industry Protection Act by the Indian Legislature in 1932 which granted protection to indigenous sugar manufacturers helped to fast track the growth of sugar mills in India. Hence the no. of mills increased from 31 in 1930-31 to 642 in 2012–13, resulting into increase in sugar production from 1.20 L tonnes to 250 L tonnes. Present statistics w.r.t. no. of factories in operation, cane acreage, sugar and molasses production is given below.

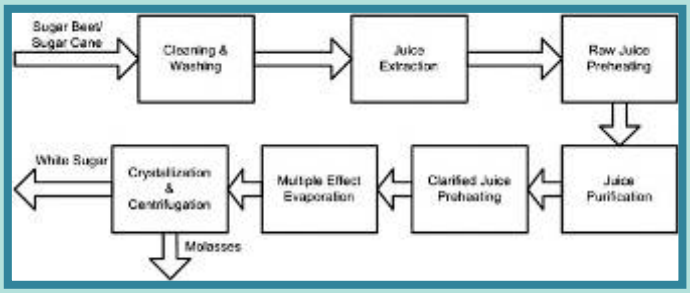
Particulars	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
No. of factories in operation	501	516	488	490	527	529
Cane acreage (000 Hectares)	5151	5055	4415	4175	4885	5086 (P)
Sugar production(000 Tons)	28828	26356	14538	18512	24394	26342
Molasses production (000 Tons)	13089	11313	6542	8400	10970	11827

Source: Website of ISMA (Indian Sugar Manufacturers Association) – April 2013

2.0 GENERAL PROCESS

The main step involved in manufacture of sugar from beet/cane would involve cleaning & washing (beet) / preparation & shredding (cane) followed by juice extraction, juice filtering and treatment, evaporation and crystallization after which we get white sugar as the product and molasses as the by-product. In case of cane we also get bagasse as waste during the juice extraction process which is used to raise steam

for use in process and also for electric power generation. Excess bagasse after usage is baled & stored for future use during off-season periods when cane crushing does not take place. A simplified process diagram is as given below.



Sugar in India is mainly manufactured from sugar cane and the process adopted for its manufacture is the Double Sulphitation Process. The article would be mostly based on cane sugar manufacturing.

The 1st step involved is the transport of cane from sugar growing fields to factories. The faster it is transported the better it is for the farmer & sugar mill owners as both weight & recovery (% of sugar production in metric ton to the cane crushed in metric ton) would be higher when cane is fresh. Various means of transportation like bullock carts, tractors, trucks is used based on distance and quantity to be transported.

2.1 Cane Handling

On reaching sugar factories, cane would be weighed in weigh bridges and then unloaded on to cane carriers. While mechanical devices (cane unloaders & feeder tables) are used for unloading larger quantities of cane that arrive in trucks/ tractors, cane that arrive in bullock carts are unloaded manually by dumping them on to cane carriers. Cane carriers transfer cane from cane handling section to the mill house. Even before this cane reaches the mill house, certain preparatory work for juice extraction is carried out on the cane conveyor. The kicker/leveller levels the height of the cane mat on the conveyor; the cutter cuts cane into small pieces and shredders/fiberisers breaks down cane into individual strands/ fibres.

2.2 Mill House

Here cane fibre is passed through a series of crushing mills to extract juice. Mills made up of huge grooved cylindrical rollers (generally 3 rollers) exert huge forces on the shredded cane which is fed through them via a vertical chute. *(Prior to 90's steam turbines were used to drive the mills. The present trend is however to go in for electric drives such as variable speed AC drives/DC motors).* Pressure between the rollers breaks down the cell structure of the fibres and extracts the juice from them. Extraction of optimum sucrose is a key element in milling and mills use a number of ways to achieve this like: application of hot water *(95 ^{0}C)* to the fibre within the mill set, a series of crushing mill sets *(the milling train)* and reapplication of mixed juice & water *(maceration)* throughout the milling process. Bagasse *(fibre residue after juice extraction)* is either immediately used as fuel in boilers or is stored for future use. Such storages could be in open heaps or in the form

of bales wherein bagasse gets pressed into small bales prior to storage.

