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REFRIGERATION PLANT TROUBLESHOOTING : 1. EQUIPMENT

This bulletin includes technical and latest development on products, systems, techniques etc. reported in journals, companies' leaflets and books and based on studies and experience. The technical information in different issues is on different areas of plant operation. It is hoped that the information contained herein, if employed in the dairy plant, will help in making its operations more efficient.

The theme of information in this issue is **Refrigeration Plant Troubleshooting (Equipment).** It may be understood that the information given here is by no means complete.

In this issue ...

1. INTRODUCTION

Refrigeration system is the heart of a dairy plant. Its trouble-free operation is necessary to ensure the smooth operation of several dairy equipment and to ensure the quality of milk and milk products.

Technews Issue 10 (September – October 1997) had included information on some refrigeration plant problems, their causes and remedies. More detailed guidelines are provided in this issue and the next one. This issue provides equipment-related possible problems and their solution, whereas the next issue (July – August 2000) would detail system-related problems.

When any problem arises, all available information on trouble spots should be critically analyzed and noted before undertaking repairs or replacing components. Always make a detailed visual inspection of the area and look for heat-damaged electrical components, loose wiring, damaged piping and even missing component. Then use the following guide to logically analyze, and solve the problem.

2. COMPRESSOR DOES NOT START

Symptom / Possible Causes	Suggested Remedial Measures
a) Control circuit is open	
▪ One of the protective switches is tripped.	*Remove cause, check setting and reset.*
▪ Anti-recycle timer is timing out	*Wait for timer to complete cycle. Depending on motor size, this may take up to 30 minutes. (screw compressor only)*
▪ No power supply to control circuit	*Check power supply and fuses.*
▪ Compressor capacity control not in minimum position.	*Reset.*
▪ Emergency stop switch engaged.	*Reset.*
▪ Interlocked equipment not yet started.	*Check the sequence and switch on the required equipment.*
▪ There is no call for the compressor to start (screw compressor only).	*Repeat starting sequence*
b) No power to motor	
▪ Check the power to and from fuses.	*Replace fuses if required.*
▪ Check starter contacts, connections, overloads and timers.	*Repair or reset as necessary. Check power at motor terminals.*
▪ Check motor windings.	*Repair or replace as necessary.*
▪ Thermistors not reset.	*Wait for winding temperature to drop. (Note that this can take at least 20 minutes).*
▪ Main circuit breaker tripped.	*Reset*
c) Motor shorted or seized/Burnt out	
▪ Check motor.	*Repair or replace as required.*
▪ Mechanical failure of compressor (sheared coupling).	*Repair or replace as required.*

Symptom / Possible Causes	Suggested Remedial Measures
d) Insufficient oil pressure to allow start: ▪ Defective start-up oil pump. ▪ Blocked oil strainer. ▪ Low oil level ▪ Start-up oil pressure switch incorrectly set or faulty. e) System pressures beyond settings (suction & discharge) ▪ See next issue, sections 3 & 6	*Repair or replace.* *Clean.* *Replenish with correct grade oil.* *Reset or repair*

3. COMPRESSOR MOTOR HUMS BUT DOES NOT START

Symptom / Possible Causes	Suggested Remedial Measures
a) Low voltage to motor ▪ Check incoming power and phase voltage.	*Remove discrepancy if any.* *Repair or replace as required.*
b) Motor shorted or seized: ▪ Check motor. Mechanical failure of compressor	*Repair or replace as required.*
c) Compressor seized: ▪ Manually turn shaft to check compressor.	*Repair or replace as necessary.*
d) Compressor not unloaded ▪ Check capacity control system - ▪ Inadequate oil pressure. ▪ Faulty unloading mechanism solenoid malfunctioning.	*Reset or repair and test.* *Remove the cause. See next issue section 8* *Check the circuit and remove the cause.*
e) One phase of power not supplied (brownout) ▪ Check wiring, fuses and incoming power.	*Repair*

4. COMPRESSOR SHUTS DOWN IMMEDIATELY AFTER STARTING

Symptom / Possible Causes	Suggested Remedial Measures
a) Low oil pressure ▪ See next issue, section 8 b) High discharge pressure ▪ See next issue, section 3 c) Low suction pressure ▪ See next issue, section 6 d) High oil temperature ▪ See next issue, section 9 e) High discharge temperature ▪ See next issue, section 12	

