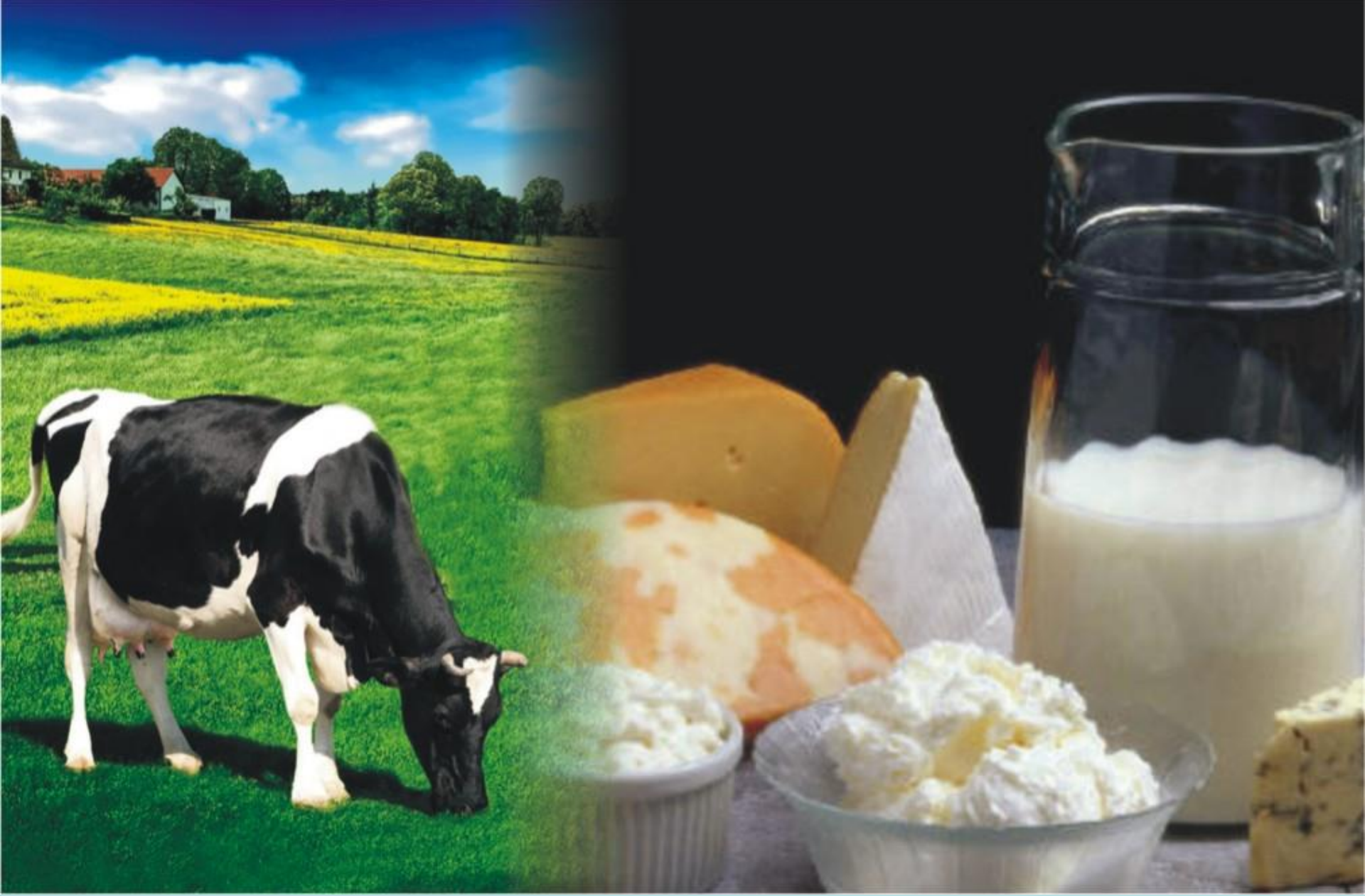




FRICK INDIA LIMITED
WELCOMES ALL OF YOU



**“Energy Efficient Refrigeration
Technologies In Dairy Sector Latest Trends
And Innovations”**

MOHAN GHARAD

(MANAGER)

FRICK INDIA LIMITED

EMAIL – mumbai@frickmail.com

MOB – 09833994591

(SECRETARY)

ASSOCIATION OF AMMONIA REFRIGERATION (AAR)

WEB SITE – ammoniaindia.org



FRICK INDIA LIMITED - Introduction

- ❖ FRICK INDIA LIMITED was incorporated as a public limited company in 1962 in collaboration with Frick Company USA.
- ❖ Over the years Frick India has developed into one of the front ranking companies rated amongst the world's best.
- ❖ Frick India provides refrigeration equipment for almost all Industrial Refrigeration Applications.



Frick India Limited

FRICK ADVANTAGES



DESIGN



SERVICE



INSTALLATION

**One
Name of
Responsibility**



COMMISSIONING



MANUFACTURE

You Still Can't Beat the System When It's all FRICK



Total Area of Factory

Covered : 2,88,936 Sq. Ft.

Uncovered : 4,22,514 Sq. Ft.

