Automation India

Enabling Global Competitiveness

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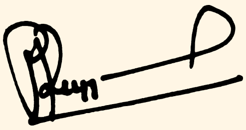
As India integrates itself with the world economy, Indian industry is also in the process of transcending geographical borders and fast coming to terms with the fact that 'factor advantages' are only one part of the story. The *'real and sustainable'* advantage to earn a place in the international arena will be *'competitiveness'* in the form of a '*complete value proposition'.* This proposition encompasses several key parameters including price, quality, productivity, efficiency, aesthetics, delivery systems etc. State-of-the-art automation technologies have a vital role to play in enabling this effort.

The vision of the Automation Industry Association of India (AIA), is to *facilitate the global competitiveness of Indian industry*. After the success of Automation Tech 2004 in Mumbai last November and in keeping with its primary mission of increasing knowledge and awareness levels to help Indian industry leverage cutting edge automation technologies, AIA is embarking on a series of seminars on industry verticals in order to provide a more focussed and sectoral view of specific industries, their challenges, and how automation can help address them.

The first of these is planned on the Pulp & Paper industry. Paper Tech 2005 is scheduled for Monday 11th July 2005 at Hyderabad. The forum will provide a common platform for information and knowledge sharing on the development and deployment of automation technologies bringing together users, consultants and technology providers. The event will showcase the latest trends and global best practices across the pulp and paper industry , regardless of the size or scale of operation. Industry leaders will share their experiences of how automation technologies are playing a key role in their premier organizations and contributing to their success stories and future vision. The technical sessions will be 'vendor neutral' and shall focus on industry specific challenges like optimization, leveraging automation, quality control and energy efficiency.



Ravi Uppal

President, AIA

Just to underline the impact

a piece of paper can have,

Paper Tech
2005

Monday, 11th July 2005

Taj Krishna, Hyderabad

Pradeep Dhobale
Chief Executive - ITC Ltd.
Paperboards & Specialty
Paper Division

Kasi Vishwanathan
President IPPTA
Pres. (Operations)
Seshasayee Paper & Boards

Ajay Kumar / Steve Bane
Rockwell

Ashish Gaikwad
Honeywell

Hakan Nytorp
ABB

Chirag Shah
L&T

O. P. Goyal
Director - J K Paper

C. N. Sudharshan
Seshasayee Paper & Boards

C. S. Panigrahi
CEO - Voith Ltd.

Victor Anandaraj
TNPL

Plenary Session

The Automation Imperative for the Pulp and Paper Industry

A pulp and paper plant is characterized by a set of many complex processes. Globally, the industry suffers from excess installed capacity, restricted raw material supply and cyclic nature. Given these constraints, for a paper plant to emerge and remain successful, it must have systems in place to provide real time visibility throughout the supply chain, across applications, platforms and organisational boundaries. Operating a pulp and paper plant requires availability of real-time business information and intelligence and systems that allow seamless collaboration.

The manufacturing environment in a pulp and paper plant is extremely complex and calls for automation and enterprise solutions that help coordinate all activities across applications and functional boundaries. Achieving production and business goals increasingly depends on the ability of an enterprise to link all business processes with the production floor and support processes. This requires manufacturers to automate and integrate plant and business enterprise processes and present processed information to involved users.

The plant automation and enterprise systems should be designed to achieve autonomous process automation and its improvement, enhanced productivity, decreased downtime, and efficiency while ensuring order fulfillment and customer satisfaction.

Systems and their designs must ensure the following :

