Unit Training Manual

On

"Maintenance of Sulphate Bagging System"

Issue: March 2016

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ROURKELA STEEL PLANT

STEEL AUTHORITY OF INDIA LIMITED

Contents

Introduction

Ammonium Sulphate production

Ammonium sulphate is one of the important fertilisers produced in India. It contains about 21 per cent nitrogen and 24 per cent sulphur and has traditionally been very popular in some parts of the country. The main advantages of ammonium sulphate are its low hygroscopic nature, good physical properties (when properly prepared), chemical stability and good agronomic effectiveness. It reaction in the soil is strongly acid forming, which is an advantage on alkaline soils and for some crops such as tea; in some other situations its acid forming character is a disadvantages.

Fertilizer grade ammonium sulphate specifications normally indicate minimal nitrogen content, which is usually not less than 20.5%. Limitations on free acidity and free moisture are also generally demanded; typical figures are 0.2% for free H_2SO_4 and 0.2% for free H_2O. Occasionally, maximal values for certain organic or inorganic impurities may also be specified for by-product material.

Several factors contribute to trouble free storage of ammonium sulphate and other fertilizers. First, the product should be of uniform crystal size and should contain a low percentage of lines. It should be dry and preferably have below 0.1% free moisture. No free acidity should be cooled with dry air under controlled condition after drying, particularly when the ambient temperature and humidity are sufficient high to cause subsequent moisture condensation after cooling in a bulk storage pile or in sealed bags. Ammonium sulphate is commonly shipped in polyethylene or paper bags. The majority of its production is coming from coking of coal as a by-product. Ammonium sulphate is produced by the direct reaction of concentrated sulphuric acid and gaseous ammonia and proceeds according to the following steps.

1. **Reaction of Ammonia and Sulphuric Acid:** The raw materials required to produce ammonium sulphate are Sulphuric acid and Ammonia, a by-product recovered from raw coke oven gas. Coke oven gas (obtained when coal is heated to make coke) contains about 1 per cent ammonia by volume. This gas is cooled and passed into saturators of special design and sprayed with a weak solution of sulphuric acid. The basic reaction is shown below

   $2NH_3$ Ammonia + H_2SO_4 Sulphuric Acid $\rightarrow$ $(NH_4)_2SO_4$ Ammonium Sulphate

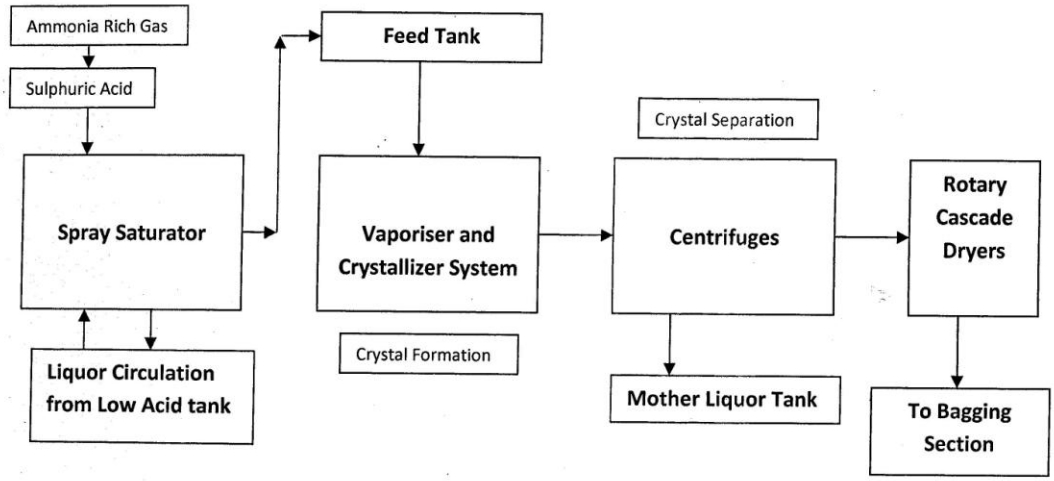
   The stoichiometric quantities of preheated gaseous ammonia and concentrated sulphuric acid (98.5% wt/wt) are introduced to the evaporator – crystalliser (operating under vacuum). These quantities are properly mixed by a circulating pump (from upper part of the crystalliser to the evaporator). The ammonium sulphate liquor is corrosive in nature.