2.3 Boiler House

Here generation of steam for meeting various needs of sugar factory takes place. One notable feature is that they are designed for using bagasse as main fuel. Number of boilers used is generally more than one. Steam generated here is used for electric power generation and in the boiling and curing houses of a sugar industry. Process steam requirements where sugar is manufactured by sulphitation process would be around 45 % on cane crushed per hour.

2.4 Power House

All sugar plants go in for cogeneration (producing two forms of energy from one fuel). The two forms of energy derived from bagasse are electrical energy generated by steam turbines at power house & heat energy mainly used in boiling house for evaporation, clarification and pan boiling purposes. This helps the plants achieve very high energy efficiency levels *(75%–90%)* because the low-pressure exhaust steam coming out from turbines is not condensed, but used for heating sugar juices. According to Energy Statistics 2012, published by the Central Statistics Office of India, the potential for bagasse-based cogeneration in India is estimated at 5000 MW which constitute around 6% of energy from renewable energy sources.

2.5 Clarification and Evaporation House

Juice extracted at the mill house is measured by juice weighing scales after which it undergoes numerous operations like - incubation, P_H adjustment through addition of lime, heating, addition of flocculants to assist contaminants to subside, addition of anti-scale chemicals, removal of mud and heavy contaminants and reduction of water levels in juice. Heating is carried out using shell and tube heaters that are either cylindrical units with multiple passes for juice in tubes surrounded by steam or multi-path plate and frame commercial units *(these are smaller than the conventional heaters)* constructed from pressed SS sheets, separated by gasket material. Lime and flocculants are added to the juice as slurry. A subsider then removes heavy contaminants from the juice by allowing heavy materials sink or fall to the bottom. This removes the majority of dirt & chemical mud present in it. The rotary drum filter is then used to spread the mud in the juice across its moving filter which is also 'washed' to leech out any remaining sucrose before being disposed of as Press Mud. Press Mud *(also known as 'Mill Mud')* is a nutrient rich product and is normally supplied free by the mills to the farmers for field use. Juice is then boiled in various evaporators *(large kettles also called multiple effect evaporators)* to reduce the water content. Construction of this section is such that vapour exhausted from each vessel is used to boil juice in the subsequent vessel at a lower

pressure thus making the process highly energy efficient. Final stages of evaporation are carried out in vacuum to reduce the boiling point. The final product from this section is a dark gold coloured liquid known as 'liquor' / 'syrup'. Syrup is then sulphited in the syrup Sulphitation tower.

2.6 Boiling and Curing House

Sulphated syrup is then taken to the pan floor to form sugar crystals. The process is similar to the evaporator section, to the extent that the pan boils off additional water. But the main function of this stage is to produce sugar crystal from liquor. The pan stage has many storage tanks such as receivers *(tanks which receive product from the pans)*, crystallisers *(series of tanks and stirrers which cool the product from the pan stage resulting in additional crystal growth before centrifuge operations)* and large transfer pipes & valves. Three massecuite boiling systems are adopted where A, B & C Massecuite is boiled, crystallised and cooled before they are put into centrifugals. There are two types of centrifugals operating in sugar mills i.e. batch and continuous types. Continuous centrifugals maintain a constant flow of product through them; while batch centrifugals fill, operate and then discharge the final product. The final product sugar is obtained from A massecuite (*formed of boiling syrup, sugar melt, 'A' light molasses with 'B'-single cured sugar as seed*) where high grade centrifuges (*usually batch, but sometimes continuous*) remove the liquid product (*molasses*) that surrounds the sugar crystal, washes the crystal and delivers it onto the conveying & drying system. A'-Light and 'A'-Heavy molasses separated at these centrifugals are pumped to the pan floor and are used in the making of 'A' and 'B' massecuite respectively. 'B' and 'C'-massecuite are processed in low grade centrifuges which are continuous and are obtained from 'B' centrifugals. 'B' single cured sugar is used as seed for 'A' massecuite and 'B' heavy molasses is pumped to pan floor for making 'C'-Massecuite in C-pans. 'C'-Massecuite is first centrifuged in 'C'-fore centrifugal machines where final molasses and 'C'-single cured sugar are obtained. 'C' Single cured sugar is again cured in another 'C' centrifugal machine where 'C'-double cured sugar and 'C'-light molasses are obtained. 'C'-light molasses is taken to pan floor and is used in making 'C'-Massecuite. 'C'-double cured sugar is melted and is used in making 'A' Massecuite.

