Latest technological upgrades to improve Energy Efficiency in Pulp & Paper Mill

Naresh Madaan
AVP–Engineering

F AIRNESS
QU **A** LITY
C OMMITMENT
SUS **T** AINABILITY
CUSTOMER **S** ATISFACTION

Incorporated in 1985

Among Top 5 Paper Producers in India

Annual Group Turnover of ₹ 3,000 Crores

The Largest Waste-Paper based Mill in India

Diversified Product Range Packaging Board, Printing & Writing, Newsprint

Single Site with 36,000 MT p.m. Capacity

MACHINE DETAILS

PM - 1

PACKAGING BOARD - 1

(DUPLEX & FBB)

GSM - 230 - 450

Deckle - 284 - 290 cm

Max Capacity - 8000 MT

PM - 2

PACKAGING BOARD - 2

(DUPLEX)

GSM - 280 - 450

Deckle - 204 - 212 cm

Max Capacity - 5500 MT

PM - 4

WRITING & PRINTING, COPIER AND VAP

(MAPLITHO & COPIER)

GSM - 54 - 120

Deckle - 438 - 444 cm

Max Capacity - 10000 MT

PM - 5

WRITING & PRINTING, AND NEWSPRINT

(W&P & NEWSPRINT)

GSM - 42 - 56

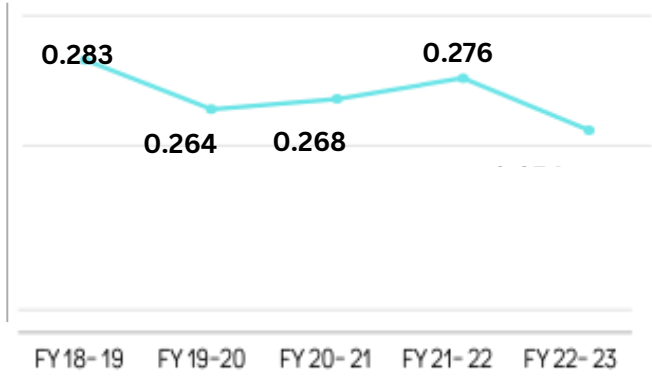
Deckle - 640 - 645 cm

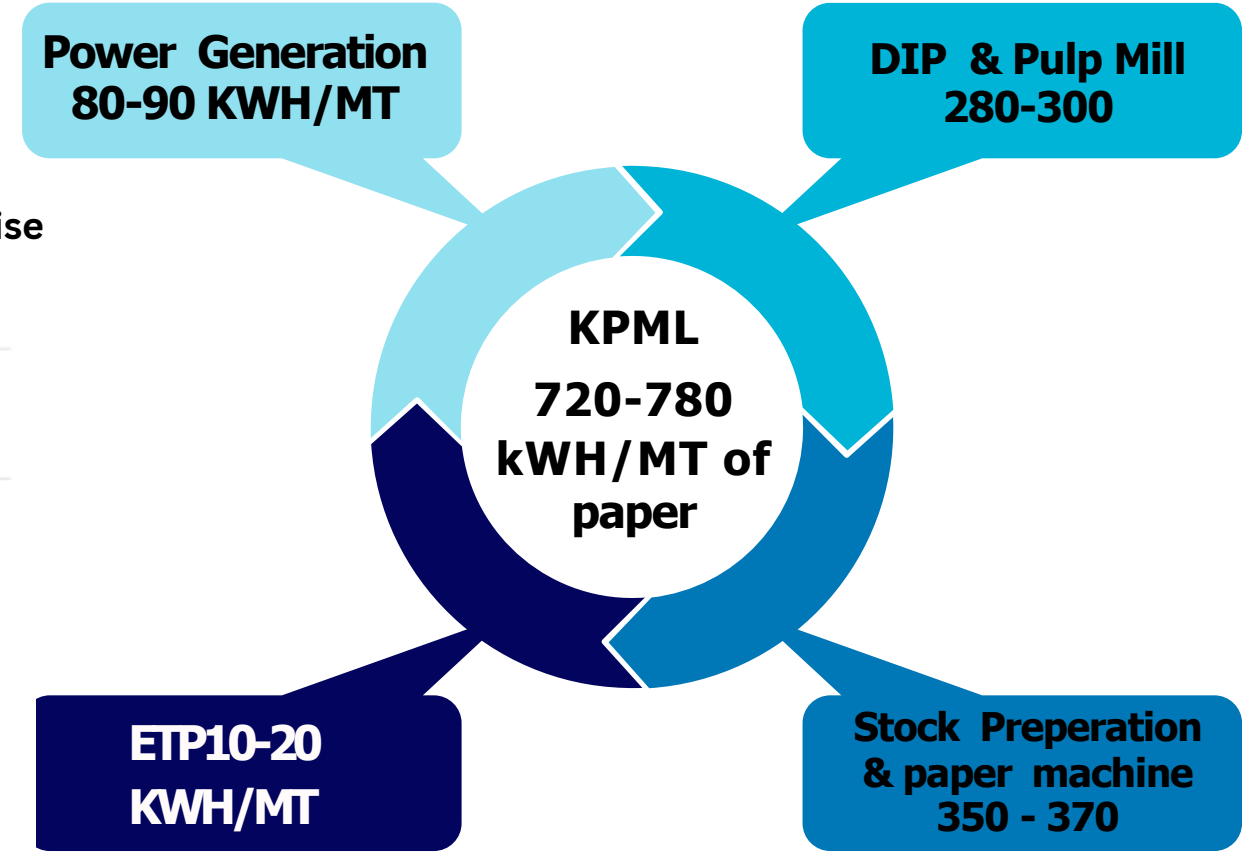
Max Capacity - 13000 MT

Energy and Power consumption overview KPML

KPML is operating at
0.252 TOE/Tonne of paper

Specific Energy consumption year wise
TOE/MT





State Energy Conservation Award-2022-2023

(Department of New and Renewable Energy, Government of Punjab)

PEDA Award

KPML Team

Replaced Liquid ring vacuum pumps with Turbo blower at PM-1 Machine

Vacuum Pump

Turbo Blower

Cost Saving Calculation Vacuum Pump Vs Turbo Blower PM-1

S.N.	Product Description	Capacity (M3/Hr)	Qty in No.	Power consumption in KWH/annum (Lacs)	Power Cost in Rs Lacs/Annum considering @ INR 7.0/KWH
1	Vacuum Pump	28080	6	41.5	291
2	Turbo Blower	21600	1	25.3	177
	Saving per Annum			16.2	113
Total Saving in Percentage					39