5. COMPRESSOR SHORT CYCLES

Symptom / Possible Causes	Suggested Remedial Measures
a) High discharge pressure ▪ See next issue, section 3 b) Low suction pressure ▪ See next issue, section 6 c) Cap. control not modulating ▪ See section 9 d) Lack of refrigerant ▪ Check for leaks.	*Repair & Recharge system.*
e) No other symptoms ▪ Faulty protective switch.	*Check both electrical and mechanical function of switches. Repair or replace as necessary.*
f) Low pressure controller differential set too close	*Too frequent stopping &starting. Reset differential according to plant operating conditions.*
g) Faulty condensing	*See section 12*
h) Excessive high discharge pressure	*Purge non-condensible Gases.*

6. COMPRESSOR RUNS CONTINUOUSLY

Symptom / Possible Causes	Suggested Remedial Measures
a) Lack of refrigerant	
▪ Check for leaks.	*Repair & recharge system.*
b) Low temperature in the process.	
▪ Welded contacts on electrical control in motor circuit.	*Repair or replace faulty Controls.*
c) Low suction pressure	
▪ See next issue, section 6	
d) Compressor noisy	
▪ See section 8	
e) No other symptoms	
▪ Faulty protective switch solenoid valve in capacity regulating system.	*Repair or replace as necessary. Check both electrical and mechanical function of switches.*
f) Excessive load, high temp in The process	*Stagger the loading if possible.*

7. COMPRESSOR MOTOR RUNS HOT

Symptom / Possible Causes	Suggested Remedial Measures
a) Bearings and stator are above normal operating temperature	
▪ Too many starts in a given period.	*Check for cause of excessive number of starts See section 5*
▪ Anti-recycle timer set incorrectly.	*Check and reset or replace if faulty.*
▪ Motor ventilation fan blades broken/loose.	*Repair or Replace.*
▪ Motor ventilation ports blocked.	*Clean.*
▪ Ambient temperature too high.	*Blow air over motor or reduce room temperature.*
▪ Bearings lubricated in-correctly.	*Add or remove grease.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Bearings worn or defective.	*Replace.*
▪ Motor drawing too much current.	*Check ampere ,unloading relay and overload switch. Replace if faulty.*
▪ Unequal phase voltage.	*Test at motor starter and plant supply.*
▪ Low voltage.	*Test at motor terminals and plant supply. Notify power supplier*

8. COMPRESSOR VIBRATING OR NOISY

Symptom / Possible Causes	Suggested Remedial Measures
a) High suction pressure	
▪ Damaged or worn thrust bearings (screw compressors). To test, stop the compressor and, if the internal pressure rises rapidly to the condensing pressure, then the bearings are damaged.	*Repair or replace.*
▪ Suction valves worn or damaged (reciprocating compressors). To check, throttle the suction stop valve and, if the pressure does not drop, the valves are worn.	*Relap or replace.*
▪ Discharge valves worn or damaged (reciprocating compressors).	*Relap or replace.*
▪ Dry or scored seal squeals or squeaks when compressor runs	*Check oil level, replenish. If seal is scored, change it.*
b) Low oil pressure	*Replace.*
▪ Compressor bearings worn.	
c) No other symptoms	*Check, realign and retighten.*
▪ Coupling or flywheel loose, out of alignment or unbalanced.	

Symptom / Possible Causes	Suggested Remedial Measures
▪ Key sheared or missing.	*Replace*
▪ Loose belts (on belt-driven machines).	*Check pulley grooves and align and tighten belts or replace.*
▪ Mounting or foundation bolts loose or in disrepair.	*Tighten, repair or remount.*
▪ Vibration mount rubbers sheared or springs worn.	*Replace.*
▪ Liquid refrigerant in suction line. (Liquid stroke)	*Check evaporator controls (liquid feed valves, expansion valves etc.) clean and reset or replace as necessary. Close suction valve until pounding stops, then gradually reopen suction valve. Consider install liquid traps if problem persists.*
▪ Compressor damaged or worn internally, friction between rotor, rotors & defective bearings.	*Open, inspect and repair as necessary.*
▪ Low oil level.	*Check level and top up as necessary. Important: Do not mix oil types. Use specified grade oils.*
▪ Insufficient support for suction and discharge lines.	*Add hangers, supports, etc. as needed.*
▪ Compressor operating outside manufacturers' specifications	*Check that compressor runs at correct speed, within compressor limits.*

9. COMPRESSOR CAPACITY CONTROL

Symptom / Possible Causes	Suggested Remedial Measures
a) <u>Plant not responding to changes of product heat load</u>	
▪ Capacity-control pressure switch set incorrectly or defective.	*Reset or replace as necessary.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Timing relay faulty or out of adjustment.	*Replace or reset.*
▪ Capacity-control system faulty or out of adjustment.	*Check individual components and wiring. Repair, reset or replace as needed.*

