

Government of Maharashtra

Directorate of Industrial Safety and Health

Kamgar Bhavan, 5th Floor, Block-E, C-20, Bandra-Kurla Sankul, Bandra (East), Mumbai- 400 51,
Phone No. 26572504/09/22/58, Fax No. 26572474, Email ID – dirdish.mum-mh@gov.in

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Subject: Safety Guidelines for Sugar Industries

Introduction:

In the current situation of Covid-19 lockdown, the inspection of all the factories may not be possible by this directorate. Hence all such type of factories are hereby directed to follow the following safety measures in addition to the provisions of The Factories Act, 1948 and The Maharashtra Factories Rules, 1963.

The given guide lines are not exhaustive in nature; any additional precaution as may be necessary based on specific requirement should be adopted by the factory management for safe manufacturing operation of the factory based on the nature of manufacturing activity

Sugar Making- The Process

The following points highlight the six main steps involved in manufacturing cane-sugar.

1. The major steps are:

- 1) Extraction of the Juice
- 2) Clarification of Juice
- 3) Concentration and Crystallization
- 4) Separation of Crystals
- 5) Refining of Sugar
- 6) Recovery of Sugar Molasses.

1. Cane Unloading-

- 1) Skilled, experienced and trained person must be employed as a crane operator, who knows the safe operating procedure (SOP) of the crane operation.

- 2) SOP of cane unloader section shall be prepared and displayed in the language understood by the majority of the workers.
- 3) No person shall be allowed to stand or work below the cane unloader.
- 4) Ensure safe access and egress for vehicles carrying sugarcane to avoid risk of major injury due to inadvertent movement of vehicle/bullock carts.
- 5) Provide and maintain sufficient lighting in the area.
- 6) Test crane controls and interlocks prior to start operation. Inspect lifting tackles attachment frequently.
- 7) Fall arrestors should be anchored while working at height- vehicle top.
- 8) Inspect crane hoisting mechanism including end attachment periodically.
- 9) Maintain crane safety limit switches, brakes, mechanical stoppers in healthy condition. Install anti-collision switches in case of cranes working in tandem.

2. Feeder, Leveller and Chopper-

- 1) DONOT RUN THE MACHINES WITHOUT GUARDS.
- 2) AVOID WORKING NEAR PITS. NEVER TRY TO STAND OR WORK ON FEEDER CONVEYOR.
- 3) Install emergency switches at strategic locations.

3. Juice Extraction-Mill

- 1) Good housekeeping practices should be followed to avoid fall, slips and trips while working in the area.
- 2) Guard all in running nip points of drives and mill rolls.
- 3) NEVER STAND ON INTERMEDIATE CARRIERS FOR LOOSENING STUCK PARTS.
- 4) ALWAYS USE LOTO WHEN WORKING NEAR ON MILL ROLLERS.
- 5) Provide eye wash/body showers in nearby area.
- 6) Provide suitable ear protection while working in mill area.
- 7) Provide and maintain safe access for working in mill area.
- 8) Suitable guard rails shall also be provided with toe boards.
- 9) Appropriate PPEs must be worn while cleaning and maintenance of mill.
- 10) Check for methane gas while carrying out mill repairs especially in boots.

4. Return Bagasse Carrier (RBC)

- 1) Proper barricading to be provided for the opening of RBC carrier to avoid the fall of person. DONOT RUN MACHINE WITHOUT GUARD.
- 2) Issue work permit for all repairs/adjustment on RBC. Ensure safe isolation through lock out tag out.

5. Clarification/Evaporation

- 1) All heating vessels shall be tested prior to take into operation. Manholes and other openings shall be provided with secured fittings. Avoid working near or below such joints.
- 2) All chemicals shall be handled safely. Read MSDS carefully. Store chemicals considering its compatibility.
- 3) Suitable PPEs shall be worn all the times while handling chemicals. Ensure safe disposal of wastes. Provide spill kits in the area.
- 4) Manual handling of sulphur or lime may lead to health hazards- provide mechanical handling system to minimise exposure.
- 5) Eye wash/body shower shall be provided near the storage and preparation area. Provide proper railing for open tanks.
- 6) Steam pressure and temperature of the raw juice heaters shall be maintained properly.
- 7) At the time of starting of the sugar factory, hydraulic pressure testing of the raw juice heaters shall be taken.
- 8) Employees shall be provided with necessary PPEs i.e. safety shoes, hand gloves, safety helmet, etc.
- 9) Provide proper railing to all open tanks to avoid falling into tanks.
- 10) The leakages of sulphur dioxide gas through the burner and pipeline shall be attended immediately and required PPEs shall be used while working in the area.
- 11) Work permit system i.e. entry into the vessels (tanks) shall be strictly followed.
- 12) After completion of the crushing season, proper cleaning of the DORR shall be carried out.