Replaced Liquid ring vacuum pumps with Turbo blower at PM-4 Machine

Vacuum Pump

Turbo Blower

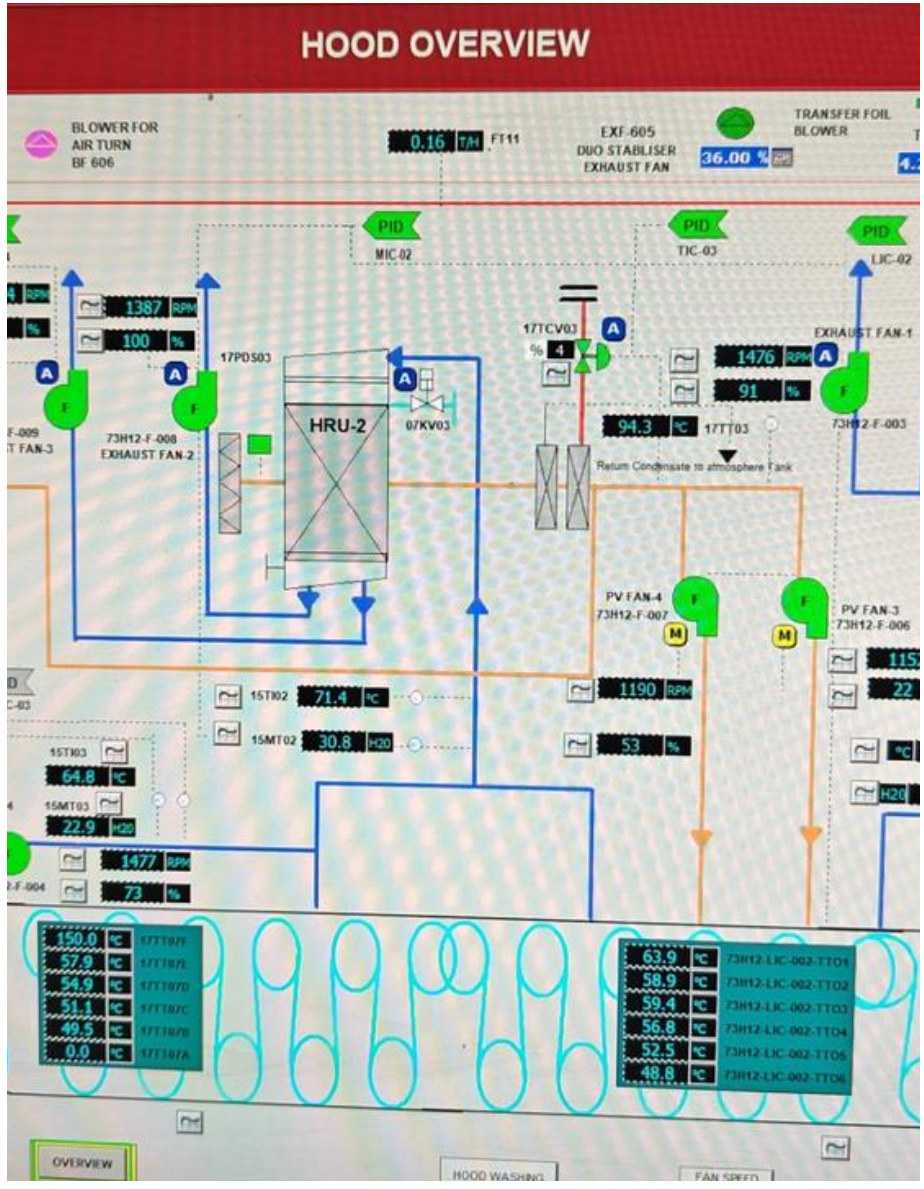
Cost Saving Calculation Vacuum Pump Vs Turbo Blower PM-4

S.N.	Product Description	Capacity (M3/Hr)	Qty in No.	Power consumption in KWH/annum (Lacs)	Power Cost in Rs Lacs/Annum considering @ INR 7.0/KWH
1	Vacuum Pump	53400	14	91.08	638
2	Turbo Blower	46680	1	74.2	519
	Saving per Annum			16.9	118
Total Saving in Percentage					19

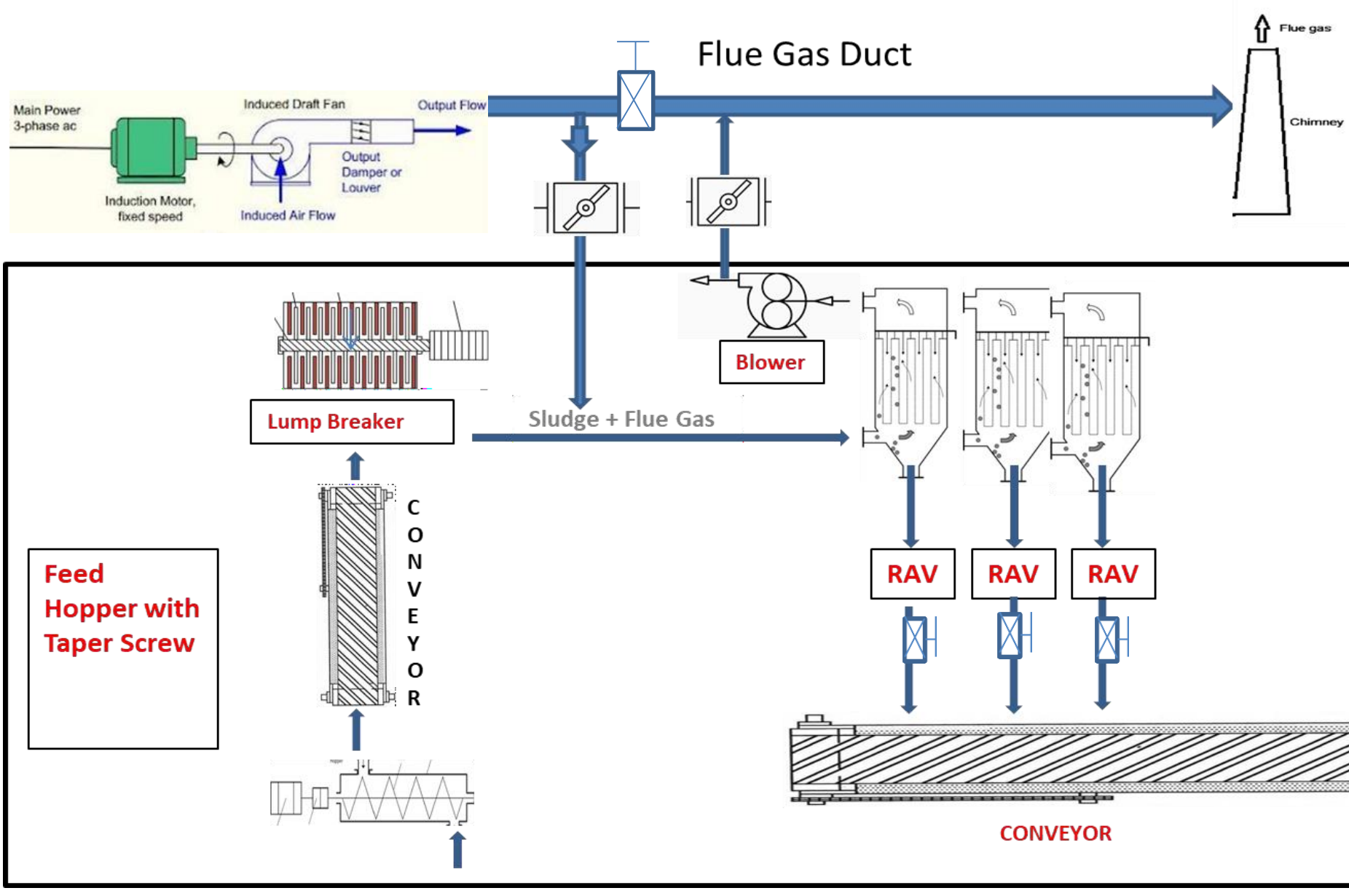
PV Hood Automation and Use of Waste Heat

- Salient features
- Specially designed hood by Brunschweller, Spain
- Utilization of heat generated by Turbo Blower
- DCS controlled.