2. **Crystallization**: The reaction takes place in the crystallizer where the generated heat of reaction causes evaporation of water making the solution supersaturated. The supersaturated solution settles down to the bottom of crystalliser where Sulphate crystals form slurry with the liquor solution. The slurry is then pumped to

centrifuges for separation of the crystals while the spent liquor is circulated back into the system.

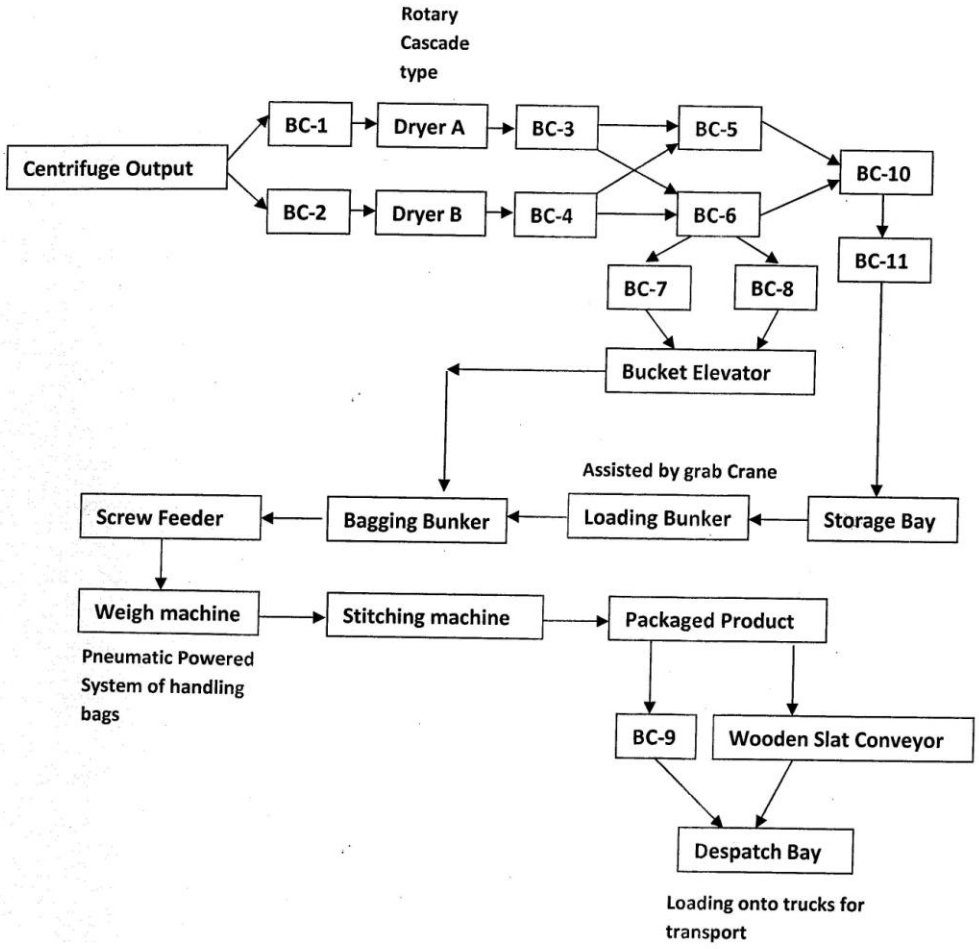
3. **Drying of the wet Ammonium Sulphate Crystals:** The wet A.S crystals are conveyed (by belt conveyors) to the rotary dryer to be dried against hot air (steam heated) and then conveyed to the storage area where it naturally cooled and bagged.

4. **Bagging:** The bagging system consists of a special screw conveyor mechanism, with an attached weighbridge system to fill bags with sulphate, capacity of 50 kg. There is a stitching machine which then sews up the bags and after which bags are set for dispatch.