6. Rotary Vacuum Filter/Press Mud conveyor-

- 1) All the rotating parts of the rotary vacuum filter shall be guarded properly.
- 2) Avoid working near rotary parts. Use incidental tool to clean the roller.
- 3) Provide guards to all the rotary parts and drives.

7. PAN Section-

- 1) At the time of starting of the sugar factory, hydraulic pressure testing of the pans shall be taken.
- 2) Work permit system i.e. entry into the vessel shall be strictly followed.
- 3) Follow operational procedure. Avoid shortcuts. Guard all nip points of gearings.
- 4) Follow lock out and tag out procedures. Depressurize system and open manholes/doors.

8. Centrifugal Machines/Dryers

- 1) Provide and maintain door/lid interlock of centrifuge machines.
- 2) Provide suitable PPEs to protect person from hot air/dust, etc.
- 3) DONOT RUN CENTRIFUGE KEEPING ITS LID OPEN.

9. Sugar Storage and Packing

- 1) Exposure to sugar dust- respiratory concerns, sugar dust explosion- Use respiratory protection. Measure dust level concentration in sugar dryer, conveyor and silo/bins.
- 2) Use mechanized cleaning of floor.
- 3) All drives shall be fitted with suitable guards. Ensure earthing and bonding to avoid static charge.

- 4) Dust monitoring should be carried out to determine if it exceeds the exposure standard of 10 mg per cubic metre.
- 5) Provide and maintain ventilation and dust collection system.
- 6) Use of appropriately rated equipment for operation within a combustible dust atmosphere.
- 7) Elimination of other sources of ignition such as hot work, smoking and naked flames.
- 8) Follow safe practices to avoid risks associated with sugar bag handling and stacking. Manual handling may lead to musculoskeletal disorders.
- 9) Temporary electrical supply shall be given through ELCB/RCCB protected panels.
- 10) Equip hoppers with a safe walkway and means of access when workers are required to work on top (e.g., a fixed ladder to a work platform with guardrails).
- 11) Guard hopper and chute openings to prevent workers from falling or reaching into hoppers or chutes.

10. Distillery Operation

- 1) Adequate & effective cooling arrangement shall be provided to the molasses tanks.
- 2) Periodical maintenance of the storage tanks shall be carried out.
- 3) Periodical testing & examination of tanks shall be carried out.
- 4) Tanks should not be filled to the full capacity.
- 5) Hourly temperature monitoring shall be carried out & foaming if any shall be observed.
- 6) The molasses storage tanks structural stability testing shall be carried out & tanks shall be repainted.
- 7) In case of open tanks/pits of molasses- provide secure fencing. Avoid working near open tanks without fall protection.
- 8) All flange joints of piping carrying alcohol shall be provided with continuity jumpers.
- 9) Ensure earthing and bonding. Install intelligent earth interlock system.
- 10) Statutory testing of gas holder shall be conducted. Maintain integrity of flameproof equipment and fittings.
- 11) Install and use fall arrestors while working on tankers.
- 12) Ethanol storage tanks shall be fitted with breather cum flame arrestor, vapour cooling arrangement and suitable level instrumentation.
- 13) Provide dyke wall of adequate capacity for emergency leakage/spillage.
- 14) Lightning protection system shall be installed and maintained in healthy condition.
- 15) Install hydrocarbon sensors as per need to warn in case of leakages.
- 16) All the vehicles carrying ethanol shall be fitted with spark arrestor in its exhaust to avoid source of ignition.
- 17) Maintain integrity of flameproof condition of equipment and other fittings.
- 18) Avoid hot work in distillery section however if it is required during maintenance and repair work; it shall be done with work permit and under strict supervision. Follow LOTO system.

11. Boiler

- 1) Provide and maintain all safety interlocks of boiler. Provide safe access with guardrail system to all the floors.
- 2) Permit shall be obtained while working in ESP, Dust/ash handling system.
- 3) Report steam leakages and correct them immediately.
- 4) Statutory testing of boiler and other accessories shall be done as per statute.