Achieved saving of 0.1ton/ton of paper Steam



SLUDGE DRYER SYSTEM



SLUDGE DRYER

Description:

1. To increase the dryness of paper waste sludge from 50% to

   75% to consume in the boilers as a fuel.

2. To generate energy by using sludge

   as a fuel for boilers after mixing it

   with coal.

3. To consume waste paper sludge received from ETP.

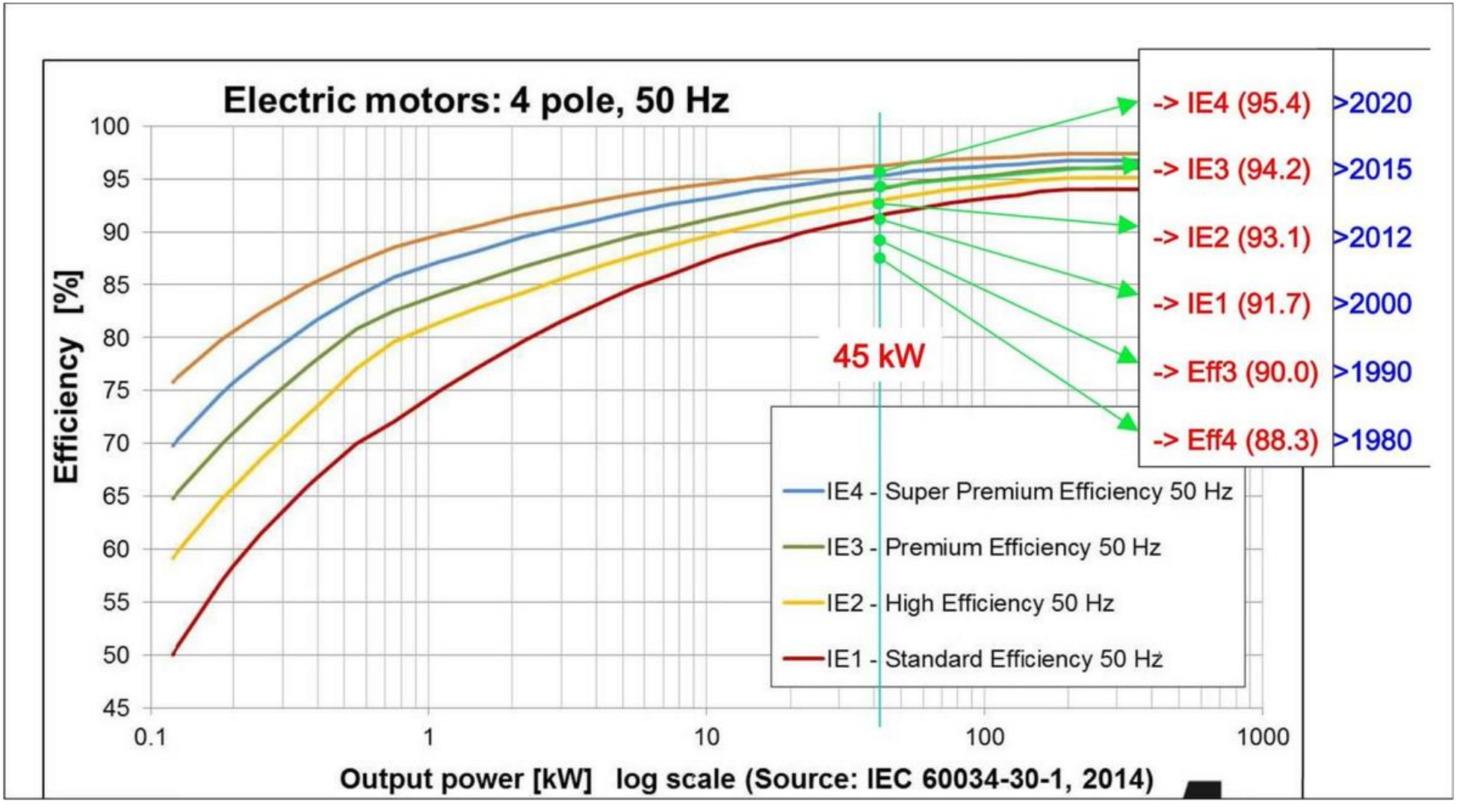
4. **Investment: 679 Lacs**

5. **Saving: 454 Lacs/annum.**

Adoption of Higher Efficiency Motors

Approach & its benefits (IE3 & IE4)

Performance Curves



EFFICIENCY VALUES COMPARISON

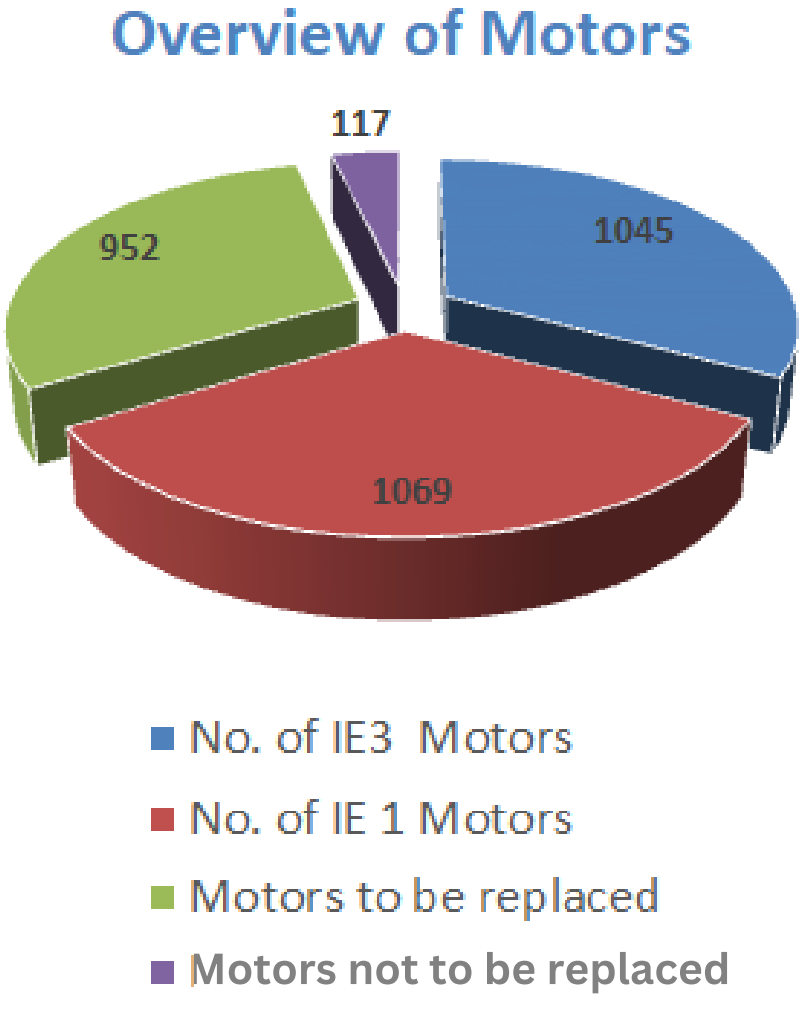
	IE1 – Standard Efficiency			IE2 – High Efficiency			IE3 – Premium Efficiency		
kW	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole
0.75	72.1	72.1	70.0	77.4	79.6	75.9	80.7	82.5	78.9
1.1	75.0	75.0	72.9	79.6	81.4	78.1	82.7	84.1	81.0
1.5	77.2	77.2	75.2	81.3	82.8	79.8	84.2	85.3	82.5
2.2	79.7	79.7	77.7	83.2	84.3	81.8	85.9	86.7	84.3
3	81.5	81.5	79.7	84.6	85.5	83.3	87.1	87.7	85.6
4	83.1	83.1	81.4	85.8	86.6	84.6	88.1	88.6	86.8
5.5	84.7	84.7	83.1	87.0	87.7	86.0	89.2	89.6	88.0
7.5	86.0	86.0	84.7	88.1	88.7	87.2	90.1	90.4	89.1
11	87.6	87.6	86.4	89.4	89.8	88.7	91.2	91.4	90.3
15	88.7	88.7	87.7	90.3	90.6	89.7	91.9	92.1	91.2
18.5	89.3	89.3	88.6	90.9	91.2	90.4	92.4	92.6	91.7
22	89.9	89.9	89.2	91.3	91.6	90.9	92.7	93.0	92.2
30	90.7	90.7	90.2	92.0	92.3	91.7	93.3	93.6	92.9
37	91.2	91.2	90.8	92.5	92.7	92.2	93.7	93.9	93.3
45	91.7	91.7	91.4	92.9	93.1	92.7	94.0	94.2	93.7
55	92.1	92.1	91.9	93.2	93.5	93.1	94.3	94.6	94.1
75	92.7	92.7	92.6	93.8	94.0	93.7	94.7	95.0	94.6
90	93.0	93.0	92.9	94.1	94.2	94.0	95.0	95.2	94.9
110	93.3	93.3	93.3	94.3	94.5	94.3	95.2	95.4	95.1
132	93.5	93.5	93.5	94.6	94.7	94.6	95.4	95.6	95.4
160	93.8	93.8	93.8	94.8	94.9	94.8	95.6	95.8	95.6