2.7 Final Products

2.7.1 Sugar

'A' centrifugals discharge sugar onto grass hopper conveyors. Passing of hot air over conveyors dries sugar crystals as they pass through them. Dried sugar gets conveyed to a sugar grader where powder & smaller size crystals get separated from the final product (sugar). This sugar is taken to sugar bins through bucket elevators where they are stored before being bagged in semi-automatic or

automatic weighing machines. Weighed & bagged sugar gets stored in sugar godown in large heaps, for which a system of fixe/portable conveyors is used. Sugar meant for export is at times packed in Jumbo sized HDPE bags.

2.7.2 Molasses

Final molasses is the mother liquor obtained from C-fore worker centrifugal machines. Molasses from these machines are pumped and stored in huge above ground conical roof tanks in sugar factory. Most sugar factories have distilleries attached to them; hence molasses gets internally consumed in the manufacture of rectified spirit. In fewer cases molasses is sold to external agencies. Molasses being prone to spontaneous combustion is a hazard.

3.0 SUGAR INDUSTRIES HAZARDS

3.1 Health Hazard

3.1.1 Bagassosis

In a sugar mill, atmospheric contaminants encountered are bagasse fibres, sugar dust & dirt – classified as irritants. Of these, issues with bagasse are serious and it was believed that **bagassosis**, an allergic reaction of lung tissue in the presence of Thermoactinomycetes Sacchari spores was a health risk associated with bagasse. Research has however indicated that bagasse does not cause bagassosis. However, if bagasse is stored in damp conditions, T. Sacchari bacteria can propagate. The spores of this bacterium can give rise to bagassosis in workers. Measures for controlling & minimising levels of bagasse dust are:

- ❑ High standards of housekeeping
- ❑ Covered conveyors and transfer points
- ❑ Local exhaust ventilation
- ❑ Use of Personal Protective Equipment
- ❑ Training and supervision
- ❑ Additional control measures after carrying out risk assessment needs to be carried out at factories where stored bagasse is in use

3.1.2 Hazardous chemicals

Besides petroleum products, other hazardous chemicals found in a sugar factory include:

- ❑ Caustic soda (sodium hydroxide)
- ❑ Acids - hydrochloric, phosphoric, sulphuric and sulphamic acids
- ❑ Formaldehyde
- ❑ Lime (Calcium Hydroxide)

The main risk associated with these chemicals is the potential for exposure to site personnel/ other persons who would be entering the premises. Exposure can occur by breathing in the chemical, through skin contact where a chemical is absorbed through the skin or ingestion when eating with contaminated hands.

High risk activities involving these chemicals would occur during unloading and bulk transfer, process/plant failure and on account of operator error. Measures to mitigate these hazards are:

- ❑ Having detailed and documented standard operating procedures

- Maintaining a register containing a list of all hazardous chemical on site
- Ensuring that material safety data sheets are readily available
- Labelling and storage standards that comply with the appropriate standards and codes
- Isolating high risk areas with barriers/ signages (e.g. where caustic boiling is carried out at multiple effect evaporators)
- Risk assessment and minimizing risks for each of the hazardous chemicals
- Provision of eye wash and safety shower facilities adjacent to the site but isolated from likely engulfment
- Training of workmen, use of personal protective equipment, monitoring or health surveillance being conducted where required
- Emergency response plan for various accident scenarios

3.2 Injury Hazards

Injury hazards in sugar mills can arise due to a variety of causes. While most of these are minor Lost Time Injury and accidents statutorily reportable under Factory Laws, instances of fatal and very serious accidents have also taken place. Various accident causing scenarios are described below.

3.2.1 Working near exposed live parts

Bare bus bars used for power supply to Over Head Travelling (OHT) cranes provided at Mill House & Power House is a potential source for electric shock hazard. It is vital that supply to crane system be switched off before undertaking any work near to the bus system.

3.2.2 Hitting/being hit by moving objects

This hazard is present in Mill/Power Houses of sugar factories during maintenance activity and off-season. Safe operating procedures, Training & safety education are the control measures.