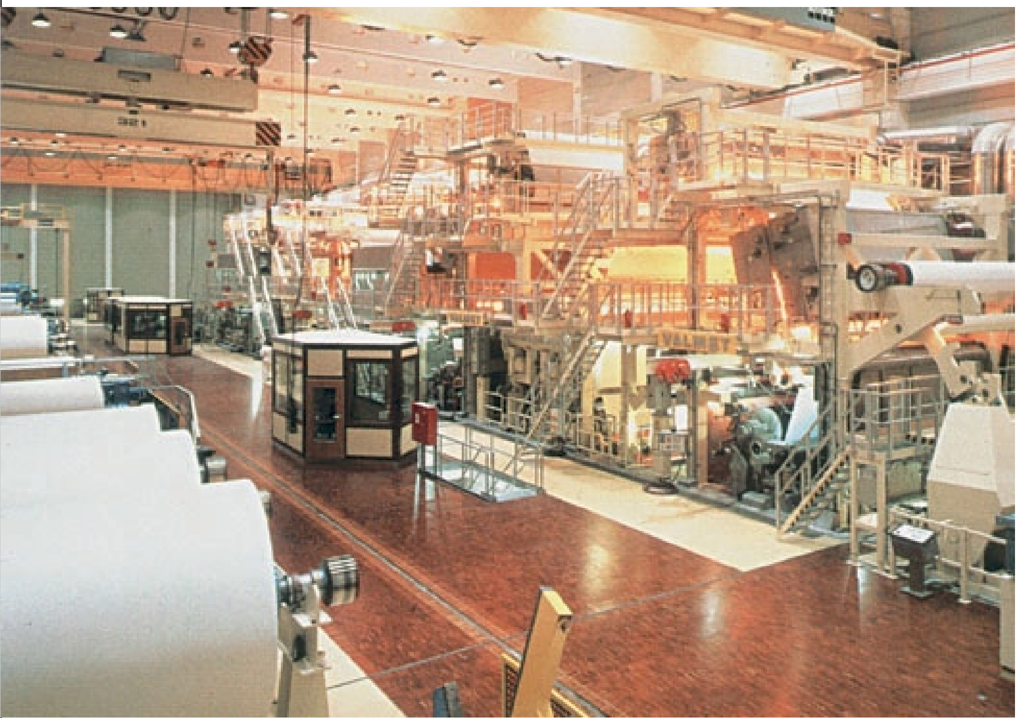
- Enable user application flexibility
- Facilitate interlinking plant automation systems and enterprise solutions
- Minimize total cost of ownership

Typically, a pulp and paper plant requires automation in terms of process measurement and control, motor control, and quality control systems. Enterprise systems will include enterprise resource planning, asset management, supply chain planning and execution, as well as other parameters.

Automation and control systems in a pulp and paper plant include stock preparation, water treatment, boiler plant, rewinder machine, paper machine, and others. These monitoring and control systems are essentially built around field devices, distributed control systems, programmable logic control systems, quality control systems, and drive systems.

Field devices encompass standard transmitters to measure parameters such as level, flow, pressure, and temperature, apart from special devices for measuring consistency, thickness, and others. Customers gain by using transmitters with communication networking features, on-board intelligence, and asset management capabilities.

The stock preparation, water treatment, and boiler controls are carried out in most large plants with the help of distributed control systems for the process and PLCs for the sequencing segments respectively. Users are



recommended to implement DCSs that are built around fieldbus and other open standards based architecture.

The application of drives in the paper industry is both from the process view point, for example the sectional winders control and /or for electrical energy saving. With energy consumption being almost 15% of total paper production cost, energy conservation methodologies have short payback times

Variable speed drives with advanced firmware have been widely adopted in the process control space, fans/ pumps, for energy saving; improved process quality ; reduced burden on the electrical system; and improved productivity.

Integration of these field devices, DCSs, PLCs, and AC drives means that systems do not work as islands, but respond to the need for continuous real time data and contribute to plant wide coordination and control.