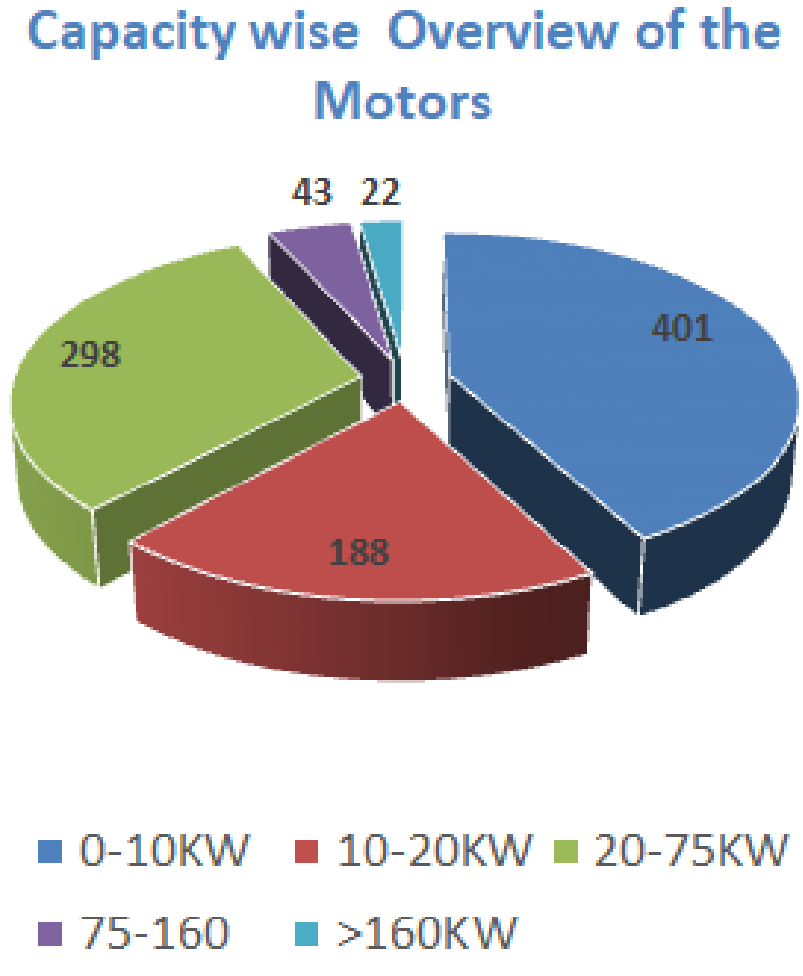
Approach for replacement

Motor Age	• Identify the age of motors as per nameplate data or logbooks/ERP system • ***Target motors which are 10-15 years old***
Motor Size	• Preparation of Motor list either rating or frame wise • ***Segregation of motor list as small, medium & large motors***
Rewinding	• Prime target should be rewound motors with minimum 2 rewinds • ***Each rewinding reduces motor eff. in range of 0.5% to 2% as per BEE***
Operating hours	• Motors running for at least 10 hours a day or more than 3300 hours annually • ***More the running hours, lower the payback period***
Motor loading	• Motors loaded (<65%) are either oversized or running at low efficiencies • **Properly loaded (>75%) run at better efficiencies & give lower payback period**

Overview of Motors in KPML

Total No. of Motors Audited : 2114 Nos.





Energy Savings & Payback Period

Symbol	Description
E1	Efficiency of IE1 Motor
E2	Efficiency of IE3 Motor
H	Annual Working Hours
T	Electricity Tariff
L	Motor Loading (%)
P	Price of IE3 motor

Annual Energy Savings = kW * [(1/E1) – (1/E2)] * H * L *in kWh*

Annual Cost Savings = Es * T *in INR*

Payback Period = (Price of Motor / Annual cost Savings) *in years*

Rating Wise Saving Details (As per Actual Running hrs)

Rating Wise	Total No's of Motors	Saving in KWH/Annum	COST SAVING IN Rs Lacs(Considering @ Rs 7.0/KWH)	Investment considering Rs2800/KW	ROI in Years
0 to 10 kw	401	246154	17.2	36	2.1
>10-20KW	188	353846	24.8	59	2.4
>20-75KW	298	923077	64.6	295	4.6
>75- 160 kw	43	292308	20.5	144	7.0
>160 kw	22	1046154	73.2	160	2.2
Total	952	2861538	200	693	3.5

Grid Islanding Project

Description

- All plant loads connected on the same network
- Separate load on the grid was not possible due to constraint of the distribution network.
- TG and Grid running in parallel mode
- Any disturbances in the Grid network resulted in disturbances in the TGs
- Loss of production amounting to huge financial loss

Improvement

- Grid Islanding and protection systems
- Isolate the in-house generator in case of fluctuations happened on the grid side.
- Prevent blackouts, production and financial loss.
- Energy saving as the TG run at lower frequency
- Reduction of fault levels in the system
- Increased life of the switchgear.