Ammonium Sulphate Conveying and Bagging System

There are a total of 9 belt conveyors (BC's) for bulk handling of sulphate salt after the centrifuge (where the sulphate crystals are separated). Conveying of sulphate is done up to the final section where bags are filled and stitched up to create the final packaged product. The block diagram is as shown below



Key Performance parameters

Parameter measured	KPI	Level
Cost	Maintenance Cost	Context specific
Cost	Maintenance Cost / Total Sales	6 - 8%
Failure	Mean Time Between Failure (MTBF)	Context specific
Failure	Failure Frequency	Context specific
Downtime	Unscheduled Maintenance Related Downtime (hours)	Context specific
Downtime	Scheduled Maintenance Related Downtime (hours)	Context specific
Work Execution	Percentage of maintenance work orders requiring rework.	Should be less than 3%

Safety in Ammonium Sulphate Bagging Section

1. First aid measures for working around Ammonium Sulphate

- **Inhalation**

  If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

- **Skin contact**

  Take off all contaminated clothing immediately. Wash off with plenty of water. Wash contaminated clothing before re-use. If symptoms persist, call a physician.

- **Eye contact**

  In case of eye contact, remove contact lens and rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If eye irritation persists, consult a specialist.

- **Ingestion**

  Never give anything by mouth to an unconscious person or otherwise unable to swallow. If swallowed, DO NOT induce vomiting unless directed to do so by medical personnel.

2. Safety when working with equipment

Safe work practices for conveyors

1	Do not perform maintenance on a conveyor until the motor disconnect is locked out.	8	Know the location and function of all start-stop controls.
2	Conveyor maintenance must be done by authorized and qualified maintenance workers.	9	Keep all start-stop controls and emergency stop devices free of obstructions and within reach of operators and affected workers.
3	Keep clothing, fingers, hair, and other body parts away from the conveyor.	10	All workers must be clear of the conveyor before it is started.
4	Do not climb, step, sit, or ride on the conveyor at any time.	11	Operate the conveyor with trained workers only.
5	Do not exceed the design limits when loading a conveyor.	12	Keep the area around the conveyor clear of obstructions.
6	Do not remove or alter conveyor guards or safety devices.	13	Report all unsafe practices to your supervisor.
7	Do not wear loose clothing or jewellery while working with or near conveyors.		

3. Pneumatics Safety

Mechanical system

- Mount all of the components securely onto the slotted profile plate.
- Limit switches may not be actuated frontally.
- Danger of injury during troubleshooting!
  Use a tool to actuate the limit switches, for example a screwdriver.
- Only reach into the setup when it's at a complete standstill.

Electrical specifications

- Electrical connections may only be established and interrupted in the absence of voltage!
- Use connector cables with safety plugs only for electrical connections.
- Use low voltage only (max. 24 V DC).

Pneumatics

- Do not exceed the maximum permissible pressure of 600 kPa (6 bar).
- Do not activate compressed air until all of the tubing connections have been completed and secured.
- Do not disconnect tubing while under pressure.
- Danger of injury when switching compressed air on!
  Cylinders may advance and retract automatically.
- Danger of accident due to tubing slipping off!
  - Use shortest possible tubing connections.
  - Wear safety glasses.
  - In the event that tubing slips off:
    Switch compressed air supply off immediately.
- Pneumatic circuit setup:
  Connect the devices with plastic tubing with an outside diameter of 4 or 6 mm. Push the tubing into the push-in connector as far as it will go.
- Switch compressed air supply off before dismantling the circuit.
- Pneumatic circuit dismantling:
  Press the blue release ring down, after which the tubing can be pulled out.

Tools and Consumable Required

1. Spanner Adjustable 6", 8"
2. Spanner Ring Ended 8, 9,10,11,12,13, 24, 27
3. Spanner Ring Ended 8, 9,10,11,12,13, 24, 27
4. Oil Can
5. Sandpaper 60, 80 grit
6. Grease Lithium based EP grease
7. Lubricating OIL , ISO VG 32, 68, 150 etc
8. Screw Driver dia. 8mm, 10 mm.
9. Needles for stitching m/c
10. PU tubing ID 6mm, 8 mm, WP 12 kg/cm2
11. Assorted nuts and bolts M6*50L, M8*50L, M10*100L, M12*150L, M16*70L full threaded, material SS316L
12. Assorted flat head screws 3/16"
13. 5 pound and 2 pound ball peen hammer
14. Hack Saw with Blade
15. Pipe Wrench
16. Files Assorted bastard type
17. Wooden Slats for slat Conveyor

MODULE - I

Maintenance Practices for Stitching M/C

General Considerations

- Establish routine periodic inspection of the entire stitching m/c to ensure continuous maximum operating performance.
- Practice good housekeeping. Keep the area around the stitching m/c equipment and clean and free of obstacles to provide easy access and to avoid interference with the function of the system.
- Lock out power to motor before doing any maintenance work—preferably with a padlock on control. Do not remove padlock from control or operate m/c until covers and guards are securely in place.