10. PUMP/SUCTION ACCUMULATOR

Symptom / Possible Causes	Suggested Remedial Measures
a) Low liquid level	
▪ Low refrigerant charge in system.	*Add refrigerant to correct level.*
▪ Refrigerant not returning from evaporator.	*Check and clean evaporator controls.*
▪ Liquid level control faulty or set incorrectly.	*Repair or reset*
▪ Refrigerant regulating device at evaporators faulty or out of adjustment.	*Repair or readjust.*
b) High liquid level	
▪ Liquid level control faulty or set incorrectly.	*Repair or reset.*
▪ Accumulator holding surge volume of system.	*Wait for refrigerant to return to evaporators.*
▪ Liquid feed assembly solenoid valve faulty.	*Repair or replace.*

11. OPERATIONAL PROBLEMS IN LIQUID REFRIGERANT PUMP

Symptom / Possible Causes	Suggested Remedial Measures
a) Pump does not run	
▪ No power supply at motor.	*Check: mains switch, fuses, connecting cable.*
▪ Differential pressure switch actuated.	*Check pump control system.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Liquid in accumulator below low level.	*Allow the liquid level to build up in accumulator.*
▪ Coupling defective.	*Check & replace if necessary.*
b) Protective motor cut-out made.	
▪ Mech. blockage after standstill.	*Rotate coupling by hand if necessary, remove foreign body in pump.*
▪ Viscous oil filling in pump.	*Drain pump of compressor oil and check that it does not fill again.*
▪ Pump runs as turbine before starting	*Check non return valve.*
▪ One phase is missing or mains voltage wrong.	*Check supply voltage supply from panel*
▪ High switching frequency.	*Check plant control system.*
▪ Motor winding defective.	*Check & replace motor if necessary.*
c) Pump fails to produce discharge pressure/pressure fluctuates	
▪ Lack of refrigerant.	*Check and recharge with refrigerant if necessary.*
▪ Wrong direction of rotation of pump.	*Check electrical connection, exchange 2 phases if necessary.*
▪ Pump shut-off valve closed.	*Check open position.*
▪ Pressure gauge defective.	*Check and replace if necessary.*
▪ Shaft broken.	*Check and replace if necessary.*
▪ Desired discharge pressure not attended at the pump outlet	*Check the gasification valve and purge any gas formed in the pump casing etc.*
▪ No throttles at evaporator inlets.	*Throttle the valve as required.*
▪ Dirt filter blocked.	*Clean.*
▪ Incorrect inlet conditions:	
– Inlet height too low (suction head)	*Consult installation agency*
– Diameter of inlet too small	
– Pump suction line does not have constant incline.	

Symptom / Possible Causes	Suggested Remedial Measures
– Gas bubbles in incorrectly mounted fittings.	
▪ Pump speed too low.	*Check frequency of power supply.*
▪ Large fluctuations at heat exchanger.	
▪ Operation at max. pump delivery pressure.	*No overflow valve or incorrect settings used.*
d) Pump makes loud noises	
▪ Pump too large.	*Replace with correct size pump.*
▪ High sound level from piping system.	*Check installation & provide necessary supports.*
▪ Operation at max. pump delivery pressure.	*No overflow valve or incorrect settings used.*
▪ Pump is cavitating.	*Install anti-vortex plates or differential pressure controllers in suction line to pump. Purge oil from accumulator & pump.*
▪ Liquid not being pumped to evaporators	*Suction and discharge valves closed or installed incorrectly. Check and open or repair.*
▪ Unbalanced or damaged impeller.	*Repair or replace.*
▪ Check usual pump faults such as misalignment, worn bearings, etc.	*Repair or replace as necessary.*
▪ Blocked suction strainer.	*Clean the strainer.*
▪ Oil in pump suction.	*Drain.*
Note: Ensure accumulator pull-down rate due to compressor is low enough to avoid liquid foaming in pump suction system. Anti-vortex plates will not protect against this condition.	*Also, see possible cause 'c' above for incorrect inlet conditions.*
e) Pump runs in wrong direction	
▪ Pump runs as turbine before starting.	*Check non return valve.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Wrong direction of rotation of pump.	*Check electrical connection, exchange 2 phases if necessary.*
f) Pump discharge pressure drops	
▪ Dirt filter blocked.	*Clean.*
▪ Pump speed too low.	*Check frequency of supply.*
▪ Wear on impellers/ inter-mediate pieces.	*Check and replace if necessary.*
g) Low oil level in sight glass (on pump casing)	
▪ Inner axial face seal defective.	*Check and replace if necessary.*
▪ Wrong oil in pump.	*Pay attention to oil specification and pour point.*
h) Inner axial face seal leaking or Outer axial face seal defective.	
▪ Pump runs as turbine before starting.	*Check non return valve.*
▪ Lack of refrigerant.	*Check and recharge with refrigerant if necessary.*
▪ Dirt filter blocked.	*Clean.*
▪ Evaporator temperature drops too quickly.	*Adjust compressor capacity control system.*
▪ Pump speed too low.	*Check frequency of power supply.*
▪ Operation at max. pump delivery pressure.	*No overflow valve or incorrect settings used.*
▪ Wrong oil in pump.	*Pay attention to oil specification and pour point.*
▪ Heavy contamination of refrigerant.	*Check filter function.*
▪ Motor will not rotate after long standstill.	*Preventive measures: move by hand.*
▪ Gas bubbles form when pump is operated continuously.	*Stop pump for approx. 2 minutes every day.*
▪ Valve spindle was not open.	*Check and open completely.*
▪ No oil.	*Fill with special oil, remedy cause of leak.*