TG-1 run in parallel with Grid and TG-2 run in island mode

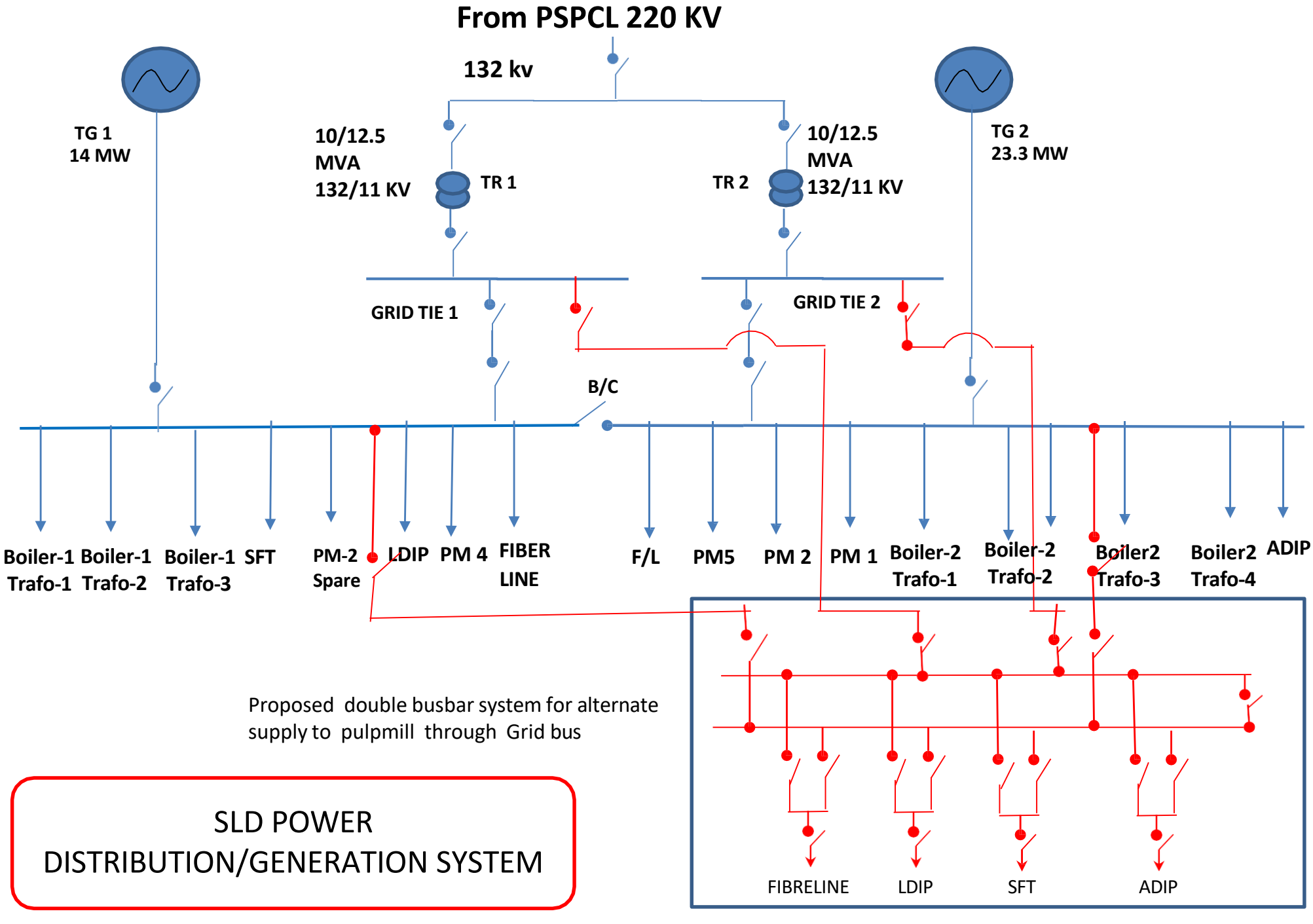
Saving due to lower frequency @ 7.0 Rs/Unit = 443 lacs

Production and quality loss due to black out situation - 50 lacs

Electronic card and drive failure spare cost due to Grid fluctuation- 50 lacs

Total saving- 543 lacs

Grid Islanding Project



Proposed double busbar system for alternate supply to pulpmill through Grid bus

SLD POWER
DISTRIBUTION/GENERATION SYSTEM

Replacement of Root Blower with Screw Blower & Maintain D.O Level with VFD in Aeration Tank

Root Blower

Screw type Blower

Cost Saving Calculation Root Blower Vs Screw Blower

S.N.	Product Description	Capacity (M3/Hr)	Qty in No.	Power consumption in KWH/annum (Lacs)	Power Cost in Rs Lacs/Annum considering @ INR 7.0/KWH
1	Root Blower	1500	5	22	154
2	Screw Blower	4500	2	15.42	108
	Saving per Annum			6.57	46
Total Saving in Percentage					30

Replacement of Root Blower with Screw Blower & Maintain D.O Level with VFD in Aeration Tank

- **Conclusion**

Screw Type Blowers combined with VFD

- Superior energy efficiency
- More stable DO level maintenance
- Earlier weren't able to maintain DO level, with this technology we are able to maintain 2PPM DO level.

Picture Of Online DO Analyser with feedback signal to Drive.

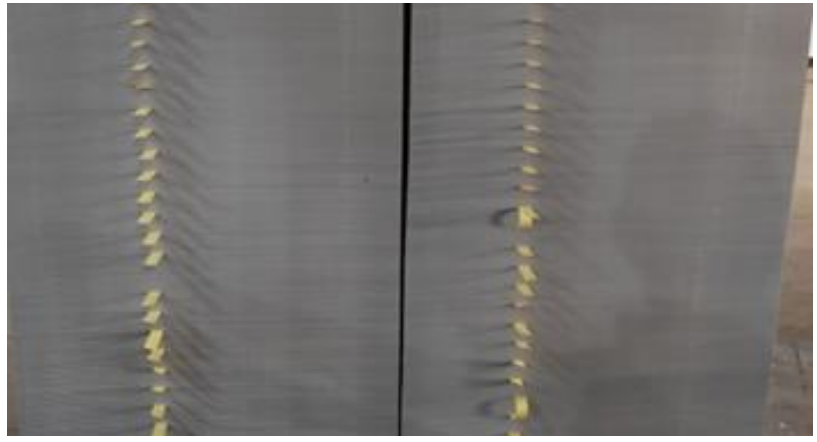
Adopting Online Packing In Converting And Finishing House

- **Background**
  - **Area : Conversion & Finishing House**
  - Manpower dependent operations
  - Operators assigned for bundling, labelling etc.
  - Delays, congestion on floor due to manual involvement

- **Initiatives**
  - Automation of Bundle packing & integration with Ream packing
  - Collating bundles based on weight
  - Feeding them into an online bundling machine
  - Automatic Bundle packing with 90 micron thick shrink film
  - Trial made for packing with 70 – micron thick shrink film also.