FRICK INDIA LTD



In house staff : 488

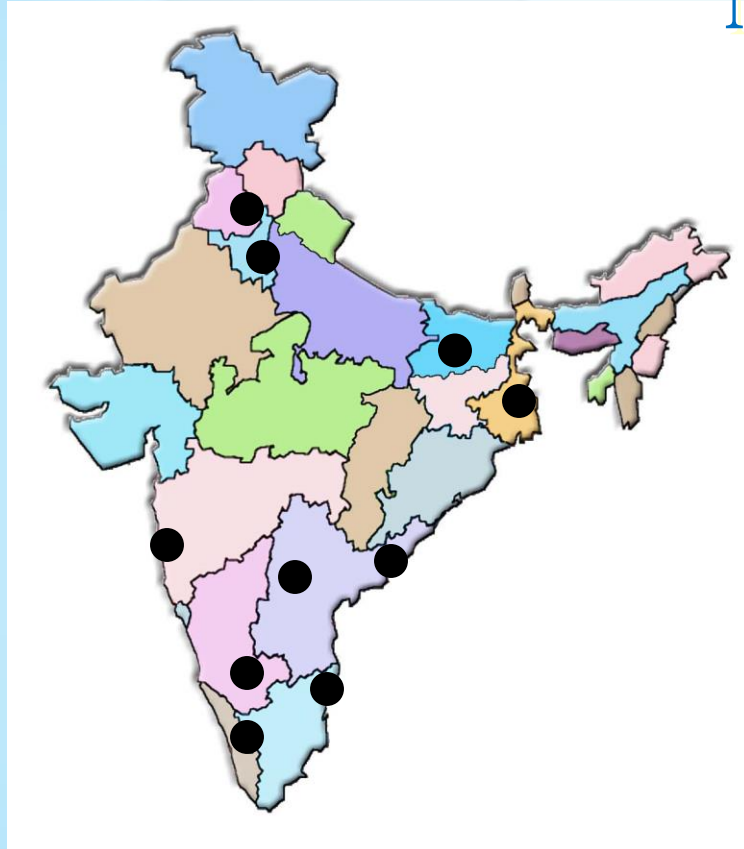
Qualified Technical Personnel : 125

Technical Quality Control Personnel : 25

Skilled Technician : 338



Frick India Service Network

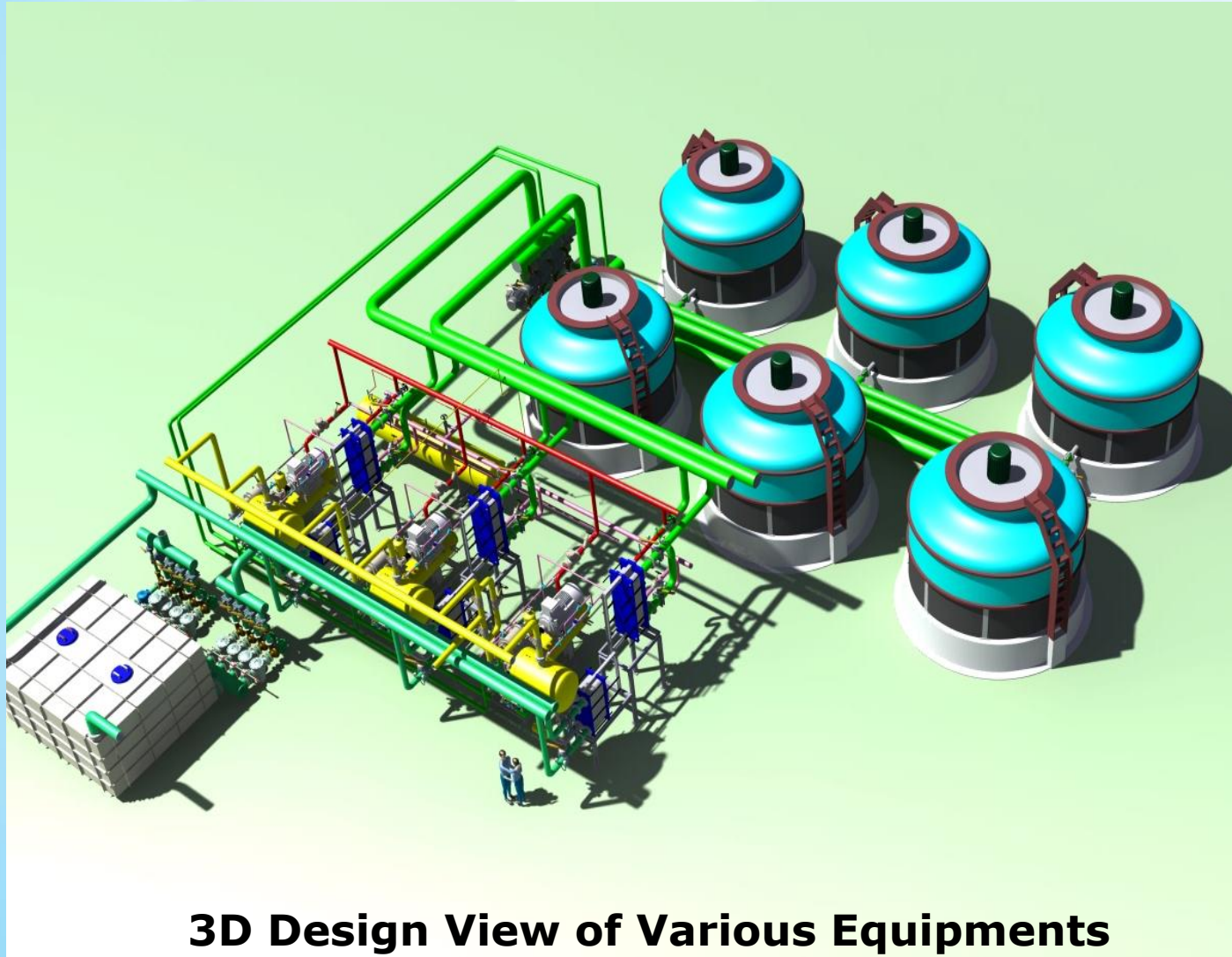


- FARIDABAD-FACTORY
- DELHI (H.O.)
- MUMBAI
- CHENNAI
- KOLKATA
- JALANDHAR
- PATNA
- SECUNDERABAD
- BANGALORE
- COCHIN
- VIZAG
- AHMEDABAD (2016)

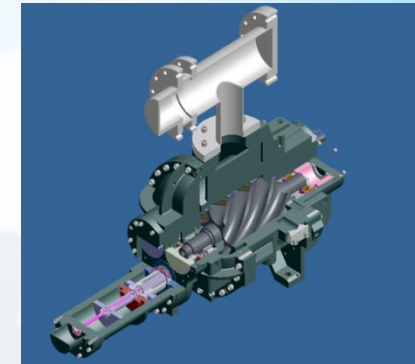
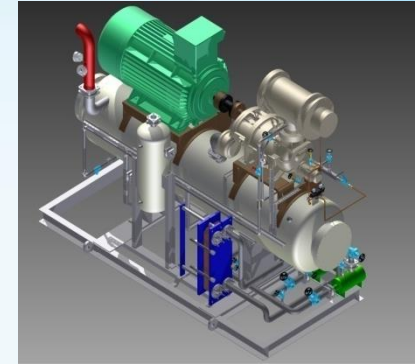
All Branches are fully equipped to provide support from ***Design*** to ***After Sales Services*** in their surrounding area within no time.

R & D & ENGINEERING DEPT R&D Design Section

INTEGRATED PRODUCTION FACILITIES



3D Design View of Various Equipments



R & D & ENGINEERING DEPT.

TESTING RIG IN OUR FACTORY



Frick India limited offers complete capacity and efficiency testing for all models of screw blocks in their in-house testing rig installed as per ISO 917:1989(E) standards.

FOUNDRY & PATTERN SHOP DEPTT.

Foundry Deptt. : 25,040 Sq.ft.



FRICK INDIA LTD

MACHINING DEPARTMENT Machine Shop





CNC Machining at Factory



MAIN REFRIGERATION LOAD IN DAIRIES

CHILLED WATER LOAD

DIRECT REFRIGERATION LOAD



REFRIGERATION LOAD IN DAIRIES



DIRECT REFRIGERATION LOAD



- 1. MILK COLD ROOMS**
- 2. BUTTER COLD ROOM**
- 3. DAHI COLD ROOM**
- 4. BLAST FREEZERS**



REFRIGERATION LOAD IN DAIRIES



CHILLED WATER LOAD



- 1. MILK CHILER**
 - i. RAW MILK**
 - ii. TANKER MILK**
- 2. MILK PASTERIZATION**
- 3. BUTTER MILK CHILLER**
- 4. AGEING TANKS**



REFRIGERATION LOAD IN DAIRIES

CHILLED WATER LOAD

MILK CHILLER

- **RAW MILK CHILLER : MILK IS CHILLED BY USING CHILLED WATER FROM 34 Deg C to 4 Deg C**
- **TANKER MILK CHILLER : CHILLED MILK COLLECTED FROM VARIOUS CHILLING CENTER IS CHILLED FROM 10 Deg C to 4 Deg C**

REFRIGERATION LOAD IN DAIRIES

CHILLED WATER LOAD

- **MILK PASTERIZATION : All Milk Chilled in Milk Chiller in further pasteurized and then cooled by Chilled Water from 14 Deg C to 4 Deg C**
- **BUTTER MILK CHILLER = 45 Deg C to 4 Deg C**
- **AGEING TANKS = 8 Deg C to 4 Deg C**