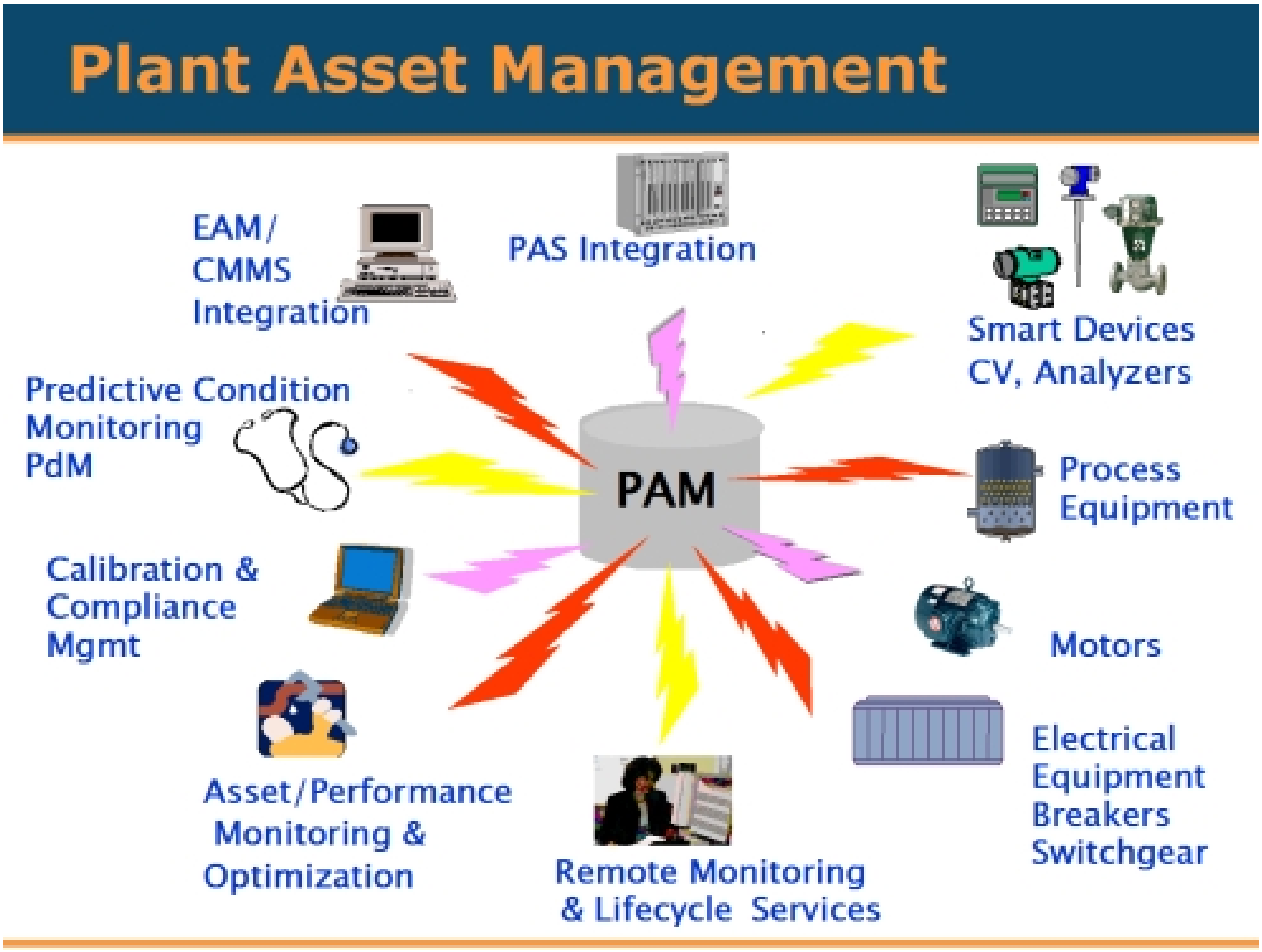
Quality control in a pulp and paper plant is extremely complex but vitally important to achieve dynamic responses. Some of these parameters are basis weight, thickness, optical parameters including color and opacity, and other parameters. Quality control systems enable manufacturers to make better process decisions that reduce waste, ensure required quality standards, save raw materials and ultimately increase share holder value.

Condition monitoring systems for offline and online monitoring of various parameters like machine vibration, motor diagnostics, thermal imaging for hot spots, and others provide not only information on impending breakdowns, but can also be linked to the enterprise asset management systems. Asset management provides another enormous opportunity for raising the standards of plant performance.