To obtain the optimum return on stitching m/c, the following components that typically make up the system must be maintained:

Important: Lock Out/Tag Out all power from drives before performing any inspection on the m/c

Trouble Shooting Bag Closer Bag Making Sewing Machines

In Most cases problems are solved by checking Number 1 to 3

1. Check threading Needle. Replace if necessary.
2. Check threading Looper.
3. In case of a problem with the stitch replace the needle first. This will solve most of you problems.

TIPS!

- To keep your machines in shape oil it at least once a day after using it. refer to oiling diagrams
- When storing the machine put it back in a plastic bag. The machines are always leaking oil.
- Use the correct type of oil. If you are not certain which oil please contact manufacturer.

MODULE - II

Maintenance Practices for Pneumatic Systems

General Considerations

- Establish routine periodic inspection of the entire pneumatic System/Air Compressors to ensure continuous maximum operating performance.
- Practice good housekeeping. Keep the area around the compressor, equipment and pneumatic circuit clean and free of obstacles to provide easy access and to avoid interference with the function of the system.
- Lock out power to motor before doing any maintenance work—preferably with a padlock on control. Do not remove padlock from control or operate compressor until covers and guards are securely in place.
- Beware of pressurised tanks and compressed air in general.

To obtain the optimum return on conveyor systems, the following components that typically make up a conveyor system must be maintained:

Important: Lock Out/Tag Out all power from compressor drives and release pressurised air before performing any inspection on the Compressor and associated pneumatic components.

Compressor Inlet Filter Cartridges

- Inspect and clean or replace per manufacturer specifications. Required frequency is often related to operating conditions.
- Dirty filters increase energy consumption.

Drain Traps

Clean out debris and check operation periodically.

Compressor Lubricant Level

- Inspect daily and top off or replace per manufacturer specifications.
- Change lubricant filter per manufacturer specifications. For general use SAE 30 to 40 weight oil should be applied periodically with a brush or spout can. Volume and frequency should be sufficient to prevent heat and wear.

Lubrication

- Select compressor and electric motor lubricant per manufacturer specifications.
- Too much lubrication can be just as harmful as too little and is a major cause of premature motor failure. Motors should be lubricated per the manufacturer's specification, which can be anywhere from every 2 months to every 18 months, depending on annual hours of operation and motor speed. On motors with bearing grease fittings, the first step in lubrication is to clean the grease fitting and remove the drain plug. High quality new grease should be added regularly and of the recommended quality like EP2 grease.

Belt Condition

- Check belts for wear and check/adjust tension per manufacturer specifications.
- Under normal operation, belts stretch causing it to and wear and, therefore, require adjustment. A good rule-of-thumb is to examine and adjust belts after every 400 hours of operation.

Air Line Filters

Replace particulate and lubricant removal elements when pressure drop exceeds 2 to 3 psi. Inspect all elements at least annually regardless of pressure drop indication.

System Leaks

Check lines (especially joints), fittings, clamps, valves, hoses, disconnects, regulators, filters, lubricators, gauge connections, and end-use equipment for leaks.

Compressor Drives

- If the electric motor driving a compressor is not properly maintained, it will not only consume more energy, but be apt to fail before its expected lifetime. The two most important aspects of motor maintenance are lubrication and cleaning.
- Since motors need to dissipate heat, it is important to keep all of the air passages clean End-Use Filters, Regulators, and free of obstruction. For enclosed motors, it is vital that cooling fins are kept free of debris.

MODULE - III

Maintenance Practices for Screw Conveyor

General Considerations

- Establish routine periodic inspection of the entire conveyor to ensure continuous maximum operating performance.
- Practice good housekeeping. Keep the area around the conveyor and drive clean and free of obstacles to provide easy access and to avoid interference with the function of the conveyor or drive.
- Lock out power to motor before doing any maintenance work—preferably with a padlock on control. Do not remove padlock from control or operate conveyor until covers and guards are securely in place.