12. Bagasse Storage and Handling

- 1) To reduce the atmospheric contaminants in sugar plant such as bagasse fibres, sugar dust and dirt, management should consider the following:
 - High standard of housekeeping.
 - Covered conveyors and transfer points.
 - Local exhaust ventilation.
 - Provision of personal protective equipment.
 - Training and supervision.
- 2) Provide fire water monitors in the area. Maintain fire hydrant system in auto mode.
- 3) Provide secured fencing to all rotary parts and conveyor nip points. Provide suitable and safe access for working near conveyor. Provide incidental tool for manoeuvring bagasse from safe distance.
- 4) Provide and maintain pull cord interlock system on both sides of the conveyor, train person on how to use it in case of an emergency.
- 5) Also provide audio visual warning alarm to warn nearby persons prior to starting of the conveyor.
- 6) Provide suitable respiratory protection to the workers working in the area.
- 7) Only authorised and trained person should be allowed to work in the area.
- 8) All vehicles working in bagasse yard shall be provided with spark arrestor in its exhaust to avoid source of ignition.

13. Lab Chemicals

Handling, mixing and transferring hazardous chemicals such as hydrochloric and sulphuric acids, sodium hydroxide and flammable liquids including ethanol are some of the activities which are undertaken in sugar mill laboratories.

Typical control measures should include:

- Detailed analytical procedures.
- Training in the standard procedures to be followed.
- Emergency response training and access to speciality first aid treatment.
- Provision of, and training with, the recommended personal protective equipment for each activity.
- Provision of eye wash and safety shower facilities adjacent to the site but isolated from likely engulfment.

- Easy access to safety data sheet, information and emergency procedures in the laboratory.
- Adequate labelling of all containers of hazardous chemicals.
- Use of automatic pipettes.
- Adequate ventilation.
- A high standard of hygiene.
- Disposal systems for used personal protective equipment.
- Separate laundering of laboratory coats, hand towels, etc.
- Use of fume cupboards.

The following control measures shall be taken in case of use of dry lead acetate

- 1) Labelling all containers in which any lead compound is stored.
- 2) Avoiding generating dust when handling dry lead acetate.
- 3) When transferring to smaller containers: - use personal protective equipment (face shield, dust respirator and gloves) - transfer in a well ventilated area free of strong air currents.
- 4) High standards of personal hygiene.
- 5) Not allowing drinking from laboratory taps.
- 6) Training and supervision to ensure that the correct procedures are followed.
- 7) Maintaining appropriate emergency response treatments.
- 8) Providing automatic dispensers for wet lead.

14. **Biological Substances**

Legionella bacteria growth in cooling tower may lead to legionnaire disease.

The control measures as follows-

- 1) Check cooling tower water samples for legionella bacteria.
- 2) Minimising nutrient accumulation.
- 3) Monitoring and treating microbial levels
- 4) Water treatment.

15. **Confined Spaces**

- 1) Appropriate precautions shall be taken while working in bins, boilers, clarifiers, pans & evaporators, filter drums, pipes, pits, sugar bins, trenches, sugar dryers and tanks.
- 2) Obtain work permit prior to start of work. Isolate all energy sources, apply LOTO.
- 3) Measure oxygen level prior to entry. Provide mechanical ventilation and shall be kept ON till the work is completed.
- 4) Provide buddy/watch. Provide rescue arrangement. Avoid hot work inside the tank/vessel. Check space for other substances like hydrocarbons, carbon dioxides, hydrogen sulphide etc depending upon the nature of process.

16. Methane-

- 1) Operators should be aware of possible methane gas deposits after extended close downs in areas such as: • molasses pipes • hollow mill rollers • between wear plates on pressure feeder chutes • juice pipes • pans • mill boots • juice pits • rotary filter boots • heaters • a range of tanks such as subsidisers, mixed juice, incubators and flash tanks.
- 2) Mill operators should consider the hierarchy of controls in dealing with potential risks from methane gas explosion, including:
 - Training of personnel
 - Engineering controls (e.g. ventilation or flame proof equipment.
 - Sign posting and marking of areas where flammable atmospheres may exist to exclude ignition sources by a safe distance.
 - Work procedures.
 - Safe work permit systems for identified high risk processes (e.g. hot work permit systems including monitoring for flammable atmospheres in areas identified to be at risk).

17. Working at height

- 1) Obtain work permit prior to start of the activity.
- 2) Provide suitable means of fall protection with rescue arrangement.
- 3) Provide training and education.
- 4) Medical checks prior to working at height.
- 5) Utmost care shall be taken while working on fragile roof- the person shall always be anchored to the lifeline.
- 6) Provide safe access.