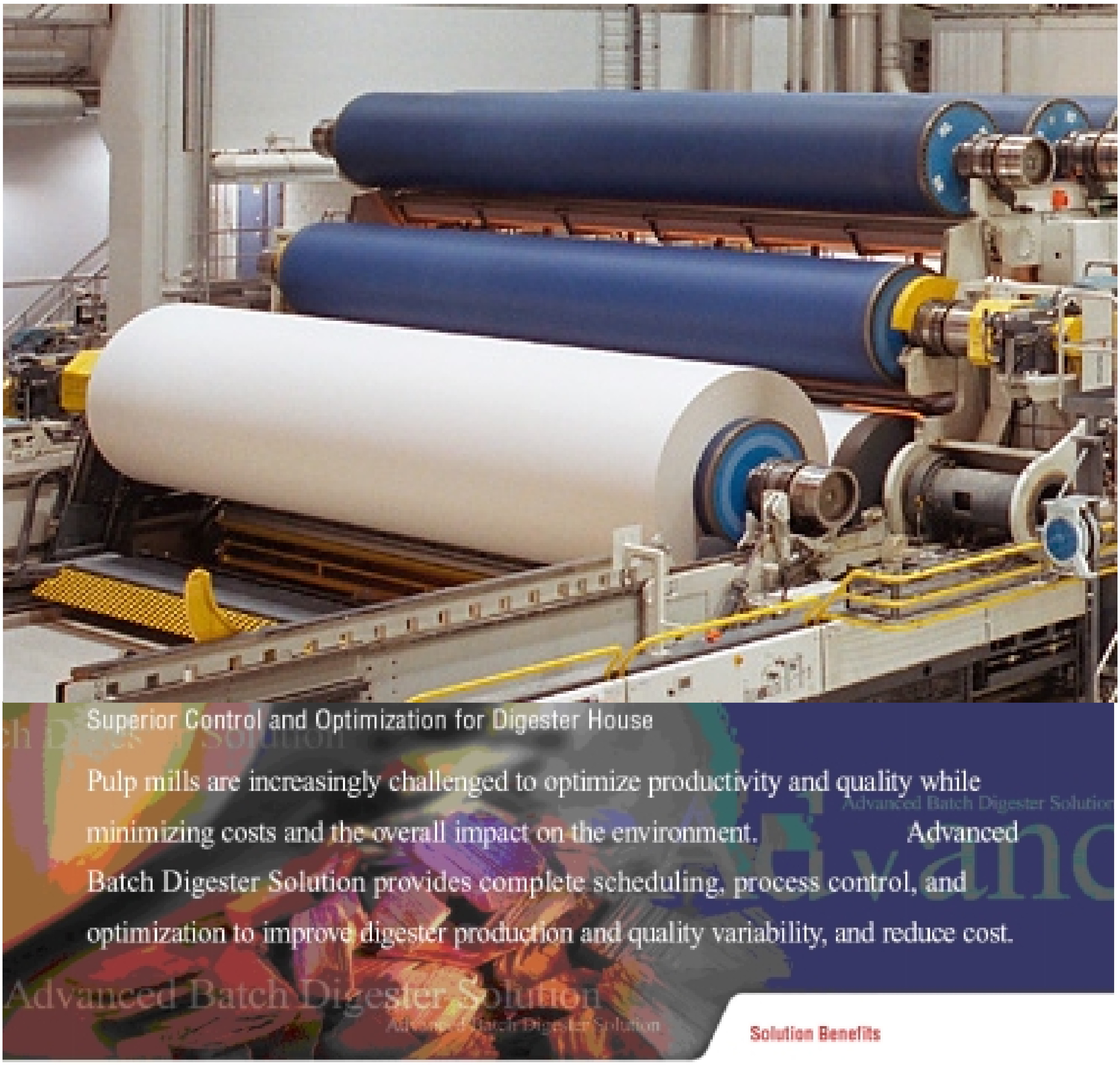
The pulp and paper industry with its variety of complex and interconnected processes demands continuous online tracking of data to identify Key Performance indicators (KPI) .The dashboard approach of viewing data provides a means of obtaining information in an appropriate form for easier decision making.

Real-time Performance Management (RPM) is a management practice that measures performance in real-time. These measures are used to adjust targets to exploit current market conditions and improve business agility.