Symptom / Possible Causes	Suggested Remedial Measures
i) Oil leaking at shaft outlet.	
▪ Outer axial face seal defective.	*Replace.*

12. CONDENSER OPERATIONAL PROBLEMS

Symptom / Possible Causes	Suggested Remedial Measures
a) Poor water supply	
▪ Water supply not turned on at mains.	*Check and turn on.*
▪ Water supplied at low pressure.	*Check and switch on required no. of pumps remove trapped air from pump & lines.*
▪ Water pump leaking.	*Check seals, etc., and repair or replace as applicable.*
▪ Water valves not opened	*Reset or open.*
▪ Blocked water sprays	*Clean or replace.*
▪ Blocked strainer on inlet to pump.	Clean
▪ Water temperature into shell-and-tube condenser too high.	*Ensure adequate water circulation to maintain TD 5 Deg.C.*
▪ Blocked lines.	*Inspect and clean.*
▪ Water boxes on shell-and-tube condenser internally corroded allowing water bypass.	*Repair or replace.*
b) Plugged tubes (Vertical shell & tube).	
▪ Check for scales, algea etc.	*Descale the tubes mechanically*
c) Excessive water consumption. (evaporative condenser)	
▪ Eliminators damaged or installed upside down.	*Replace or install correctly.*
▪ Sump drain plug loose or missing.	*Tighten or install new plug.*
▪ Sump or water boxes leaking.	*Check and repair.*

Symptom / Possible Causes	Suggested Remedial Measures
d) Poor air flow (evaporative condenser)	
▪ Fans rotating in wrong direction.	*Check rotation and motor wiring. Repair.*
▪ Blocked air inlet screens.	*Clean*
▪ Blocked eliminator blades or dampers.	*Eliminators rusted and collapsed. Clean or replace.*
▪ If condenser is positioned indoors.	*Check doors are open to give adequate air flow.*
▪ Dust or plastic bags blocking fins.	*Remove large objects, brush fins and blow through with compressed air.*
▪ Air recirculation from exhaust to inlet.	*Install ducting. Relocate condenser.*
e) Other symptoms for faulty condenser operation	
▪ Air or other non-condensable gases in system.	*Purge system*
▪ Corroded or fouled tubes or fins.	*Clean and renew.*
▪ Check all inlet and outlet valves on both the refrigerant side and water side are fully open.	
▪ Oil in condenser coil/shell.	*Drain.*
▪ Too much refrigerant in the system.	*Remove refrigerant until level is visible in liquid receiver sightglass.*
▪ Check fan belt drive not slipping.	
▪ Check liquid refrigerant does not hold up in condenser coils (multiple condenser installations).	
▪ Check piping connections are correctly sized and installed.	

13. EVAPORATOR

Symptom / Possible Causes	Suggested Remedial Measures
a) Product temperature high	
▪ Lack of refrigerant.	*Check strainers, liquid feed valves, expansion valves and other evaporator feed controls. Check chilled fluid or air flows. Clean, repair, reset or replace as necessary.*
▪ Also check liquid refrigerant pump and refrigerant level in liquid receiver.	*Charge if low level.*
b) Evaporator fouled	
▪ Surface fouled by ice, oil or product deposits.	*Drain oil and clean surfaces. Defrost the ice from fins and tubes.*
▪ Defrost hot gas leaking through valve.	*Check, repair or replace the valve*