18. Hot Work

Consideration should be given to:

- 1) The removal of flammable or explosive materials before work commences.
- 2) The reduction in the flammability of materials (wetting down).
- 3) Isolating plant.
- 4) Residues of flammable materials.
- 5) Testing for flammable and fermentation gases (e.g. methane)
- 6) Special precautions (e.g. using a lookout).
- 7) Personal protective equipment.
- 8) Suitable tools, equipment and materials to be used for the work.
- 9) Emergency procedures.
- 10) The location of the fire fighting equipment.

19. General Guidelines-

- 1) Avoid entering near IRC while it is in operation. Specially during loosening up of pile at mill exit chute.
- 2) Cooling fans shall be provided with mesh guards to avoid finger injuries.
- 3) Never stand or work on or near mill while it is in running condition.
- 4) Access ladders of evaporator bodies and other vessels shall be provided with proper access.
- 5) Install warning siren/alarm for rise in steam pressure/temperature, vapor pressure/temperature, juice temperature, etc.
- 6) Avoid standing near or on the open tanks, vessels. Provide adequate guarding.
- 7) Hot liquid (juice/water) pipeline flange joints shall be provided with protection covers to avoid release of hot liquid due to gasket problem.
- 8) Any maintenance/repair (welding patch work, tapping to vessel/pipeline) shall be followed by hydraulic testing of vessel prior to take into service.
- 9) Working at height shall be restricted to the trained personnel and permit shall be issued for height work. Necessary safety precautions shall be taken.
- 10) To avoid the Maillard reaction occurring in the storage tank, the molasses must be cooled to below 40°C. It is therefore essential that after the centrifugal station molasses should not be heated to lower its viscosity to facilitate pumping.
- 11) The molasses storage tank should be well equipped with facilities for ventilation and re-circulation with an air injection, and preferably an inhibitor dosing system.
- 12) During plant shutdown, necessary precautions shall be taken while working at height, confined space. LOTO shall be applied prior to work on electrical system.
- 13) Tank cleaning activity shall be done with continuous monitoring. Ventilate tanks/vessels prior to entry into the tank.
- 14) Inspection of safety interlocks, devices at periodic intervals to ensure its healthiness.
- 15) Training shall be conducted on storage, use and transportation of flammable substances.
- 16) Energy Isolation points shall be identified and marked distinctively.
- 17) Basic Fire Training shall be conducted to the operatives. (Use of First Aid Fire Fighting Equipment- Fire Extinguishers and Hose Reel System)
- 18) Training shall be conducted to the persons handling chemicals.
- 19) Safety Signs/information shall be displayed and communicated to the plant personnel.
- 20) MSDS extract shall be displayed and communicated to the plant personnel. Interpretation of hazard symbol shall be communicated to the end users.
- 21) Unloading procedures shall be prepared and displayed at unloading station preferably in local language.
- 22) Use of personal protective equipment shall be made compulsory as per the potential risks in the operation.
- 23) Access to the Roof access ladders shall be restricted by providing locking key arrangement and suitable instructions. (Presently no roof access provided)
- 24) Lock out Tag Out shall be implemented for maintenance activities.

- 25) Electrical equipment- Transformer, Protective Relays, Earth Pits, Lightning Protection system periodic inspection shall be carried out and record to be maintained.
- 26) Wind Sock, Ambu bag, Stretcher, SCBA and additional first aid kit shall be provided at site.
- 27) It is advised to use warning signs during floor cleaning/washing to avoid slips and falls.
- 28) Use of Radio Telephony (RT) is recommended for communication in the plant instead of mobile.
- 29) SCBA (Self Contained Breathing Apparatus) shall be made available at site.
- 30) All lifting machines shall be plainly marked with their Safe Working Loads.
- 31) Warning labels shall be displayed on the pipelines, surfaces where there is risk of burn injuries.
- 32) Drinking water coolers should be kept in lock and key arrangement.
- 33) Emergency arrangements like PA system, Emergency Eye/Body Showers, Exits, Escape Routes, Emergency Lighting, Assembly Point areas shall be maintained in order.
- 34) Process plant interlocks shall be reviewed for its adequacy to avoid any major accident.
- 35) Alcohol tank vents shall be suitably provided with flame arrestors.
- 36) Ethanol tanker loading shall be done with due care. Provide earthing to tanker prior to each loading. It is strongly recommended to provide intelligent earth system to ensure proper earthing. The interlock shall be provided to the loading pump to avoid pumping if no/poor earthing is provided.
- 37) Use non sparking tools in distillery section to avoid source of ignition.
- 38) All portable electrical equipment shall be provided with ELCB/RCCB to protect workers from electric shocks.

Dr. Mahendra Kalyankar (IAS)
Director
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Mumbai (A. C)