REFRIGERATION LOAD IN DAIRIES

CHILLED WATER APPLICATION

➤ **MILK PASTEURIZER :**



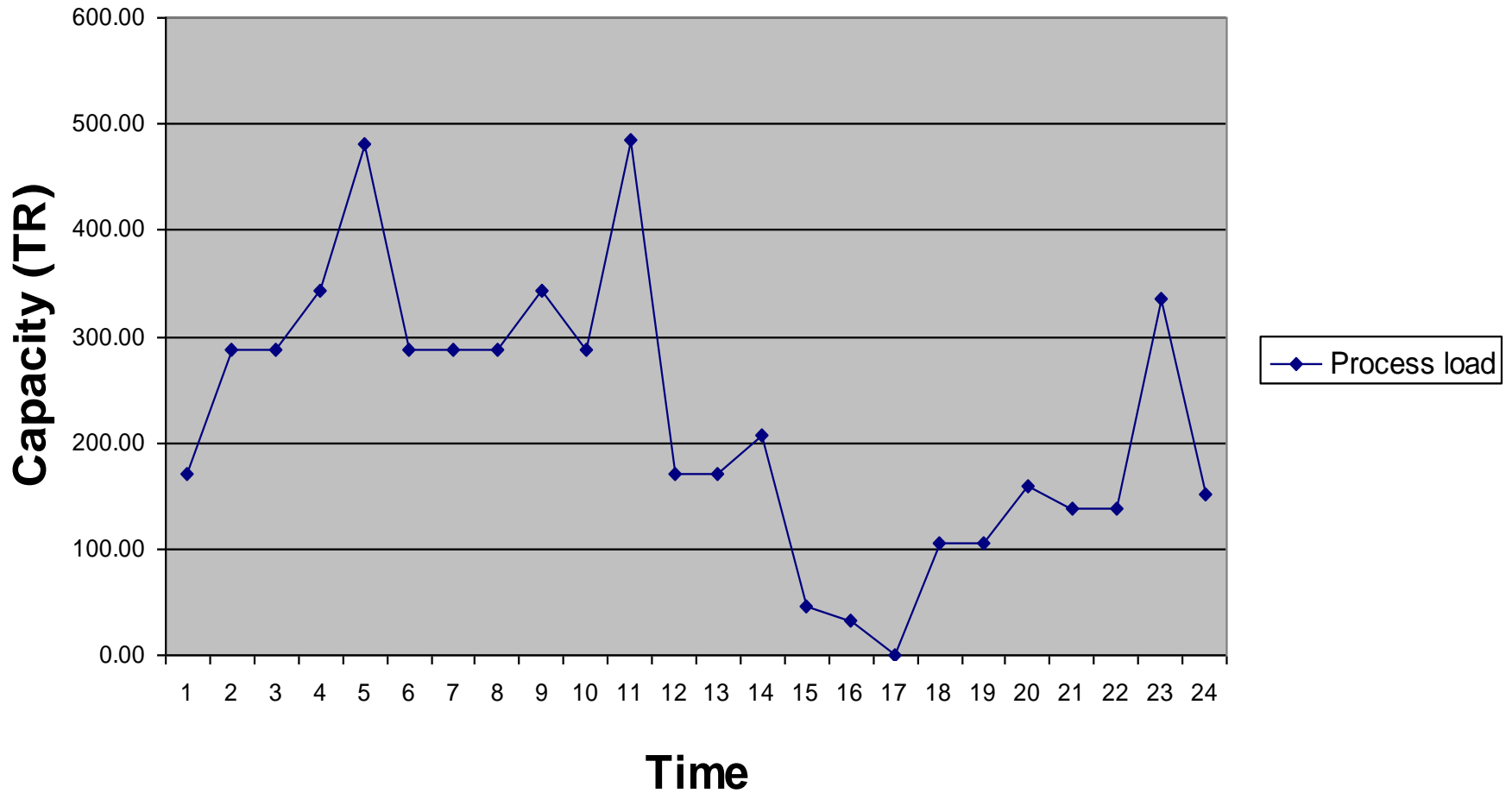
REFRIGERATION LOAD IN DAIRIES

CHILLED WATER LOAD

- **Calculation of refrigeration capacity**
- **Plotting a histogram**
- **Decide a base load for the refrigeration**
- **Design a optimum system**

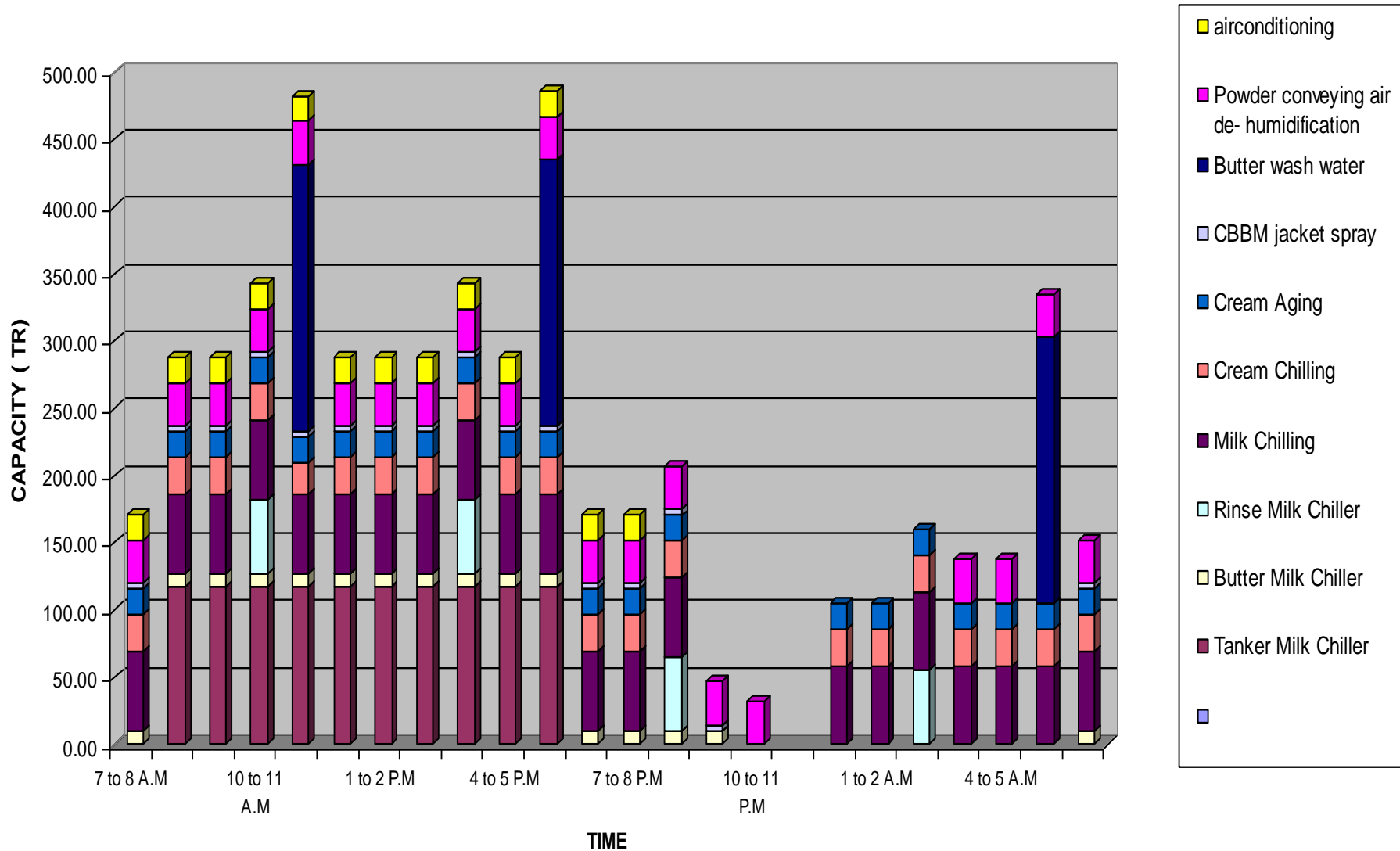


Load distribution





HISTOGRAM



- Total Load = 5, 292 TR / day
- Average Load / 20 Hrs = 264.6 TR
- Peak load = 483.38 TR

TYPES OF CHILLED WATER GENERATION

- **IBT SYSTEM : This is conventional system**
- **ICE SILO**
- **IBT/ ICE SILO + PRE CHILLER SYSTEM : A combination of IBT And Pre Chiller depending upon load histogram.**
- **PHE CHILLER :**
 - i. Chilled Water PHE**
 - ii. Chilled Glycol System for Deep Chilling**

TYPES OF CHILLED WATER GENERATION

- **IBT SYSTEM : This is conventional system**



TYPES OF CHILLED WATER GENERATION

ADVANTAGES OF IBT SYSTEM :

- ❖ **Thermal Storage of energy available**
- ❖ **Refrigeration plant capacity smaller**
- ❖ **Latent heat available**
- ❖ **Safe during power cuts/ break downs**

- Total Load = 5, 292 TR / day
- Average Load / 20 Hrs = 264.6 TR
- Selection of coil length normally thumb rule 110 -120 rft /tr

PHE / FALLING FILM CHILLER WITH IBT SYSTEM

The concept of Pre (PHE) Chiller and IBT combination i.e. return water from process will be pre chilled in the PHE/Falling film chiller and fed into IBT for further chilling.

In the above system, power saving will be enormous



Pre Chillers with IBT In Dairy Plant

PRE (Phe) Chiller

In a Dairy, 60,000 liters of milk will be processed in 4 Hours in the morning and 40,000 liters of milk will be processed in 2-½ Hours in the evening.

For a 15,000 LPH milk process PHE chilled water flow of 30,000 LPH shall be circulated with a temp range of 12 to 0.5 °C. 12 Deg C return water shall be pre chilled to 2 Deg C in a PHE chiller and fed into IBT for further chilling down to 0.5 °C.