Adopting Online Packing In Converting And Finishing House

Infeed Conveyors of Ream Packing



Reams with Auto tabs

Ream Feeding through Auto tabs

Ream Shrink Packing

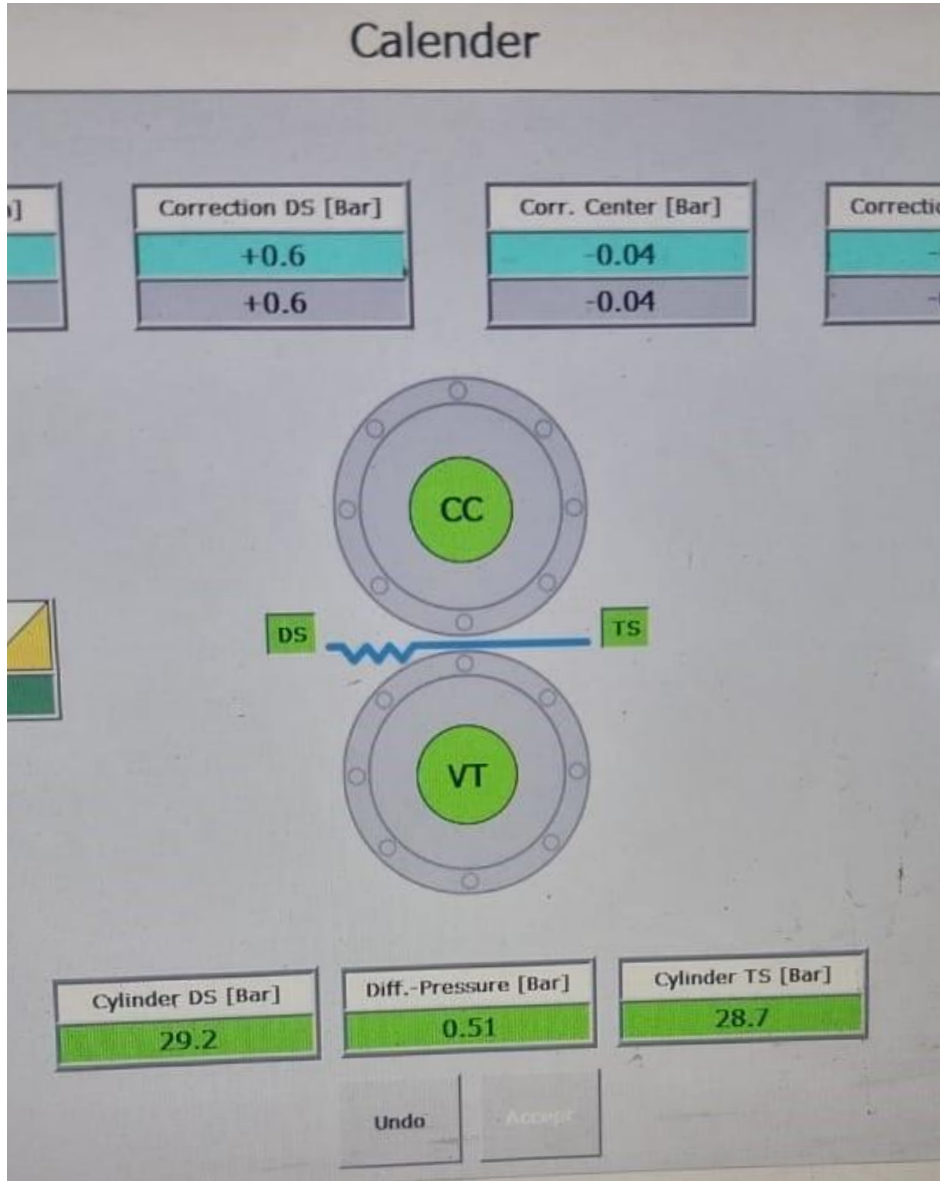
Adopting Online Packing In Converting And Finishing House

HDPE Bundle packing

Bundle Shrink Wrapping Station

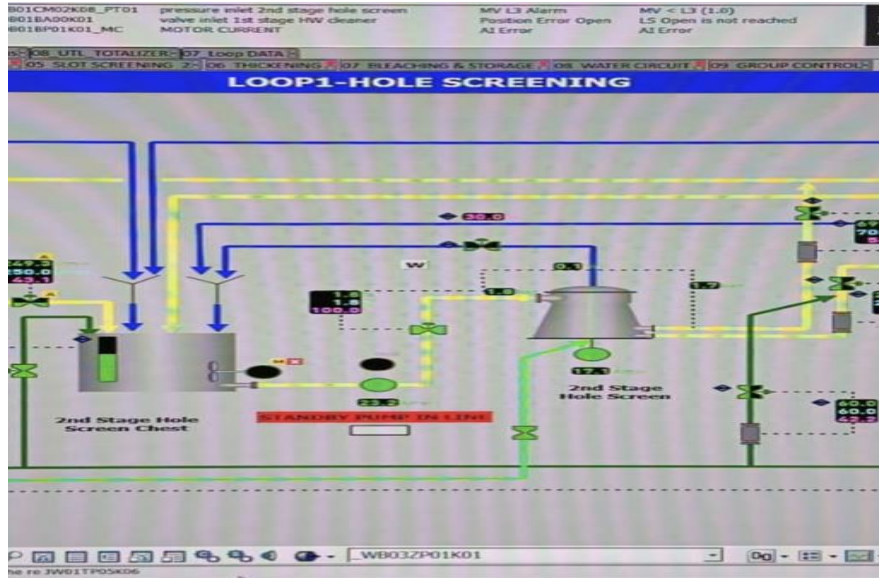
Calendar Automation

- Salient features
  - Upgradation of Calendar control from manual to electronic nip control
  - Calendar loading time reduced from 2.5minutes to 30 sec after each break.
  - Reduced rejections by 0.3% after each break.



Under Top Layer Upgradation & Automation

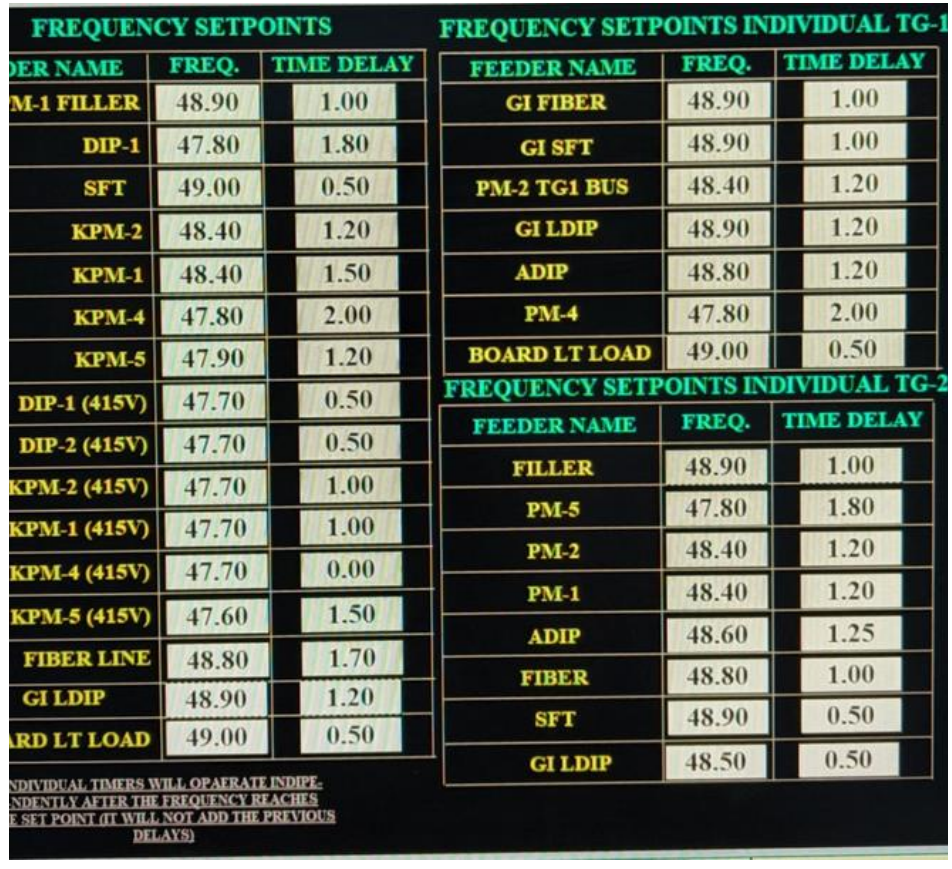
- Salient features
- Under Top layer Pulp Production Capacity increased from 60 TPD to 90 TPD.
- Plant yield increased by 0.3 %.
- Power Consumption reduced by 15 KWH/ Mt.
- Plant Fiber loss Less then 3.0 %.
- Fully DCS controlled VOITH plant.