3.2.3 Slips trips and falls

Sugar manufacturing has processes which can affect the risk of slips trips and falls. E.g., reactions between concrete & sugar products *(sugar dust, molasses or massecuite)* can damage floors/walkways giving rise to slip and trip hazards. Housekeeping, maintenance & regular safety inspections would help mitigate this hazard.

3.2.4 Falling objects

Since sugar mills are multi-level installations *(especially the sections at boiling house),* falling objects could be a potential hazard. Issues to be considered here are - type of work conducted, equipment used, number of people using the area below and how far an object might fall and what the object might be. A work permit system similar to the one used for work at heights could serve as a good mitigation measure. In addition, cordoning off the unsafe area below upper sections where work is being carried out is a good safety measure that would help safeguard against falling objects.

3.2.5 Injury to upper & lower limbs

Most injuries of this type occur when manual handling of sugar stacked in piles or shifting of portable conveyors for shifting the stack locations is required. Injuries to upper/ lower limbs and more particularly to fingers/ toes occur due of working with bare hands/feet *(no proper safety shoes)* and careless work methods that disregard safety. Contract workmen training, supervision and enforcement on use of safety shoes are the mitigation measures.

3.2.6 Electrical Hazards

Electrical shock hazards are likely due to frayed wires & cables used for connecting portable conveyors and in boiling house area where entry into vessel is carried out using portable hand lamps. Elimination of shock hazard would require period inspection and maintenance of portable conveyors & their wiring systems are carried out to ensure that damaged switch boards, wires are immediately repaired and rectified and that all electrical equipments are provided with proper and secure earth connections. To eliminate shock hazard during vessel, entry use of 24 volt hand lamps is vital. Hence it would augur well to have fixed 230/24 volts transformers at strategic locations near vessels with outlet sockets that can be made use of during vessel entry. Electric flashovers at switches & starters near boiler area can occur due to carbon deposits generated by burning of bagasse/coal in boilers. Switching off supply before carrying out electric work on these boards & cleaning interiors after undertaking repair work are mitigating measures.

3.3 Fire hazard

Fire hazard in sugar manufacturing process don't exist due to high water content in the process from the beginning till the end. It arises in a sugar factory from the presence/use of bagasse and from the final product sugar being stored.

3.3.1 Bagasse storage

Excess bagasse during milling operations getting stored in heaps

30 tonnes of bagasse is generated for every 100 tonnes of cane crushed. While most of this is internally consumed in sugar mills as fuel for boilers, there still happens to be a huge excess quantity that needs to be handled. This excess quantity and the loose form in which it is present pose a serious fire hazard to sugar industries. In addition, bagasse is also liable for spontaneous combustion arising from

microbiological reaction. Measures that help in mitigation of this hazard are:

- Electric supply cables & cable trenches should be routed at least 10 metres away from bagasse storage areas
- Bagasse should not be stored below & near to high voltage (H.T.) transmission lines
- Baling and storing of bagasse helps in reducing the fire hazard
- Machinery with hot exhausts/engine parts should not be parked near loose bagasse
- Train operators for emergency procedures, required to respond to fire in the bagasse yard

3.3.2 Sugar godown

Sugar is flammable and it can burn. In addition sugar which is normally stored in HDPE or jute bags are combustible. Ignition energy required to ignite an HDPE or jute bag is lower than the energy required to ignite sugar. Common causes for fires in sugar godowns are hot work, bad electrical wiring and unregulated smoking. Recommended control measures are:

- Loose/temporary wiring should be avoided and all electric wiring inside godowns should strictly conform to IS: 732–1983. Wiring should be of recessed metallic conduit type and PVC cables conforming to IS: 694-1990 should be used. Provision of socket outlets inside the godown to be avoided and Wall mounted (*not hung from the roof truss*) 'Protected type' light fittings (*in which the lamp is enclosed by heat resisting toughened clean glass*) are to be provided
- Strict enforcement of Hot Work Permit, with work being carried out in the presence of a fire watch and post welding survey of the work areas are necessary
- Smoking to be strictly regulated by ensuring that all smoking materials are removed at the entry gate
- A master control switch should be provided outside the sugar godown at the entrance and the same should be switched off during non-occupancy hours