FRICK INDIA LTD

	IBT System	IBT cum Pre chiller
Total handling of milk	2.00 Lakhs	2.00 Lakhs
No of compressor	2 nos screw (1w+1S)	2 nos Screw (1 w + 1 s)
Comp. connected motor working	1nos. x 215 HP	1 no. x 180 HP
Suction/ Cond temp.	-10 ⁰ C / 38 ⁰ C	-5 ⁰ C / 38 ⁰ C
System Details	IBT	Pre chiller with IBT
Liq. pump system	Yes	Yes
Condenser Type	Evaporative Condenser	Evaporative Condenser
Refrigeration Capacity	150 TR	150 TR
Comp. BKW/ TR	0.95	0.782

ONLY PHE CHILLERS

The concept of only (PHE) Chiller has also been introduced without ice bank tank but with a hot and cold well or buffer tank

The compressor size increases

better for peak loads



For the above chilling, heat load works out to 125 TR (approximately), a screw compressor selected @ $-2\text{ }^{\circ}\text{C}$ SST & $40\text{ }^{\circ}\text{C}$ SDT delivers refrigeration capacity of 129.23 TR which consumes 138.29 BHP.

$$\begin{aligned} \text{BKW / TR} &= 0.746 \\ \text{Power consumption in} & 129.23 \text{ TR} \times 0.746 \text{ BKW / TR} \times 6.5 = 626 \\ \text{a day} & \text{ Hours of Operation} \text{ Units} \end{aligned}$$

Equivalent IBT System

The BKW/TR of a SCREW compressor for an IBT application at $-10\text{ }^{\circ}\text{C}$ SST & $40\text{ }^{\circ}\text{C}$ SDT will be 1.01.

$$\begin{aligned} \text{Total refrigeration capacity required per} & 129 \text{ TR} \times 6.5 \text{ Hours} = 838 \text{ TR Per} \\ \text{day} & \text{ Day} \\ \text{Considering 20 Hours of operation} & 838 \text{ TR} / 20 \text{ hours} = 42 \text{ TR} \\ \text{BKW / TR @ } -10\text{ }^{\circ}\text{C SST \& } 40\text{ }^{\circ}\text{C} & = 1.01 \\ \text{SDT will be} & \\ \text{Power consumption} & 42 \text{ TR} \times 20 \times 1.01 = 840 \text{ Units per} \\ & \text{day} \end{aligned}$$

From saving of approx 25 TO 30 % with the above , you will notice a unit (power) Pre-Chiller system

SELECTION OF REFRIGERANT

FRICK

**Ammonia –
A Natural Refrigerant**

FRICK

Environmental issue and natural refrigerants

Depletion of Ozone Layer

Global Warming

- ❖ Montreal Protocol (1987)
- ❖ CFC : Fazed out in 1996
- ❖ HCFC : Regulation starts in 2004 to be fazed out by 2020

- ❖ Kyoto Protocol (1997)
- ❖ Requires : Reduction 6% of green house gases compared to 1990 level (First target annual : 2008~2012)
- ❖ Regulated gases : 3 gases such as HFC

Recovery and disposal of Fluoro-carbon (Freon) law : Refrigerants CFC, HCFC, HFC

PRTR :Aw (Chemical Control promotion law) : HCFC22, HCFC123, EG Brine etc.

Utilization of natural refrigerants

Refrigerants

- The choice of refrigerants for refrigeration and air conditioning systems in buildings is undergoing rapid change.
- A new regulation on ozone depleting substances has banned recycling of CFCs for maintaining old CFC based systems.
- The regulation also bans the use of HCFCs in all new systems over the next 3 years and will ban the use of HCFCs for maintaining existing systems by 2015.
- HFCs were developed as replacements for CFCs and HCFCs but are now themselves under threat on account of their high global warming potentials.

Comparison of refrigerant characteristics

Refrigerant	OD P	GWP 100 years	Safety Group	COP ratio	Refrigeration Capacity	Discharge Pressure MPa	Discharge Temp. °C
HCFC-R22	.055	1700	A1	1	1	1.53	57.5
HFC-R134a	0	1300	A1	0.99	0.91	1.02	44.5
HFC-R404A	0	3870	A1/A1	0.89	0.68	1.83	44.8
HFC-R407C	0	1650	A1/A1	0.99	0.99	1.64	53.6
HFC-R410A	0	1980	A1/A1	0.93	1.0	2.41	57.2
HFC-R507A	0	3850	A1	0.88	0.65	1.88	44.4
R717(Ammonia)	0	<1	B2	1.04	6.90	1.55	93.3
R290(Propane)	0	3	A3	0.97	1.71	1.37	44.2
R600a(Isobutane)	0	3	A3	1.01	1.66	0.53	40.0
R744(CO2)	0	1	A1	0.63	0.85	9.0	72.0

Tc/Te = 40/00C (Sc = Sh=00C) (Calculated by REFPROP V6.01)

COP and Refrigeration capacity ratios are compared with R22

Discharge pressure at discharge temperature of 400C

Safety group is according to AHRAE standard safety group 34

A: Lower Toxicity, B : Higher toxicity 1: Nonflammable, 2: Flame resistant 3: Inflammable

ODP : Ozone Depletion Potential

GWP : Global Warming Potential

Ammonia – A Natural Refrigerants

- Ammonia is a colourless gas that liquefies under pressure and has a pungent odour.
- Ammonia is considered a natural refrigerant because it occurs in nature's material cycles.
- Ammonia is also an ideal refrigerant from a climate protection point of view
- It contributes neither to ozone depletion nor to global warming .
- Ammonia has no ozone depletion potential (ODP = 0) and no direct greenhouse effect (GWP = 0).
- Ammonia is combustible only to a limited degree; its ignition energy is 50 times higher than that of natural gas

Ammonia – A Natural Refrigerants

- Thermodynamic properties :means that its indirect global warming potential is also very low.
- Plants that use ammonia as opposed to other refrigerants have a better TEWI (Total Equivalent Warming Impact).
- The TEWI is the sum of the direct global warming impact – caused by the refrigerant lost through leakage and recovery

HEART OF THE REFRIGERATION SYSTEM



COMPRESSORS

FRICK

TYPES OF COMPRESSORS IN AMMONIA

RECIPROCATING
OR

SCREW COMPRESSORS

SELECTION OF EQUIPMENT

COMPRESSOR

- Heart of the Refrigeration System.
- Types of Compressor in Industrial Refrigeration
 - Reciprocating Compressor.
 - Screw Compressor.
- Compressor are selected based on the application & capacities.

SELECTION OF EQUIPMENT

Reciprocating Compressors

- Recip Comp are selected if the refrigeration capacity is less than 350 kW (100 TR).