To obtain the optimum return on conveyor systems, the following components that typically make up a conveyor system must be maintained:

Important: Lock Out/Tag Out all power from conveyor drives before performing any inspection on the Conveyor.

Bearings

- Check for proper lubrication.
- Lubricate all bearings in accordance with manufacturer's instructions.
- Check hanger bearings for proper alignment and excessive wear.
- Replace hanger bearings if wear on the bearing seat causes to have a clearance of 1/8".

Gear Reducers

- Check for proper lubrication
- Lubricate all gear reducers in accordance with manufacturer's instructions.

Drives

- Check for signs of wear and play on chain sprockets.
- Check for sign of wear on chains.
- Check for lubrication on chain and their proper tension.
- Replace chains and sprockets as necessary.

Screw

- Check for damage, excessive wear and material build up.
- Replace complete screw sections as necessary.

Trough

- Routine cleaning of the trough is advisable, especially when handling materials that are corrosive, moist or have a tendency to set.
- Also check periodically for damage and excessive wear.

Shaft and seals

- Check for signs of wear on shaft at the interfaces where bearings, chain sprockets are fitted on to the shaft.
- Check clearances if any.
- In case the shaft ends are passing through some seal arrangement, check seals for leakage. Adjust packing or replace with new as required.

Servicing of Conveyor Components

In most cases, this involves removing an unserviceable part and installing a replacement. Specific instructions for the removal of various conveyor components follow.

- To remove a section(s) of conventional conveyor screw, proceed from end opposite the drive.
- Remove trough end, conveyor screw sections, coupling shafts, and hangers until all screw sections are removed, or until damaged or worn section is removed.
- To reassemble, follow above steps in reverse order.

MODULE - IV

Maintenance Practices for Wooden Slat Conveyor System

General Considerations

- Establish routine periodic inspection of the entire conveyor to ensure continuous maximum operating performance.
- Practice good housekeeping. Keep the area around the conveyor and drive clean and free of obstacles to provide easy access and to avoid interference with the function of the conveyor or drive.
- Lock out power to motor before doing any maintenance work—preferably with a padlock on control. Do not remove padlock from control or operate conveyor until covers and guards are securely in place.

To obtain the optimum return on conveyor systems, the following components that typically make up a conveyor system must be maintained:

Sprocket and Chain

- Remove drive chain guard and inspect all chains and sprockets.
- Chain should have ¼" or 2% sag, when measured on the lower run of chain, half way between the two sprockets. A loose chain can jump the drive sprockets and can cause sprocket wear and failure. A tight chain requires excessive motor power, and can cause chain and sprocket failure.
- Inspect drive sprocket and pulley set screws for tightness against the reducer and pulley shafts.
- Check sprocket alignment. Misalignment causes wear on one side of the sprocket.
- Check for a misaligned shaft or a sprocket off centre.
- Check shaft bearing set screws. Lubricate all chains with SAE-30 oil approximately every 40 hours of operation. Lubricate more frequently under extreme ambient conditions. Rinse chain in solvent before lubricating.
- Re-install chain guard after inspection and maintenance.
- Check slat bolts and tighten as necessary.

Motor and Reducer

- Make sure the reducer is filled to the proper level with oil.
- Make sure breather hole is clean and the orifice is open.
- Inspect reducer for leaks.
- Use only oil recommended by the reducer manufacturer.
- Check motor fan air holes are clear.

Rollers and Bearings

- Check all shafts and sprockets for tightness. All shafts must rotate freely. If a shaft does not turn freely check for dirt accumulation in bearing area and clean.

- Lubricate all flange type bearings that have grease fittings. Use NLGI Grade 2 Lithium base grease, Shell Alvania EP2, or equal. Listen to bearing for excessive noise. Replace as required.

Conveyor Bed and Supports

- Check conveyor frame, splices, supports, and bearings for loose or missing hardware. Replace hardware as required.

Cleaning

- Periodically remove drive chains and clean by immersing in solvent and scrubbing with a wire brush. Rinse thoroughly and re-lubricate.
- Verify proper chain tension. Clean chain box and keep free of all debris.

