

ITC Limited

Paperboards & Specialty Papers Division



Unit : Bhadrachalam

Title of Paper : Energy Efficiency Consideration in Vacuum Pumps Upgradation

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ITC Bhadrachalam

India`s largest & most technologically advanced Integrated Pulp & Paperboard Manufacturing Facility
Pioneer in Ozone bleaching, BCTMP technology in India



Certifications & Compliances

Category	Certification/ Compliance	Description
Manufacturing & Safety	ISO 9001	Quality Management System (QMS)
	ISO 14001	Environmental Management
	OHSAS 18001	Occupational Health and Safety Management
	ISO 50001	Energy Management
	BRC Global Standard	Hygiene & quality for Packaging & Packaging Materials
Regulatory	SMETA 4 Pillar	Member of SEDEX (Supplier Ethical Data Exchange)
	REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) - a European Union regulation
	RoHS	Restriction of Use of Hazardous Substances like lead, cadmium, mercury
Food Contact	BfR Recommendation XXXVI	German Regulations for migration
	US FDA CFR 21, 176.170	For contact with aqueous and fatty food
	US FDA CFR 21, 176.180	For contact with dry food

Unit Bhadrachalam at a Glance

- ❖ 8.0 Lakh TPA Paper and Paper Board Production Capacity
- ❖ 1.2 Lakh TPA Bleached Chemi Thermo Mechanical Pulp (BCTMP) Pulp Capacity
- ❖ 100% Self Sufficiency in Power through in-house Co-Generation Power Plant
- ❖ **Green Covered area so far 9.53 (FY 21-22) Lakh acres** through Social and Farm Forestry.
- ❖ **48.1% of total energy in 2021-22 is from RENEWABLE SOURCES**
- ❖ **Carbon Positive for 17 Consecutive years**
- ❖ **Water Positive for 20 years in a row**
- ❖ **Solid Waste Recycling Positive for the last 15 years**
- ❖ **Green Co Platinum Plus Certified by CII-GBC**
- ❖ TPM Methodology for manufacturing excellence
- ❖ Adopting I 4.0, IOT Based predictive models for energy & process optimization

Process at Unit Bhadrachalam

High Speed Chippers



Super Batch Digesters
SP. Steam Cons < by 30%



Ozone Bleaching *India's First*



BCTMP *India's First*



Wood +
Bamboo

Chipping

Cooking &
Bleaching

Paper
Making

Paper
Finishing

Paper to
Market



State of Art Paper / Board machines &
Rewinders

High Speed Sheeters

Automatic Storage &
Retrieval Facility Warehouse

Purpose of Vacuum pumps in Paper Industry

The paper industry during the production of sheet paper it is necessary to eliminate a high percentage of water.

For better performance and drainage, a vacuum system is indispensable.

Vacuum pumps consume nearly 15-20% of total power required by a paper machine.

Among all kinds of vacuum pumps, the liquid ring vacuum pump is the most widely used one in the paper mill field.