Latest developments for energy optimization in reciprocating compressors

- High speed compressors
- Direct drive.
- PLC control panel



High Speed Reciprocating Compressors



450 XL Series Compressors

FRICK INDIA LTD 450 XL Series High Speed Cut Away Oil Flow

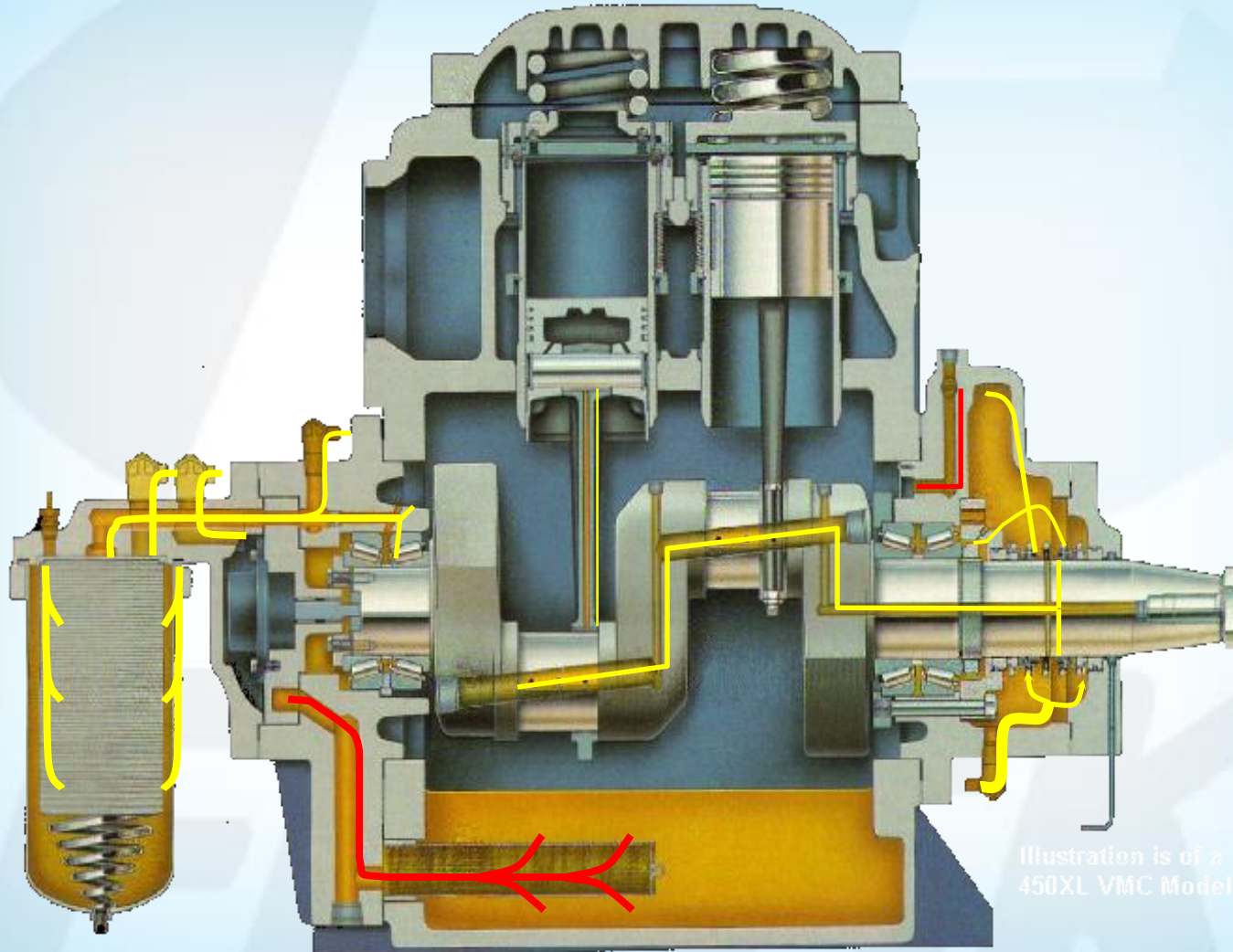


Illustration is of a
450XL VMC Model

450 XL Series Compressor Advantages

- 1. One piece ductile iron casting body**
- 2. Has advanced micro oil filter with three way valve to monitor pressure drop. Keeps the internals free of any foreign particles greater than 3 microns.**
- 3. Oil cooler attached**
- 4. Energy saving roller bearing to reduce frictional forces.**
- 5. Has a gauge to measure oil temperature in crankcase to maintain oil temperature. Leads to long life of both the oil and machine.**
- 6. Easy to Repair. Recovers full efficiency after repair.**
- 7. Superior un loader does not pump oil into the liner cavity. Has a separate piston type unloading system which is more efficient and with a lesser oil splash.**
- 8. Successfully running with 1200 RPM. Compact design can be directly coupled To 960 RPM motor**
- 9. Spring loaded Safety heads protect against liquid slugging.**

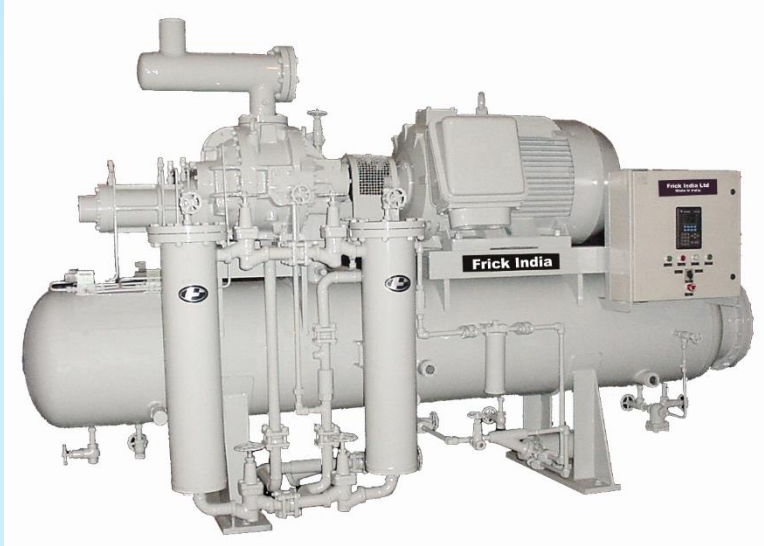
450 XL Series Compressor Advantages

- 10. Maximum Suction and Discharge Porting through the compressor achieves minimum pressure drop.**
- 11. Unique design of Piston and connecting rod assembly allows for movement only between the connecting rod bushing and piston ring, while providing positive lubrication throughout the compression cycle.**
- 12. The 450 XL piston ring set of three compression rings and a single, special oil scraper ring for keeping oil consumption to an absolute minimum.**
- 13. Double bellows Shaft Seal**
- 14. Vibration is minimum hence can be installed almost anywhere even on an upper floor if necessary.**
- 15. Noise level is minimum due to use of quick acting precise ring plate suction and discharge valve.**
- 16. Improved piston design**
- 17. These compressors can be belt driven upto 200 BHP or direct driven all the way to 250 BHP.**

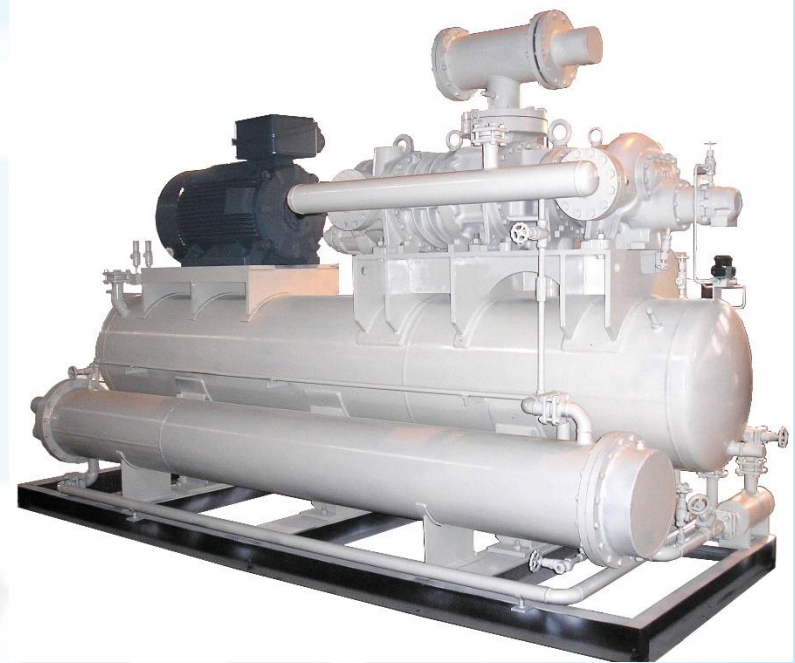
450 XL Series Compressors Packages



Screw Compressors



Screw Compressor Package

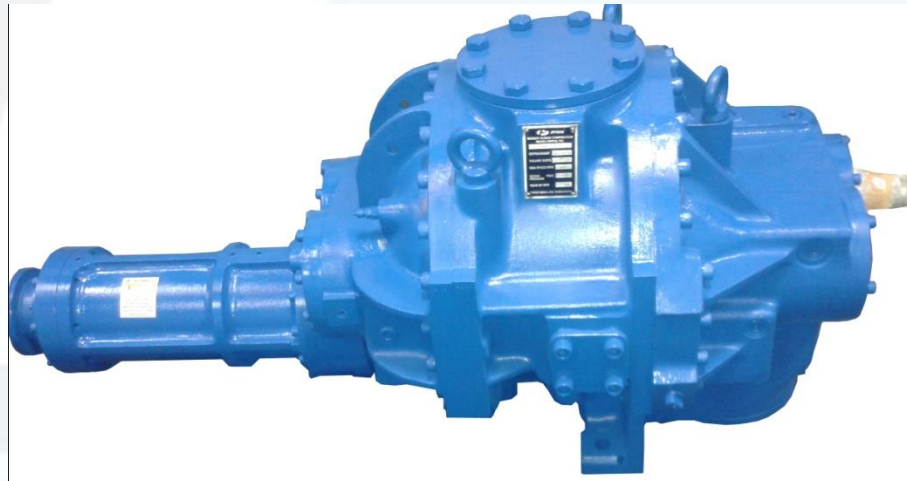


Two Stage Screw Compression System

Advantages



Frick India offers High Efficiency Twin Screw Blocks (Capacity Range : 521 m³/hr to 2290 m³/hr.) manufactured in our ISO 9001 certified and high precision Manufacturing Facility at Faridabad.



Capacity Range :
521 m³/hr.
to
2290 m³/hr.

Refrigerants

R - 717
R - 22
R - 290
R - 134a
R - 404a
R - 1270



Wide Temperature Range
minus 40
plus 40

Advantages



- “N Type” Rotor Profile World Patent 97/43550
- Tested as per ISO 917: 1989(E) and IS 10431 Standard
- Automatic Capacity Control from 10% to 100%
- VFD operation allows speed range of 1700 rpm to 3500 rpm
- Rigid Anti-frictional Roller Bearings having ISO B 10, Bearing Life more than 1,000,00 Hours.