Troubleshooting

TROUBLE	CAUSE	SOLUTION
Conveyor does not start or motor stalls.	• Motor overloaded Check conveyor loading against design parameters. • Motor drawing excessive current.	• Check if motor rating is appropriate. • Check circuit breaker
Excessive wear on drive chain and/or sprockets	• Lack of lubrication. • Sprockets out of alignment. • Loose drive chain.	• Lubricate chain. • Align sprockets. • Correct chain slack.
Loud popping and/or grinding noise	• Defective bearing. • Loose drive sprocket set screw. • Loose drive chain.	• Replace bearing. • Tighten sprocket set screws and check key. • Correct chain slack.
Motor or reducer overheating. (Note: Many motors and reducers can be hot to the touch and still be operating within normal parameters.)	• Conveyor overloaded. • Low voltage to motor. • Reducer lubricant level low.	• Check conveyor loading against design parameters. • Correct voltage level as stated on motor name plate. • Fill reducer reservoir.
Chain drive moves with jerky motion.	• Conveyor overloaded. • Loose chain.	• Check conveyor loading against design parameters. • Tighten chain.

MODULE-V

Maintenance Practices for Belt Conveyor System

General Considerations

- Establish routine periodic inspection of the entire conveyor to ensure continuous maximum operating performance.
- Practice good housekeeping. Keep the area around the conveyor and drive clean and free of obstacles to provide easy access and to avoid interference with the function of the conveyor or drive.
- Lock out power to motor before doing any maintenance work—preferably with a padlock on control. Do not remove padlock from control or operate conveyor until covers and guards are securely in place.

It is important to establish a routine periodic inspection of the entire conveyor to ensure maximum continuous operating performance

Important: Lock Out/Tag Out all power from conveyor drives before performing any inspection on the Conveyor.

To obtain the optimum return on conveyor systems, the following components that typically make up a conveyor system must be maintained:

Safety and Control

Check that all safety devices are in good working order and are not damaged. In particular, check that emergency stop cords, located in all accessible areas along the conveyor, are not frayed or loose.

Drives, Motor and Reducer

- Make sure the reducer is filled to the proper level with oil.
- Make sure breather hole is clean and the orifice is open.
- Inspect reducer for leaks.
- Use only oil recommended by the reducer manufacturer.
- Check motor fan air holes are clear.

Lubrication

- Lubricate all Plummer block or pillow block type bearings that have grease fittings. Use NLGI Grade 2 Lithium base grease, Shell Alvania EP2, or equal. Listen to bearing for excessive noise. Replace as required.

Belting

- Check that splices are in good condition and have no raised edges that could catch on and damage skirt seals, belt wipers, and other components.
- A belt should only be tight enough to prevent slipping on the drive pulley and sagging between troughing idlers.

- If a cut or tear is serious, a section of belt may need to be cut out and a new section of belt spliced in. The two most common methods of belt splicing are vulcanizing and mechanical splicing. Vulcanizing usually is preferred because it creates a stronger splice and has a longer service life.

Pulleys, Head and Tail Sections

- Check the condition of the head, tail, bend, and take-up pulleys. Loose or worn rubber on a pulley can cause a belt to slip or track to one side.
- Check that the tail pulley is aligned with the head pulley, bend, and take-up pulleys, and that all pulleys are set at 90 degrees to the centre line of the conveyor structure. In addition, ensure that all pulleys are level.

Idlers, Troughing, impact and return

- Check that all idlers and rollers are turning. The friction caused by a travelling belt against a frozen idler can quickly wear thro u g h the idler. This can create a razor-sharp edge that can easily and quickly cut a belt.
- if idlers and bearings do not receive sufficient grease they can stop turning and cause heat build-up that can destroy bearings and wear through the walls of an idler.

Skirting and Belt scrapers

- Check the condition of wear liners in chutes and along skirt boards. A cracked and loose liner along a skirt board can quickly tear a belt to shreds if not replaced immediately. In addition, a liner that becomes loose and falls onto a belt can find its way into other equipment where it can do major damage.
- Check that rubber sealing strips along skirt boards are providing an adequate seal. Seals should be checked while material is travelling along the belt because the position of the sealing strip against the belt can be dramatically diff e re n t between a loaded and unloaded belt.
- Skirt boards, which usually are constructed of metal, should not be allowed to contact the belt. Rather, the gap between the skirt board and belt should be sealed with a strip of flexible rubber clamped to the outside of the skirt board. The clamps should allow the sealing strip to be adjusted easily.
- If a scraper wears away, the metal bracket it is mounted in can contact a belt and cause serious damage. In addition, an ineffective scraper allows material to collect in areas where it can create additional problems.