3.3.3 Sugar dust explosion

Sugar from process area is transferred to storage bins through enclosed bucket elevators/ conveyors. Low moisture levels in final sugar product, dispersion of dust particles in sufficient quantity and concentration are factors that influence explosion when the combustible sugar dust gets confined in bins and its conveying system. Sugar dust explosions are extremely rare; but have occurred in sugar refining mills overseas. On Feb 7, 2008, a huge explosion and fire occurred at the Imperial Sugar refinery northwest of Savannah, Georgia, causing 14 deaths and injuring 38 others, including 14 with serious and life-threatening burns. The explosion was fuelled by massive accumulations of combustible sugar dust throughout the packaging building. The U.S. Chemical Safety and Hazard Investigation Board (CSB)

determined that the first dust explosion initiated in the enclosed steel belt conveyor was located below the sugar silos. The recently installed steel cover panels on the belt conveyor allowed explosive concentrations of sugar dust to accumulate inside the enclosure. An unknown source ignited the sugar dust, causing a violent explosion. The explosion lofted sugar dust that had accumulated on the floors and elevated horizontal surfaces, propagating more dust explosions through the buildings. Secondary dust explosions occurred throughout the packing buildings, parts of the refinery and the bulk sugar loading buildings. The pressure waves from the explosions heaved thick concrete floors and collapsed brick walls, blocking stairwell and other exit routes. The resulting fires destroyed the packing buildings, silos, palletizer building & heavily damaged parts of the refinery & bulk sugar loading area.

3.4 Water Damage to Sugar stock

Seasonal nature of sugar factory operations that give rise to huge quantities of stock during peak season *(this creates issues regarding storage)* and proneness of sugar to water damage are factors for this risk. Instances of sugar being stored in open with temporary tarpaulin covers & in inadequate shelters where entry of rain water during monsoons would rise are causes for losses in sugar factories. Storms/ cyclones can damage roofs and cause entry of rain water. Sugar godowns should be constructed using reinforced cement-concrete columns and tie beams with structures designed in accordance with IS: 456-2000. Walls may be made of either stone or brick masonry work of minimum 350 mm thickness having properly grouted joints between columns & walls. Roofing is to be carried out with corrugated asbestos cement sheets/light coloured Polyester pre-coated sheets/corrugated GI sheets, laid over steel gable truss or prefabricated portal frames. Sheets should project at least 0.75 m from the longitudinal walls. Where there is recurrence of heavy hailstorms, the use of corrugated asbestos cement sheets are to be avoided. Sheets should overlap longitudinally at least by one and half corrugations. Asphalt impregnated hessian cloth of at least 10 cm width is to be interposed in the overlapping of sheets. Purlins & sheets shall be well anchored and secured. Bituminous washers shall be used for securing sheets. In areas liable to excessive heat, use of heat reflecting paint on top may be considered. Drainage requirement for sugar godown shall be in accordance with IS: 1742-1983. Rain-water pipes shall be provided at every alternate bay for drainage of rain-water and rain-water gutter shall be made of G I sheet or asbestos cement pipe of adequate size that would be properly fixed to the roof. The gutter shall open into the rain-water collection pipes of cast iron or cement of adequate size. Pipes shall be properly secured at the off take and also securely fixed with clamps to the wall at a distance of every 2 m. The lower ends of the

drain pipes shall be 15 cm above the ground level and shall be provided with shoes. Further, all rain-water shall be drained off by suitable open drains 1.5 m away from the main structure.

4.0. FIRE DETECTION & PROTECTION

4.1 Fire Detection

Godowns are generally unmanned and closed during night. As the ceiling heights are high, it is recommended that beam detectors be provided for early detection of fire in these areas. Provision of detection system should be in conformance to IS: 2189-2008 *(Code of practice for selection, installation and maintenance of automatic smoke/fire detection and alarm system)*. Hardware stores where engineering spares and consumables are stored and office areas especially those housing servers and computers are other areas where fire detection is recommended.

4.2 Fire Protection

4.2.1 Passive Fire Protection

Provision of an automatic fire door is recommended for door openings between sugar godown & sugar house in case these are adjacently located.

4.2.2 Active Fire Protection

Fire extinguishing hand appliances conforming to IS: 2190-2010 *(Code of Practice for Selection, installation and maintenance of first-aid fire extinguishers)* should be provided at all process, utility and storage blocks. Appropriate extinguishers should be so located that a person would not have to travel more than 15 m. for accessing it during an emergency.