Advantages



- Lowest Energy Consumption due to infinite volume control ranging 2.2 – 5.0
- API 619 design for gas application to comply 100% customer specification
- CE Proof conforming to EN:12693-2008
- Lowest Service Costs and Design Life of 20 years.

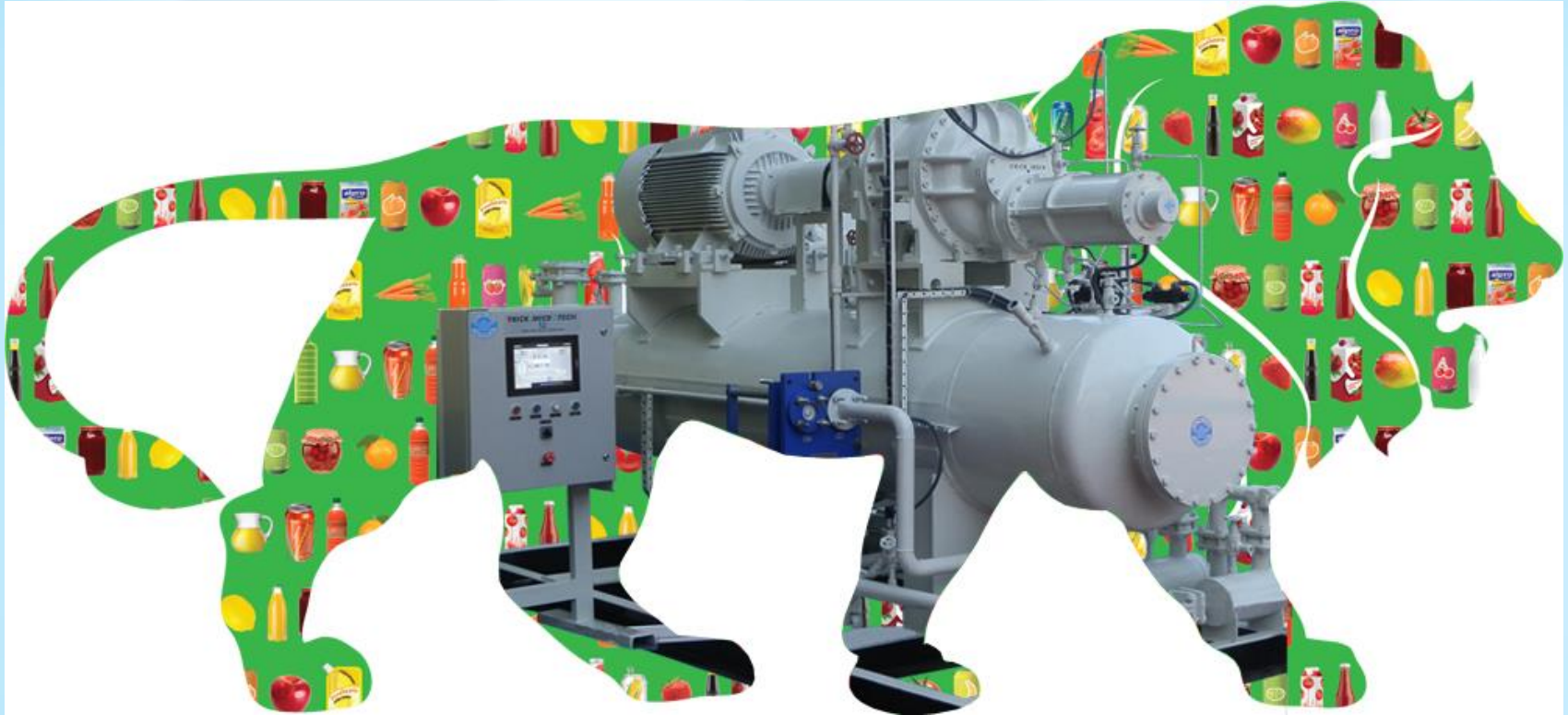


Advantages

- Little or no maintenance
- Reliability backed by Expertise.
- Lowest Energy Consumption
- Lowest Service Costs



Making in India



Screw Package with vertical oil Separator



Special features of Screw Compressor

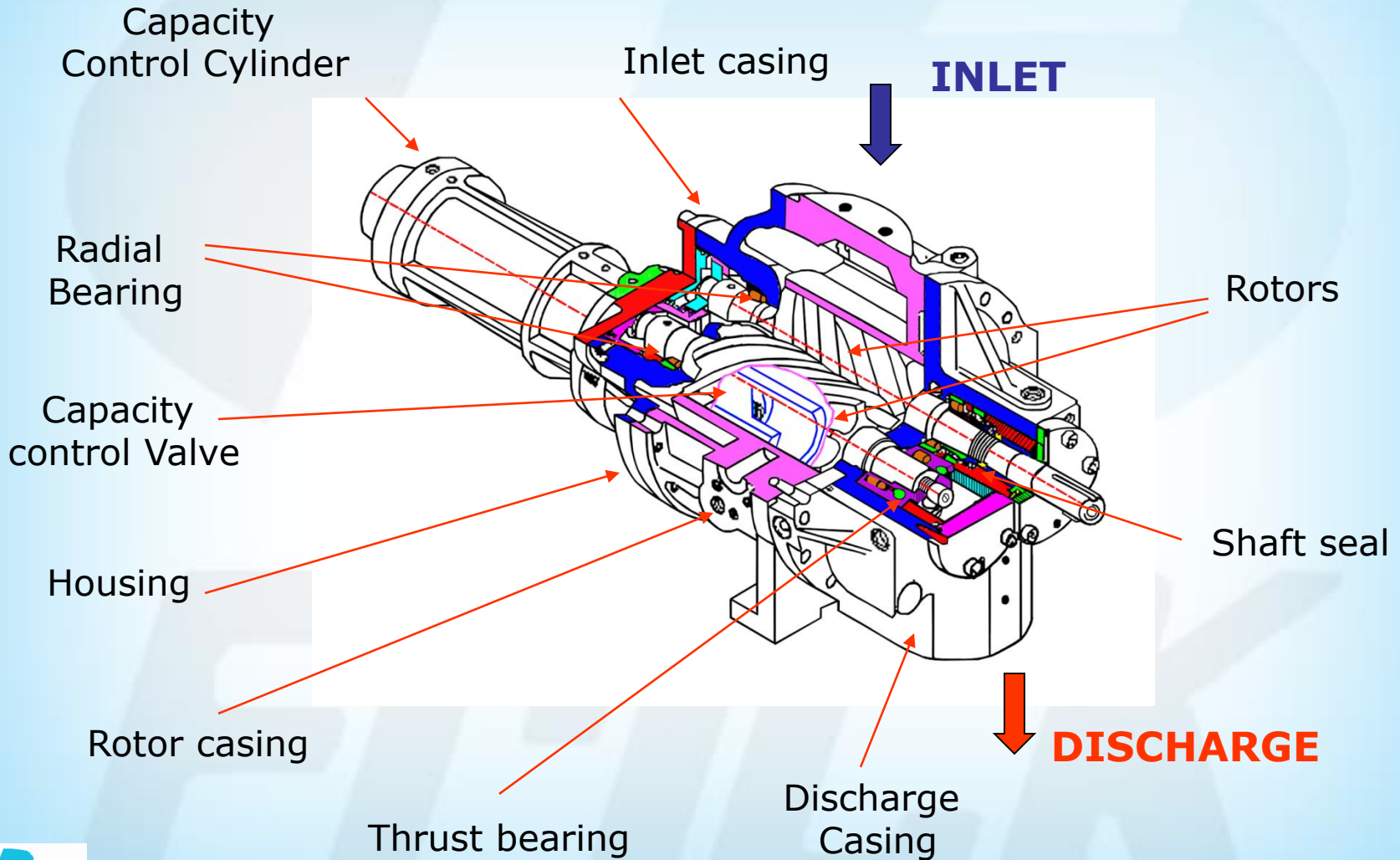
- Less Space for big plants
- Adapts better for power saving in large plants running at part load.
- Dual capacity control system monitors volume as well as compression control.
- Total installed horsepower reduces.
- Easy to automate
- Very low maintenance.