Load Management System

Salient Features

- Load shedding based on source failure
- Frequency base load shedding
- Grid MDI control option
- Grid overcurrent load shedding
- One of TG is controlling the Grid PF to 0.995 through LMS system



FREQUENCY SETPOINTS

DER NAME	FREQ.	TIME DELAY
M-1 FILLER	48.90	1.00
DIP-1	47.80	1.80
SFT	49.00	0.50
KPM-2	48.40	1.20
KPM-1	48.40	1.50
KPM-4	47.80	2.00
KPM-5	47.90	1.20
DIP-1 (415V)	47.70	0.50
DIP-2 (415V)	47.70	0.50
KPM-2 (415V)	47.70	1.00
KPM-1 (415V)	47.70	1.00
KPM-4 (415V)	47.70	0.00
KPM-5 (415V)	47.60	1.50
FIBER LINE	48.80	1.70
GI LDIP	48.90	1.20
ARD LT LOAD	49.00	0.50

NDIVIDUAL TIMERS WILL OPAERATE INDIPE-
NDENTLY AFTER THE FREQUENCY REACHES
E SET POINT (IT WILL NOT ADD THE PREVIOUS
DELAYS)

FREQUENCY SETPOINTS INDIVIDUAL TG-1

FEEDER NAME	FREQ.	TIME DELAY
GI FIBER	48.90	1.00
GI SFT	48.90	1.00
PM-2 TG1 BUS	48.40	1.20
GI LDIP	48.90	1.20
ADIP	48.80	1.20
PM-4	47.80	2.00
BOARD LT LOAD	49.00	0.50

FREQUENCY SETPOINTS INDIVIDUAL TG-2

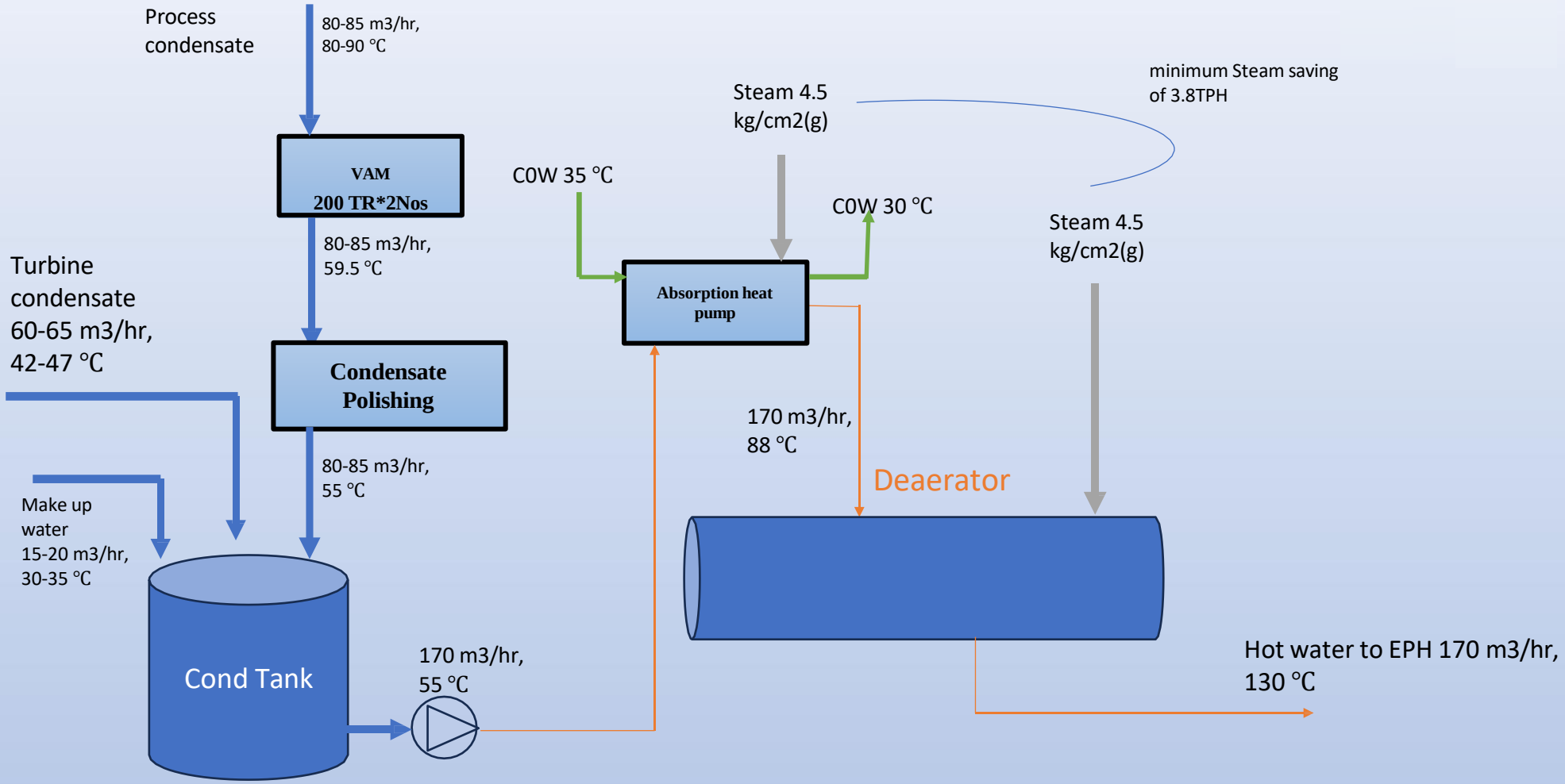
FEEDER NAME	FREQ.	TIME DELAY
FILLER	48.90	1.00
PM-5	47.80	1.80
PM-2	48.40	1.20
PM-1	48.40	1.20
ADIP	48.60	1.25
FIBER	48.80	1.00
SFT	48.90	0.50
GI LDIP	48.50	0.50

Installation of VFD at Various Plant Areas

Project Description	Savings (kW)	Monetary Savings (Lacs)	Investment (Lacs)
Optimisation of differential Pressure across Air Dryer in ZHC 630+ HT Compressor	63.0	31.75	7.0
Installation of VFD to Sec. screen Feed Pump at PM4	30	15.12	5.0
Installation of VFD to NP-01 Floatation Cell Feed Pump	70	35.28	7.5

@7200 hrs & Rs. 7.0 / kWH cost.