Fire hydrant system designed as per TAC or NFPA norms; should be installed for protecting all the blocks in the premises. Once installed, these should be periodically maintained and tested for its effective functioning during an emergency. In case this is not carried out, at least the bagasse storage area would need to be protected with hydrants.

A trained fire-fighting squad should also be available round the clock to handle fire emergencies. Where a hydrant or sprinkler systems is not there, storage of 50,000 litres of water would be quite useful to the public fire brigade in handling major fire emergencies.

Our ten loss prevention commandments for sugar industries are given in the page that follows.

G. Sajiv
Vice President – Risk Engineering
Bharti AXA General Insurance Company Limited
Bangalore

Ten Loss Prevention Commandments for Sugar Industries

1. **Fire Safety in Godowns:** Common causes for fires in sugar godowns are bad electrical wiring, hot work and smoking. Godown should be provided with wall mounted lighting fixtures and wiring should be carried out in recessed metallic conduits using PVC cables conforming to IS: 694–1990. Regulation of hot work with permit systems and fire watches, and strict enforcement of 'No-smoking' regulations in plant areas are measures that will promote fire safety in godowns. In addition, provision of a Master Control Switch at the godown entrance and a procedure to switch it off during non-occupancy hours is recommended.

2. **Fire safety at Bagasse storage**: Huge quantities of bagasse in loose form and the spontaneous combustion property of bagasse are factors that contribute to a major fire risk in sugar industries. Baling and storing of bagasse, not storing bagasse below & near high voltage (H.T.) transmission lines, routing supply cables & cable trenches at least 10 m. away from bagasse storage areas and ensuring that machinery with hot exhausts or engine parts are not parked near loose bagasse storage areas help in improving fire safety.

3. **Controlling sugar dust explosions**: Though extremely rare sugar dust explosions have occurred in sugar refining mills overseas. Since contributory factors for this hazard are low moisture levels in final sugar product, dispersion of dust particles in sufficient quantity and concentration capable of getting ignited, and presence of sources of ignition the required mitigation measures are good housekeeping and maintenance in sugar elevator and sugar bin areas as these are confined spaces where sugar dust is present. Care should also be taken when carrying out hot work in this area.

4. **Preventing Water Damage to stock**: Sugar should only be stored in properly constructed godowns built of reinforced cement-concrete columns and tie beams with brick/ stone masonry walls having roofing carried out with light non-combustible material. In cyclone prone areas, roofing requirements would need a review based on anticipated wind speeds. Provisions of roof gutters/ down pipes and drainage arrangements for draining away of rain water are key features that need attention. In addition gutters and down pipes should be well maintained and cleaned prior to the monsoon season.

5. **Prevention of electric shock in godowns:** Carry out periodic inspection and maintenance of portable conveyors and wiring systems to ensure that damaged switchboards/wires are rectified and all electric equipment is provided with proper earthing.

6. **24 volt supply provisions at boiling house**: Provision of fixed 230/ 24 volts transformers at strategic locations with outlet socket provisions near vessels in boiling house is recommended to promote the usage of safe hand lamps by workmen entering the vessels for cleaning and maintenance work.
7. **Avoiding Slips trips and falls:** Sugar manufacturing has some processes which can induce the risk of slips trips and falls. E.g., reactions between concrete and sugar products (sugar dust/molasses/ massecuite) which damage floors/ walkways giving rise to potential slip/ trip hazards. Housekeeping, maintenance and regular safety inspections are the required risk control measures.
8. **Injury Prevention at sugar godowns**: Most of the injuries that happen in sugar factories occur in sugar godowns where manual handling of sugar that is stacked in piles and shifting of portable conveyors takes place. Injuries to upper/lower limbs, particularly to fingers and toes occur due to reasons such as working with bare hands and feet (without safety shoes) and due to careless work practices. Contract workmen training, supervision of their activities and strict enforcement on the use of safety shoes are measures that would mitigate this hazard.
9. **Fire Detection**: Since godowns are generally unmanned during night and as their ceiling heights are high it is recommended that beam detectors are provided for early detection of fire during non-occupancy hours. Provision of detection system should be in conformance to IS: 2189-2008 and other areas where detection systems are recommend are hardware (engineering) stores and office areas which house servers and computers.
10. **Fire Protection**: Fire extinguishing hand appliances conforming to IS: 2190-2010 should be provided at all process, utility and storage blocks. While we recommend that all blocks in the premises be protected with an automatic hydrant system it is absolutely necessary that the bagasse storage area be provided with a proper hydrant system.