Ammonia Screw Compressor

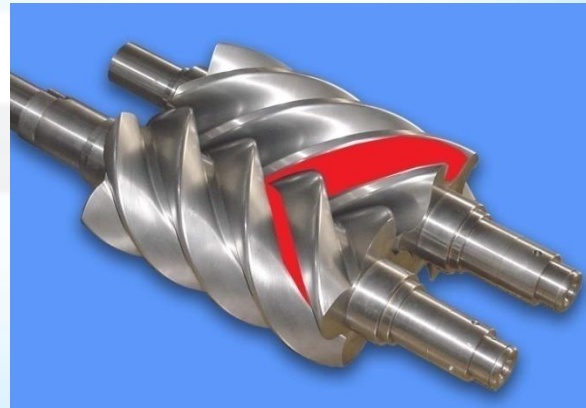
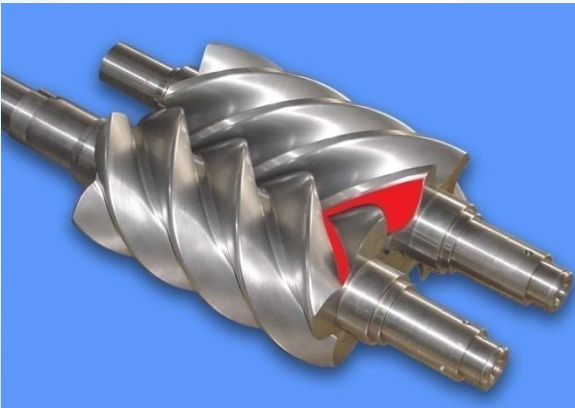
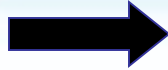
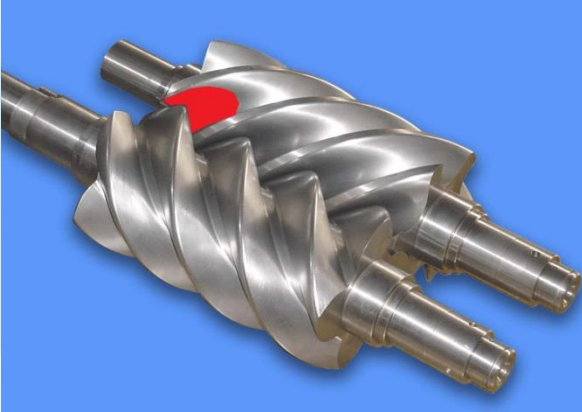
1. Power Saving : Less BKW / TR at same suction compare to any make Reecip compressor at least 0.09 to 0.10 BKW /TR
2. Moving part : No moving part ,So Less maintaintence.
3. Capacity control : 0-100%-Whereas stepwise in recip.
4. Direct Coupled : means no frictional loss

- 5. Oil Cooling System : Thermosiphon - no water cooling required**
- 6. No of Compressor : Eliminate 2 or 3 receip comp & motor and its maintenance cost.**
- 7. Maintenance : No - Upto 25,000,Hrs**
- 9. Connected Motor : At least 5 to 10% less.**

Parts of Screw Compressor Block



Compression



Advantages of Evaporative Condensers over Open type Condensers

Evaporative condenser is a water conservation device and in effect, a condenser and a cooling tower combined into a single unit.

Most of the refrigeration plants in dairies are having open type atmospheric condensers, which mean indirectly getting affected by power penalty. Power penalty by way of running the make-up water pump continuously due to water wastage by splashing, high wind velocity etc.



Here we highlight the advantages of evaporative condensers

The space required will be very less. You can also place the condenser on terrace of plant room

Construction of sump tank for open type condensers will be costlier, whereas no sump is required for evaporative condenser.

Very often changing of valves are required in atmospheric condensers due to continuous drenching of vapour / liquid valves

Atmospheric condenser and PHE Cond with cooling tower will consume around 50% more power than evaporative condenser approximately.

Evaporative Condenser

- **Less Space, no civil work required.**
- **Less Connected pump & fan motor.(at least 50%)**
- **Combination of S/T Condenser & Atmospheric Condenser.**
- **Run at lower condensing Temp – means BKW / TR of Compressor come down and it will reduce the power cost**

- For Example:-

For 150 TR plant need 18.5 KW for PHE Cond. With C.T combination as against 9.7 KW for Evaporative Condensers.

So app power saving will be,

= 8.8 KW x 20 Hrs. x 365 days

= **64520 units**

Advantages of using Re-circulation System

- ❖ **Superb refrigerant distribution**
- ❖ **Lower inlet liquid temperature**
- ❖ **Cut down capital costs**
- ❖ **High system efficiency**
- ❖ **Reduced operating expenses**
- ❖ **Low maintenance**
- ❖ **Protection of compressors from liquid slugs**
- ❖ **Tremendous power saving in operation.**



Liquid Pump System

- 1. Power Saving : 10 to 20%**
- 2. Refrigeration Feeding : 4 times more than normal system**
- 3. Reduce running time**
- 4. Other Advantages :**
 - a. Liquid entering never happen.**
 - b. Controls in Plant room**
 - c. Eliminate individual accumulator**
 - d. Reduce Eqts Size**
 - e. Better flow rate**
 - f. Gas (due to throttling) removed before evaporators.**
 - g. System remains constant temperature.**

Priority Vessel And Thermosyphon Oil Cooler



ADVANTAGES OF THERMOSYPHON OIL COLLING SYSTEM




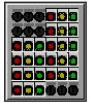
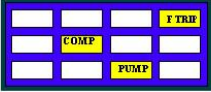
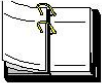



- There is no possibility of contamination of the cooling water circuit
- The water in the cooling circuit does not require to be diverted to produce free cooling
- The free cooling is produced by evaporation of a relatively small flow of refrigerant. Thus a
- Thermosyphon system might require 80 mm refrigerant piping and valves whereas a free cooling
- system, in which the water to be cooled is circulated directly through an ambient cooler, might require 250mm piping and valves.

Automation in Refrigeration Plant Operation.



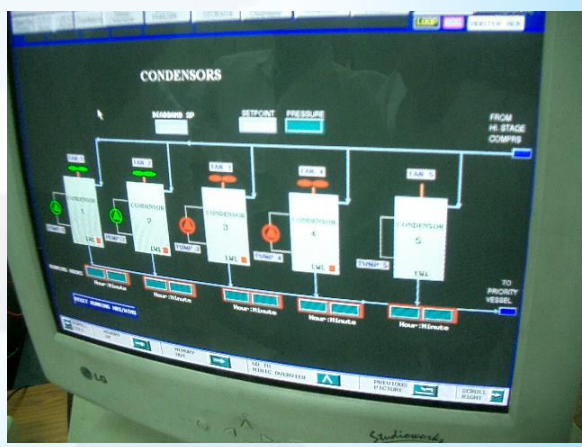
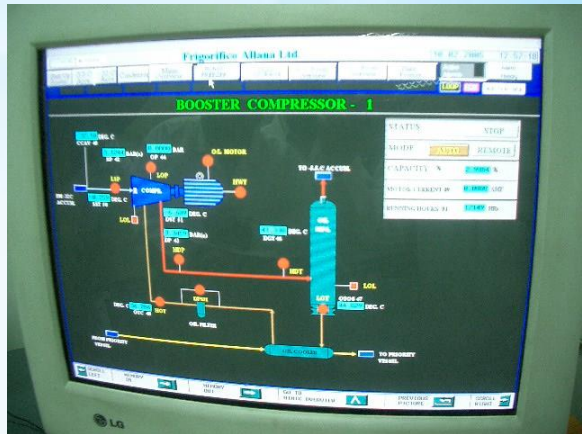
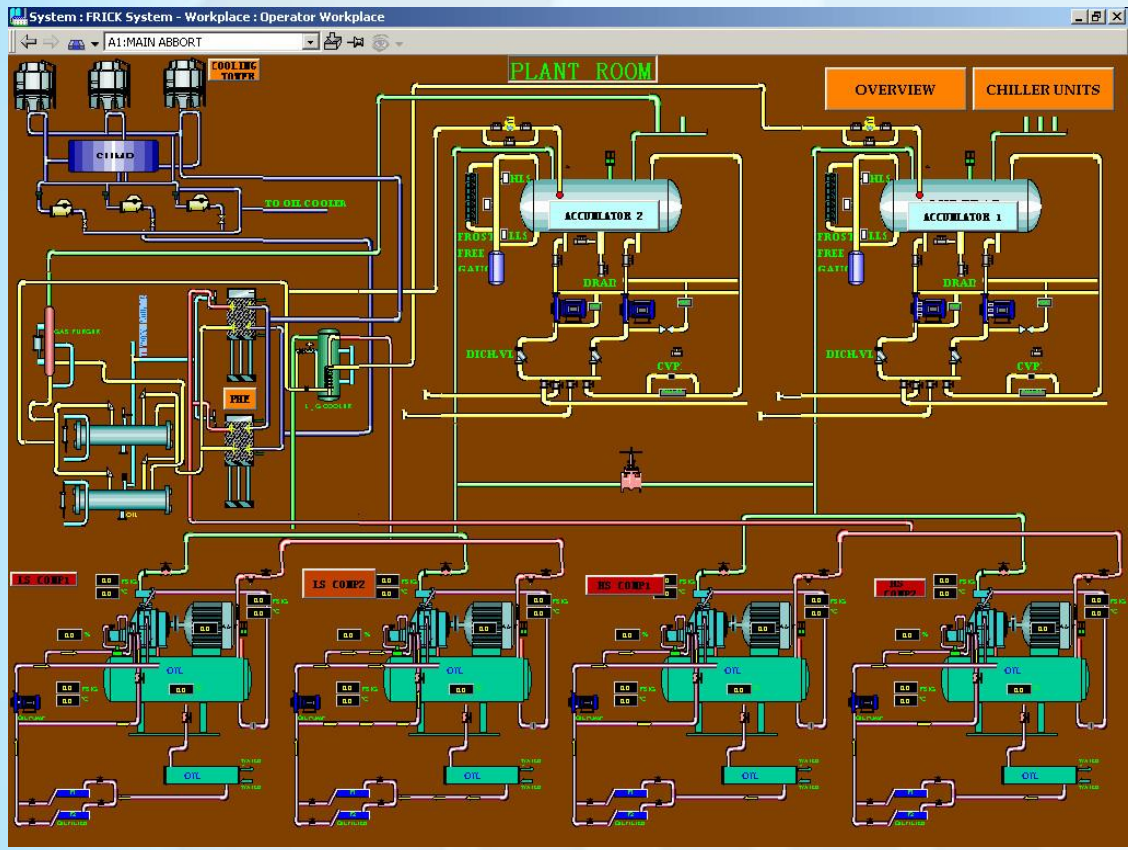
System : FRICK System - Workplace : Operator Workplace
Operator Workplace:Plant Overview