Belt Conveyors Troubleshooting

This easy to use guide can help you find the solution to common problems with belt conveyors. Once you find the problem, refer to the cause/solution next to them.

TROUBLE	CAUSE AND SOLUTION
Belt runs off at head pulley or tail pulley	1. Idlers or pulleys out-of-square with centre line of conveyor - Realign. Install limit switches to prevent damage. 2. Idlers improperly placed - Relocate idlers or insert additional idlers spaced to support belt. 3. Pulley lagging worn - Replace worn pulley lagging. Use grooved lagging for wet conditions. 4. Pulleys too small - Use larger diameter pulleys. 5. Frozen idlers - Free or replace idlers. Lubricate. Improve maintenance. 6. Material between belt and pulley.
Belt slip	1. Pulley lagging worn - Replace worn pulley lagging. Use grooved lagging for wet conditions. 2. Insufficient traction between belt and pulley - Increase wrap with snub pulleys. In wet conditions, use grooved lagging. Install cleaning devices. Tighten take-up. 3. Counterweight too light - Recalculate weight required and adjust counterweight or screw take-up accordingly.
Material spillage between belt and pulley, rollers etc	1. Use skirt boards. Remove accumulation. Install cleaners. Improve maintenance. 2. Skirts improperly placed - Install skirt boards so that they do not rub against belt. 3. Material build-up - Remove accumulation. Install cleaning devices. Improve housekeeping. 4. Improper loading, spillage - Feed should be in direction of belt travel and at belt speed, centred on the belt. Control flow.
Ply separation	1. Damage by abrasive, acid, chemicals, heat, mildew, oil - Use belt designed for specific condition. For abrasive materials working into cuts and between plies, make spot repairs with cold patch or with permanent repair patch, seal metal fasteners or replace with vulcanized step splice. Enclose belt line for protection against rain, snow, or sun. 2. Excessive tension - Recalculate and adjust tension. Use vulcanized splice within recommended limits.

Questionnaire

1. **What is the width of majority of belt conveyors used in Sulphate Production unit?**

a. 600 mm.
b. 800 mm.
c. 650 mm.
d. 1000 mm.

2. **What is the full form of FRL in the context of pneumatic circuit?**

3. **What is the type of pneumatic cylinder used in weighbridge arrangement?**

a. Single Acting.
b. Single Acting with cushioning.
c. Double Acting.
d. Double Acting with cushioning.

4. **What is the container named within which the screw of a screw conveyor system rotates?**

5. **What is meaning of troughing angle?**

6. **How many needles are used in the stitching machine?**

7. **What is the maximum value of air supply pressure at which the compressor is set to run?**

a. 4 kg/cm2
b. 6 kg/cm2
c. 8 kg/cm2
d. 12 kg/cm2

8. **What is the meaning of pitch of a chain?**

Answer Key

1. **600 mm.**
2. **Filter Regulator Lubricator.**
3. **Double Acting with cushioning.**
4. **Trough.**
5. **The arrangement of idler rollers in such a way so that the belt forms a curvature or trough when it rests on the idlers. The angle of inclination of idlers is called troughing angle. As shown in figure 1**
6. **One.**
7. **6 kg/cm2**
8. **Pitch is the distance between the hinge pins of the individual links. As shown in figure 2.**

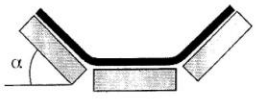


Fig-1

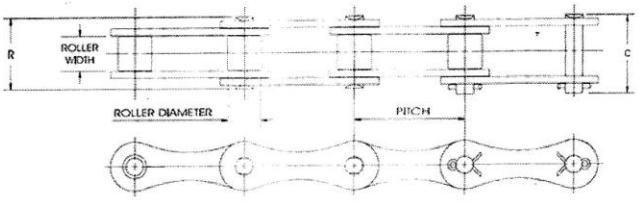


Fig-2

Any Suggestions for improvement

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

Name: _____

Designation: _____

Department: _____

Signature: _____