– Rajshekhar Uchil
ARC Advisory Group



Advanced Batch Digester Solution



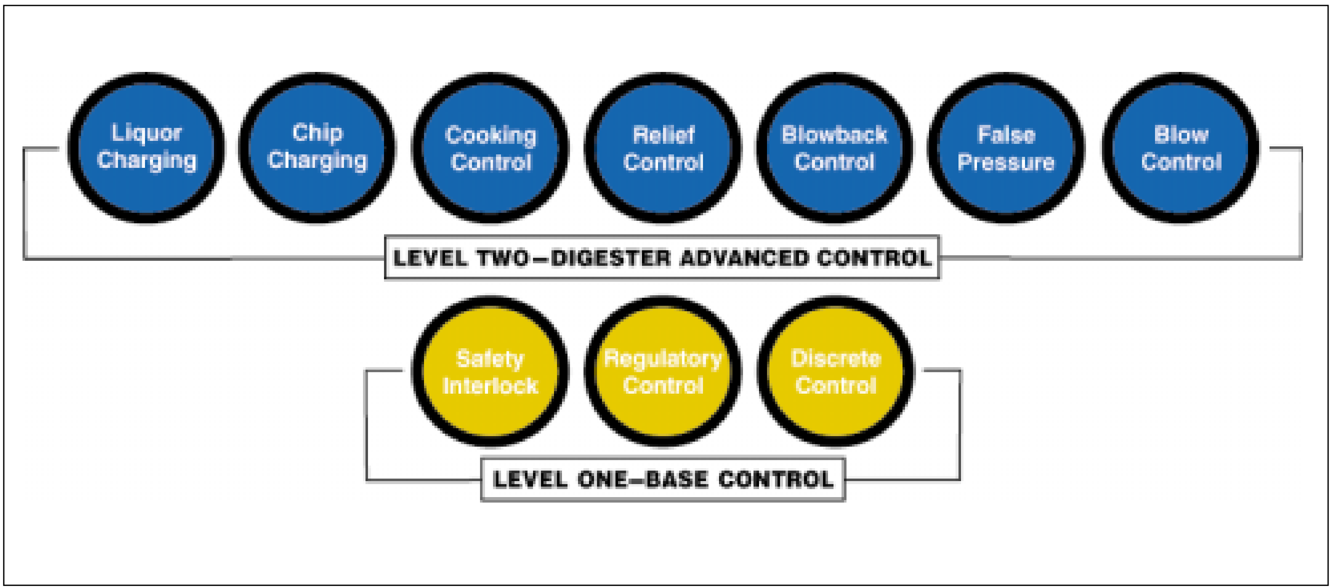
Pulp mills are increasingly challenged to optimize productivity and quality while minimizing costs and the overall impact on the environment. Advanced batch digester solutions provide complete scheduling, process control, and optimization:

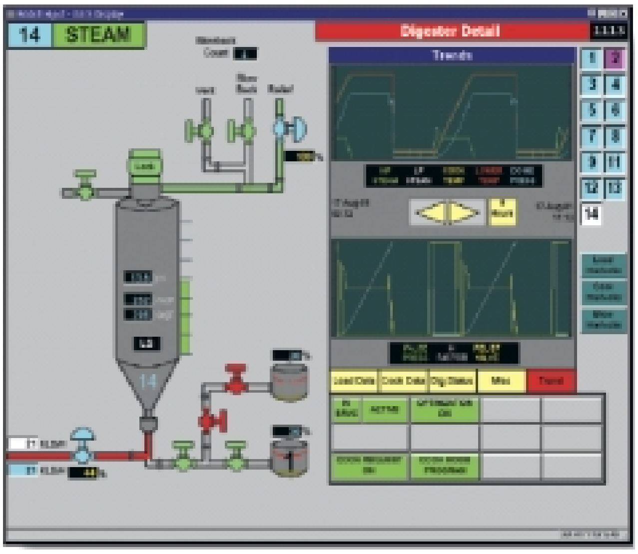
- To improve digester production through increased blows
- To reduce quality variance by maintaining consistent and stable kappa
- To reduce operational costs

Tight control of the loading and cooking processes provides digester batch operational flexibility and capacity utilization, allowing the digester house to dove tail the dynamic production requirements at the paper machine.