VAM and Heat Pump Scheme

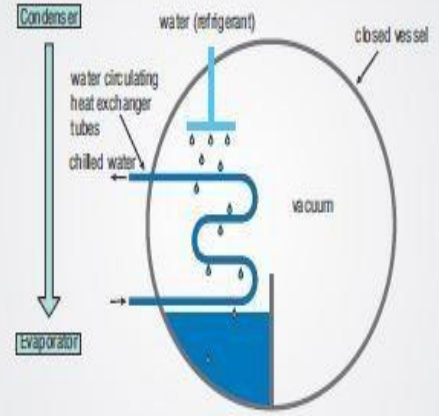


Feasibility Study of VAM Through Condensate

			VAM(200TR)HOT WATER
	DESCRIPTION	UoM	
	CAPACITY	TR	200
	ENERGY SOURCE		Steam Condensate (80-90 deg C)
	ENERGY CONSUMP:		
	VAM Machine/AC	KW/H	10.0
	Chilled water pump	KW/H	16.8
	Cooling water pump(Exisitng CT)	KW/H	31.5
	AHU	KW/H	55.0
	Hot water pump	KW/H	12.4
	Total Power Consumption	KWH	125.73
	Steam Consumption	kg/hr	NA
	LP Steam Cost	Rs/kg	NA
	Power Cost	Rs/KWH	9.00
	Operating Cost Per hour	Rs/hr	1131.53
	Operating Hours	HRS.	7200.00
	Annual Operating Cost	RS	8146980.00
	Annual Savings	Rs Lakhs	81

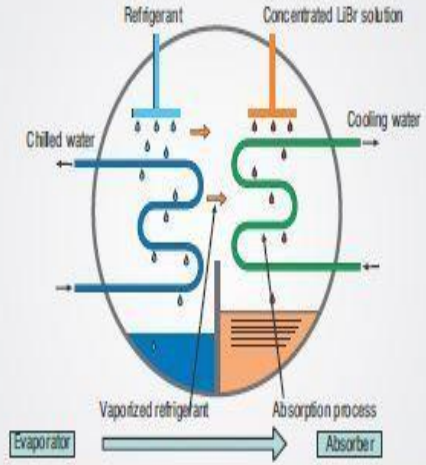
HEAT PUMP

1



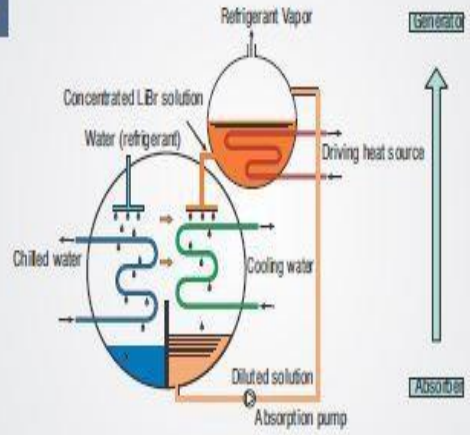
When maintained at high vacuum, water will boil and flash cool itself.

2



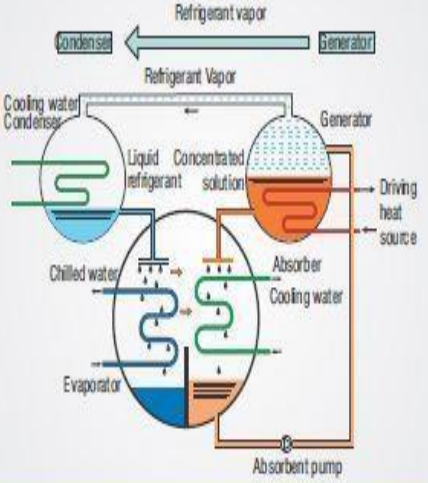
Concentrated Lithium Bromide solution has affinity towards water.
The solution absorbs Vaporized refrigerant water.

3



As Lithium Bromide becomes dilute it loses its capacity to absorb water Vapor. It thus needs to be reconcentrated using a heat source.

4



This heat causes the solution to release the absorbed refrigerant in the form of vapour. This vapor is cooled in a separate chamber to become liquid refrigerant. The Concentrated LiBr is sprayed back in absorber.

Feasibility Study of Heat Pump

Sr. No	Parameters	UoM	Absorption Heat Pump	Existing System
1	Hot water flow	M3/Hr	170	170
2	Hot water inlet temp. to Heat Pump	°C	55	55
3	Hot water outlet temp. from Heat Pump	°C	88	88
4	Cooling water inlet temp. to Heat Pump	°C	35	NA
5	Cooling water outlet temp. from Heat Pump	°C	30	NA
6	Cooling Water flow	M3/Hr	437	NA
7	Heat recovered from Cooling tower(Q1)	Kcal/hr	2171890	0.0
8	Balance heat to added with steam(Q2)	Kcal/hr	3359486	5531375.9
7	Steam Consumption	Kg/hr	5894	9704.2
	Operating Cost calculation			
1	Heating Load in Kcal/hr(Q3)	Kcal/Hr	5531375.9	5531375.9
2	Heating Load in KW	KW	6431.8	6431.8
3	Operating Hours per Year	Hrs/year	8064.0	8064.0
4	Steam Cost	Rs/Kg	1.5	1.5
5	Power Cost	Rs/Kwh	9.0	9.0
6	Specific Enthalpy of steam at 4.5 kg/cm2(g)	Kcal/kg	650.0	650.0
7	Steam consumption	Kg/Hr	5890.0	9704.2
8	Power Consumption	KW/h	18.5	0.0
9	Steam cost	Rs/Hr	8776.1	14459.2
10	Power Cost	Rs/Hr	166.3	0.0
11	Operating Cost per Hour	Rs/Hr	8942.4	14459.2
12	Operating Cost per Year	Lacs/Year	721	1166
	Annual Operational Cost Savings with Heat Pump			
1	**Annual Savings with Heat Pump over Present scheme**	**Lacs /Annum**	**445**	

Incinerator: Waste to Energy Boiler

Description

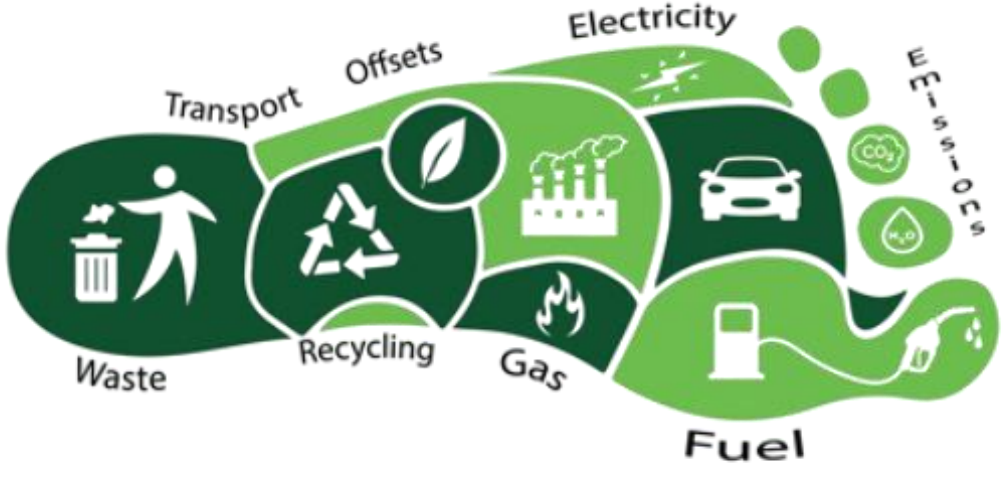
- To generate energy from waste plastic.
- To consume plastic waste produced by KPML which is 120-130 TPD.
- To safely disposing the plastic waste and getting gains from it by producing energy.

Present Status

Technical Finalization in Progress

Conclusion

- KPML is dedicated to continuously upgrading technology across it operations and focusing on sustainable practices.
- To ensure environmental compliance and maintain a clean eco – system. We have adopted efficient blower technology for our aeration basin and achieved Energy saving of 46 lac INR/Annum.
- We have save around INR 256.53 lacs due to other Energy conservation Initiatives.
- KPML is working towards the sustainable future



Conclusion

Let’s go green…. **THANK YOU**