Principle of Liquid Ring Vacuum pumps

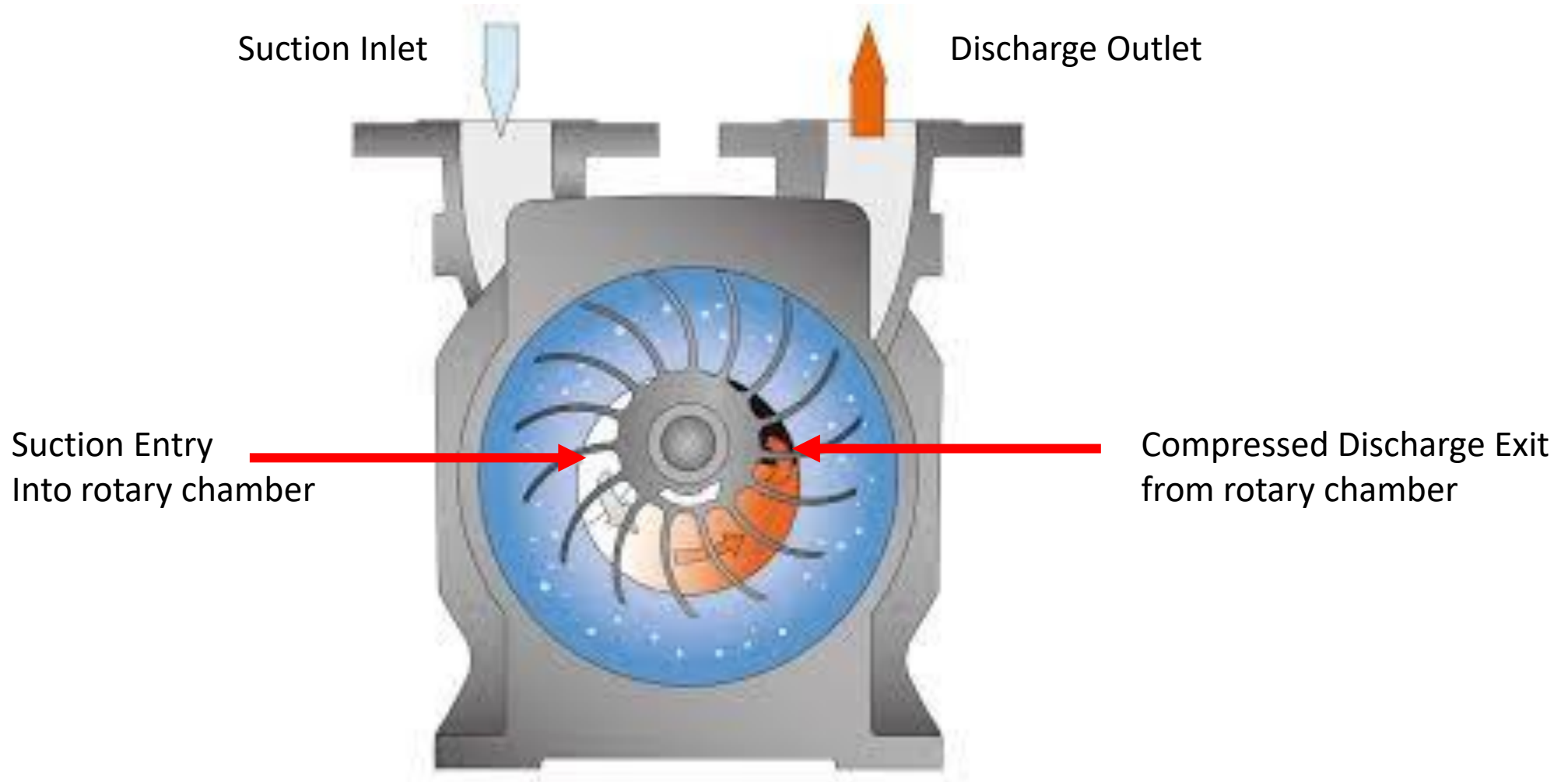
The principle of [liquid ring vacuum pump](#) is that the pump shell is equipped with appropriate water as working fluid. When the centrifugal impeller rotates clockwise in azimuth, the water is thrown around by the centrifugal impeller. Because of the centripetal force, the water produces a closed ring which is approximately equal in thickness to the shape of the pump chamber.

The upper part of the inner surface of the water ring is just tangent to the circle of the centrifugal impeller, and the lower part of the inner surface of the water ring is just touching the top of the leaf (in fact, the leaf has the necessary insertion depth of 1 in the water ring).

At this time, a crescent-shaped interior space is created between the wheel ring and water ring of centrifugal impeller, and this interior space is divided into several small cavities with the same number of leaves by centrifugal impeller. If the upper end of centrifugal impeller is 0 degree as the starting point, the capacity of the small chamber increases from small to small when the impeller rotates 180 degrees, and interacts with the breathing port on the end surface. At this time, the vapor is sucked in, and at the end of the breathing, the small chamber is blocked from the breathing port.

When the centrifugal impeller rotates again, the small chamber shrinks from large to small, so that the vapor body is reduced; when the small chamber interacts with the outlet, the vapor body is discharged out of the pump.

Principle of Vacuum pumps in Paper Industry



Upgradation in Vacuum Pumps PM5

Category	Location	Equipment	Installed capacity		Existing Pumps' Performance (audited during shutdown)			M/s.Kakati			
			Flow (m3/min)	Vacuum level (mmHg)	Flow (m3/min)	Vacuum level (mmHg)	Power consumption (kW)	Flow (m3/min)	Vacuum level (mmHg)	Power consumption (kW)	Savings
Low vacuum	Wire part	VP-1	70	278	45	250-300	54	235	270	216	23
		VP-2	150	278	145	250-300	134				
		VP-3	42	278	47	250-300	51				
High vacuum	Couch	VP-4	80	427	80	450	139	160	400-450	150	212
	Press section Pick up zone	VP-5	80	547	90	450	127				
		VP-6	90	547	72	450	111	160	400-450	150	
		VP-7	80	547	80	450	135				
Medium vacuum	UHLE Boxes	VP-8	126	353	105	340	103	190	340	190	49
		VP-9	126	353	Removed						
		VP-10	126	353	110	340	118				
		VP-11	126	353	105	340	102	190	340	190	
		VP-12	126	353	90	340	106				
		Total					1180			945	235