2.0. SAFETY QUIZ

1. **Fire will continue to burn until _____.**
   a. its heat is removed
   b. all its fuel is burnt up
   c. its oxygen runs out
   d. any of the above

2. **Class of fire fuelled by reactive metals and extinguished with special chemical powders**
   a. Class B
   b. Class C
   c. Class D
   d. Class K

3. **When performing hot work, all flammables within __ feet should be removed from the area if they cannot be properly protected from fire**
   a. 15
   b. 25
   c. 35
   d. 50

4. **Minor burn injuries should be treated by applying an antibiotic ointment to the affected area and then covering it with a bandage**
   a. True
   b. False

5. **What is a blind spot in case of driving or riding?**
   a. An area not seen due to bike rider's helmet
   b. Area not reached by the headlights
   c. An area not seen through the rear view and wing mirror

6. **If it is wet or raining, when using brakes, on a 2-wheeler the best thing to do is to?**
   a. Pump both brakes alternately
   b. Use only back brake, not touching the front brake
   c. Use both brakes carefully, progressively and smoothly

7. **The only thing that can keep you safe consistently is _____.**
   a. Personal Protective Equipment
   b. Your supervisor
   c. obeying all warning signs
   d. your attitude

8. **Which of the following require training and authorization before you can perform them?**
   a. Forklift operation
   b. Lockout/tag out
   c. Crane use
   d. All of the above

9. **In the event of a fire, facility and company property are of primary concern**
   a. True
   b. False

10. **Who is responsible for making sure you are using the appropriate PPE and that it is in good working condition?**
    a. You
    b. Your supervisor
    c. Your manager
    d. Person in charge of safety

Answers:

1	2	3	4	5	6	7	8	9	10
d	c	c	b	c	c	d	d	b	a

P K Roychowdhury

Zonal Manager – Risk Engineering

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New Delhi

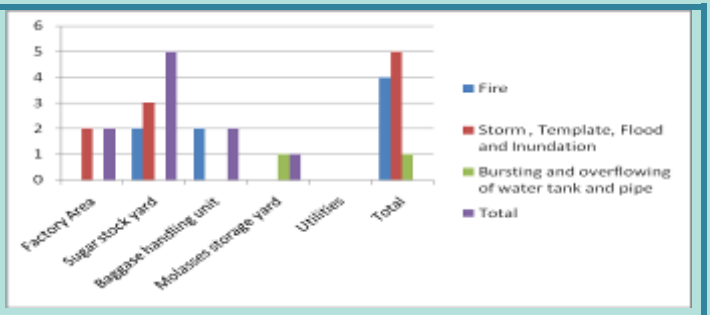
3.0. Learnings from recent losses in Sugar Industry

An analysis of 10 major losses (loss above INR 25 lakhs) that occurred in sugar industries in India between 2010 and 2013 were collated and analyzed. As per this data, the total loss reported during the period was around INR 10 crores involving 10 loss incidents. Cause wise distribution with regard to frequency and severity of losses is given in the table below:

Table.1: Cause wise distribution of events and loss severity

Cause of loss	No of events	Total loss
Fire	4	Rs. 63,072,500/-
Storm , Template, Flood and Inundation	5	Rs. 28,781,000/-
Bursting and overflowing of water tank and pipe	1	Rs. 12,000,000/-
Total	10	

Table.2: Further analysis of the above loss scenarios

Further analysis of these loss scenarios reveal that the largest loss producing event amongst the above incidents is fire in sugar godown (INR 63,072,500/-) followed by a water damage loss again occurring in a sugar godown (INR 28,781,000/-). These statistics also reveal that sugar godown and bagasse storage are the most loss prone areas in a sugar factory	 Fig.1: Distribution of the analysed 10 loss incidents within a sugar factory

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Response Invite:

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