PLANT MENU

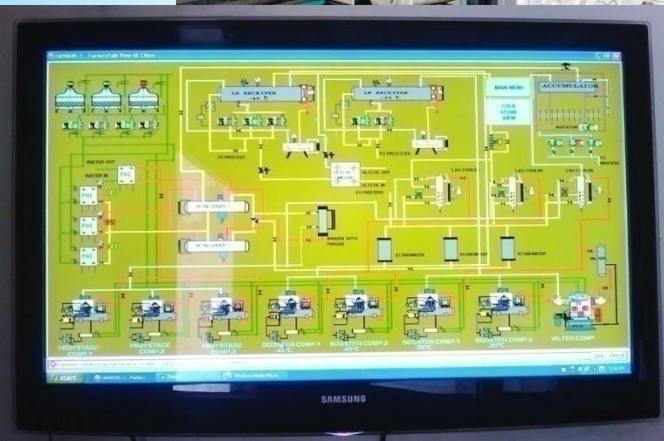
 PLANT ROOM	 FAULT ANNUNCIATOR	 PLANT DATA SHEET
 MOTOR CONTROL	 TRIP ANNUNCIATOR	 COMP DATA SHEETS
 HOT GAS DEFROSTING	 TEMPERATURE TRENDS	 PRESSURE TRENDS

Frick India Ltd.
21.5 km, Main Mathura Road, Faridabad - 121 003

Total Plant Control. centralized temperature recorder and interlocking electric circuit for various process controls can be interlocked to your PC/PLC



DATE	PANEL	1Shift			2Shift			3Shift									cost of
		start Reading	Stop Reading	Units	start Reading	Stop Reading	Units	start Reading	Stop Reading	Units	Ref.plant total units	Total units of Frc panel	PROD. LTR.	UNIT/LTR	RS. / LTR.	unit	
01/10/20	12																
	FRC-1	3581.21	3583.91	2700	3583.91	3585.73	1820	3585.73	3586.28	550	5070						
	FRC-2	837.24	838.62	1380	838.62	839.86	1240	839.86	840.05	190	2810						
	FRC-3	66159	66548	389	66548	66924	376	66924	66926	2	767	8647	51203.78	0.168874	1.220961	62517.81	
02/10/20	12																
	FRC-1	3586.28	3586.91	630	3586.91	3587.67	760	3587.67	3588.45	780	2170						
	FRC-2	840.05	840.34	290	840.34	840.52	180	840.52	840.82	300	770						
	FRC-3	66926	66926	0	66926	66926	0	66926	66999	73	73	3013	1	3013	21783.99	21783.99	
03/10/20	12																
	FRC-1	3588.45	3590.68	2230	3590.68	3592.9	2220	3592.9	3593.67	770	5220						
	FRC-2	840.82	841.99	1170	841.99	842.67	680	842.67	843.01	340	2190						
	FRC-3	66999	68206	1207	68206	68668	462	68668	68675	7	1676	9086	48987.68	0.185475	1.340986	65691.78	
04/10/20	12																
	FRC-1	3593.67	3595.59	1920	3595.59	3597.72	2130	3597.72	3598.48	760	4810						
	FRC-2	843.01	843.85	840	843.85	844.54	690	844.54	844.87	330	1860						
	FRC-3	68675	69819	1144	69819	70268	449	70268	70269	1	1594	8264	52904.08	0.156207	1.129378	59748.72	
05/10/20	12																
	FRC-1	3598.48	3600.68	2200	3600.68	3602.98	2300	3602.98	3603.68	700	5200						
	FRC-2	844.87	845.72	850	845.72	846.42	700	846.42	846.61	190	1740						
	FRC-3	70269	71313	1044	71313	71808	495	71808	71905	97	1636	8576	54818.8	0.156443	1.131081	62004.48	
06/10/20	12																
	FRC-1	3603.68	3605.89	2210	3605.89	3608.22	2330	3608.22	3609.12	900	5440						
	FRC-2	846.61	847.09	480	847.09	847.66	570	847.66	847.92	260	1310						



Compressor Motor & its Drives.

- Motor should select based on the efficiency.
- The efficiency of an electric motor is defined as the ratio of usable shaft power to electric input power.

Motor efficiency [%] = shaft Power [kW] / electrical input [kW]

- Based on the Efficiency level, Motor are classified as Eff1, IE1, IE2, IE3 motors.



Compressor Motor & its Drives.

For 200 kW Motor			
	IE1	IE2	IE3
Efficiency	0.94	0.95	0.96
Power consumed (kW)	212.76	210.53	208.33
For 20 Hours	4255.53	4210.53	4166.67
Per day consumption for unit charge approx Rs. 7 / unit	29787.23	29473.68	29166.67
Saving Per day	620.63		
Saving Per Annum (300 Days)	186189		

Types of Drives

- Soft Starter
- Variable frequency drive (VFD)

A variable frequency drive (VFD) is a motor control device that protects and controls the speed of an AC induction motor.

VFD can control the speed of the motor during the start and stop cycle, as well as throughout the run cycle.



VF D

For Screw Compressor

Slide valve Position at	Capacity (TR)	Power (BkW)	BkW/T R	Speed Control By VFD	Power (BkW)	BkW/T R	Difference
100 %	109.8	113.5	1.03	2950	113.5	1.03	
75%	81	93	1.14	2250	86.6	1.06	0.08
60%	68.6	84.2	1.22	1960	75.4	1.09	0.13
50%	61.6	79.2	1.28	1800	69.3	1.12	0.16
Say at 50% there is a 14% Saving							

VFD & Vertical in line pump for chilled water circulation

- **Installed HP of pump will be reduced**
- **Speed will vary depending upon load means reduce power cost.**
- **Increase overall efficiency.**

LATEST TRENDS

- **Introduction of VFD for compressors.**
- **Screw Compressors**
- **PHE/ Falling Film chiller +IBT**
- **Evaporative Condensers**
- **Liquid Ammonia pumping system**
- **Thermosyphon Oil Cooling system**
- **Chilled water pump automation with VFD**
- **Energy efficient motors IE 2 / IE3**
- **Automation of the complete plant**

NEW INNOVATIONS/CHALLENGES

- **LOW CHARGE AMMONIA REFRIGERATION SYSTEM**
- **CO2 REFRIGERATION SYSTEMS**
- **AMMONIA REFRERATION CHILLER SYSTEMS FOR COMMERCIAL AIRONDITIONING.**

Thank You
GEF – UNIDO- BEE- CII

YOU CAN MAIL YOUR QUERIES TO
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