Upgradation in Vacuum Pumps PM6

			Existing pumps performance (during audit)			M/s.Kakati			
Category	VP NO	APPLICATION	Vacuum-mmHg	Flow	Power consumption (kW)	Flow (m3/min)	Vacuum level (mmHg)	Power consumption (kW)	Savings
LV	VP-1	FLAT SUCTION BOX	150	102	152	180	300	165	207
	VP-2	COUCH LOW ZONE	250	81	113				
	VP-3	SUCTION PRESS T/F ZONE	250	88	107				
HV	VP-4	COUCH HIGH ZONE	380	66	149	110	450-500	130	57
	VP-5	PICK UP ROLL	450	105	160				
	VP-6	SUCTION PRESS NIP ZONE	450	93	163	280		285	
	VP-8	1st FELT UHLE BOX			0				
	VP-9	TOP FELT UHLE BOX			236				
MV	VP-7	P.U FELT UHLE BOX	300	125	0	175	375	165	152
	VP-10	UHLE BOX	375	320	446	305		365	
					1526			1110	416

Comparison of Energy performance of Vacuum pumps at BCM

Description	Small capacity liquid ring vacuum pumps in PM5 (12 nos running)	Bigger capacity energy efficient pumps in PM5 (5 nos running)	Man turbo blower in PM7	Runtech Eco Pumps
Avg prod rate	14 TPH	14 TPH	20 TPH	20 TPH
Vacuum power	1180 units/hr	945 units/hr	1350 units/hr	894 units/hr
Specific power	84 kwhr/Ton	67.5 kwhr/Ton	67.5 kwhr/Ton	44.7 kwhr/Ton

Vacuum pumps upgradation over years at BCM

PM#5 machine



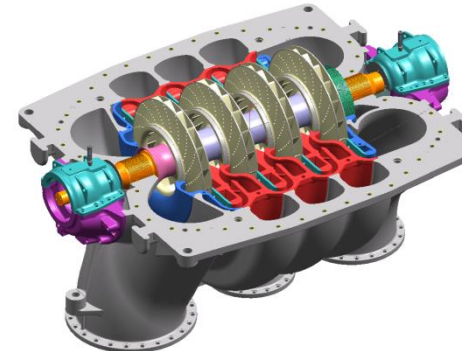
Sp.Power: 84 kwh/ton



Sp.Power: 67.5 kwh/ton

12 nos of small pumps replaced with 5 nos of big energy efficient pumps in PM5 Machine

PM#7 machine



1500 KW x 1 Nos.

Sp Power: 67.5 kwh/Ton

PM#1A machine



550 KW x 3 Nos.

Sp Power: 44.7 kwh/Ton

Benefits

- A RunEco Paper Machine Vacuum Blower System offers:
- Savings of 30% to 70% in energy compared to traditional vacuum systems
- No water usage
- Lower CO2 emissions and a smaller carbon footprint
- EP Turbo Blowers that operate with variable speed and capacity
- Quick optimization with no need to bleed air
- Minimal throttling and expansion losses

Total Vacuum Solution

Runtech EP Turbo Blowers are thoroughly modern blowers that use an integrated high-speed motor controlled by a frequency converter. Their rotation speed and vacuum level can be adjusted according to the process requirements. EP Turbo Blowers come in various sizes to accommodate the size of paper machine. The EcoFlow Dewatering Measurement System provides accurate real-time feedback on dewatering performance. With sensors located along the paper machine, it can be used to optimize dewatering and vacuum levels in the forming and press sections. At Runtech, our goal is to be your one stop shop for dewatering and vacuum systems that fit all your requirements and budgets.



Benefits

Savings got by upgradation in PM5 is 18.29 lakhs units.

When converted to cost it is about Rs 73 lakhs.

Investment made for upgradation is Rs 255 lakhs.

Payback is 3.49 years.

The project cost of Runtech Eco pumps (3 nos) is Rs 800 lakhs.

The saving per ton compared with liquid ring pumps is 22.8 kwhr/Ton.

The annual savings in cost or Runtech eco pumps compared with liquid ring pumps for a machine with average production rate of 20 TPH is Rs 145 lacs.

Payback is 5.53 years.

Other new technologies in Vacuum

Atlas Copco liquid ring vacuum pump with intelligent controller

- Some models have direct coupled motor with inbuilt drive thereby power saving and transmission loss reduction due to belt is avoided.

Atlas Copco screw vacuum pump

- It has 25% reduction compared with liquid ring vacuum pump, it can be used where the suction fluid is clean.

HCH liquid ring vacuum pump with pressure relief design:

- This pump has excess pressure relief valve inside the pump, it will release excess pressure built inside during low load time thereby reducing load on motor.



Thank You