Advanced batch digester solutions are usually a complete, multi-level package designed to stabilize and optimize the batch digester operation.

The functions at Level One provide safety interlocking, motor start/stop logic, and sequencing.





Level-Two functions handle automated chip and liquor charging, steam ramping, and cook and blow controls.

In a sustained endeavor to improve the profitability, Pulp Mill Managers adopt a two pronged strategy:

- To push down the cost of production
- Increase the production efficiency

The cost of production is reduced by having a supervisory control on the consumption of White Liquor and Steam. The efficiency of the digester is improved by implementing interactive controls which help reduce the cooking cycle time, and also maintain consistent kappa for each blow.

As a first step towards achieving the desired objective one needs to ascertain the current metrics of digester performance. Detailed study of the existing operational philosophy and the type of raw materials used and their properties (ADT / BDT) is required. Current consumption figures of white liquor and steam are gathered from the log books.

The metrics collected are base lined as the current performance. A scientific analysis is done using statistical tools to estimate the mean and the sigma of the current operation. This helps in providing an opportunity to sigmatize the process and push the mean towards optimum profitability of operation.

The Digester House is the most important unit in the Fibreline area - and often a bottleneck for any pulp mill operation. It also offers great opportunity for maximizing the benefits by adopting better controls and APC implementation in this area helps in maximising swiftness, magnitude and sustainability of returns. Besides quantifiable and tangible benefits as described above, APC also offers a range of other soft benefits such as improved and stable downstream operation,less operator intervention, ease and flexibility of operation etc.

Sr. No.	Operating Parameter	Improvement
1.	Improvement in Yield	0.5 to 0.75%
2.	Reduction in Steam	15%
3.	Reduction in WL consumption	5%
4.	Increase in Throughput	0.5 Blows / Day

Conclusion

Advanced batch digester solutions are a key element of Pulping Solutions. Results are proven based on the implementation of these solutions in various Paper mills world wide.

– T.Nandakumar

Paper Industry - F

Indian paper industry

- 15th largest in the world
- Provides employment to 1.3 mn people in the country contributing Rs. 25 bn to the Government
- Produced 5.26 mn tons of paper in 2003-04
- Newsprint capacity in India is estimated at 1.12 mn tons volume growth of CAGR of 5.47% over the last 3 years
- Indian paper industry has a 1:1 correlation with the economy
- With the expected GDP growth of 6.0% for FY05 and 7-8% for FY06 as per RBI, the paper sector is expected to record a similar growth rate
- The domestic per capita consumption is the lowest at 6 kg compared to the South Asia and the world average of 11 kgs and 53kgs respectively
- The Indian paper industry has an installed capacity of 6.7 mn tons while, the effective capacity is estimated to be lower at 6.15mn tons
- Domestic production is only 0.59 mn tons, while consumption of newsprint is 1.1 mn tons

Increasing demands

- The demand for paper in India is rising by nearly 7 per cent pa
- In 2000, the paper consumption in India amounted to some 4.2 million tonnes, by 2010 it will have reached 8 million tonnes
- The annual per capita consumption of approximately 4 kilograms at the end of the last millennium will have grown to nearly 7 kilograms by 2010. In order to satisfy this demand, more than 10 new paper machines will be necessary. As it is, the Indian paper industry is already struggling to meet national requirements
- Last year, India imported approximately 500,000 tonnes of paper
- By 2010, the import volume is expected to have more than tripled, with an estimated amount of 1.7 million tonnes
- At present, there are 540 paper mills in India

Industry capacity Utilization peaking up

- Average capacity utilization of major players has been around 99% in FY04
- No new greenfield capacity in the paper industry in the last 8 years
- The last major projects were TNPL's 90000 tpa bagasse based mill in 1994 and Sinar Mar's 115000 tpa coated paper plant in 1996
- Stringent environment guidelines have been deterring fresh greenfeild investment in the sector

Proposed capacity expansions

Capacity expansions of over 600,000 tons have been announced by the 7 large players in the sector

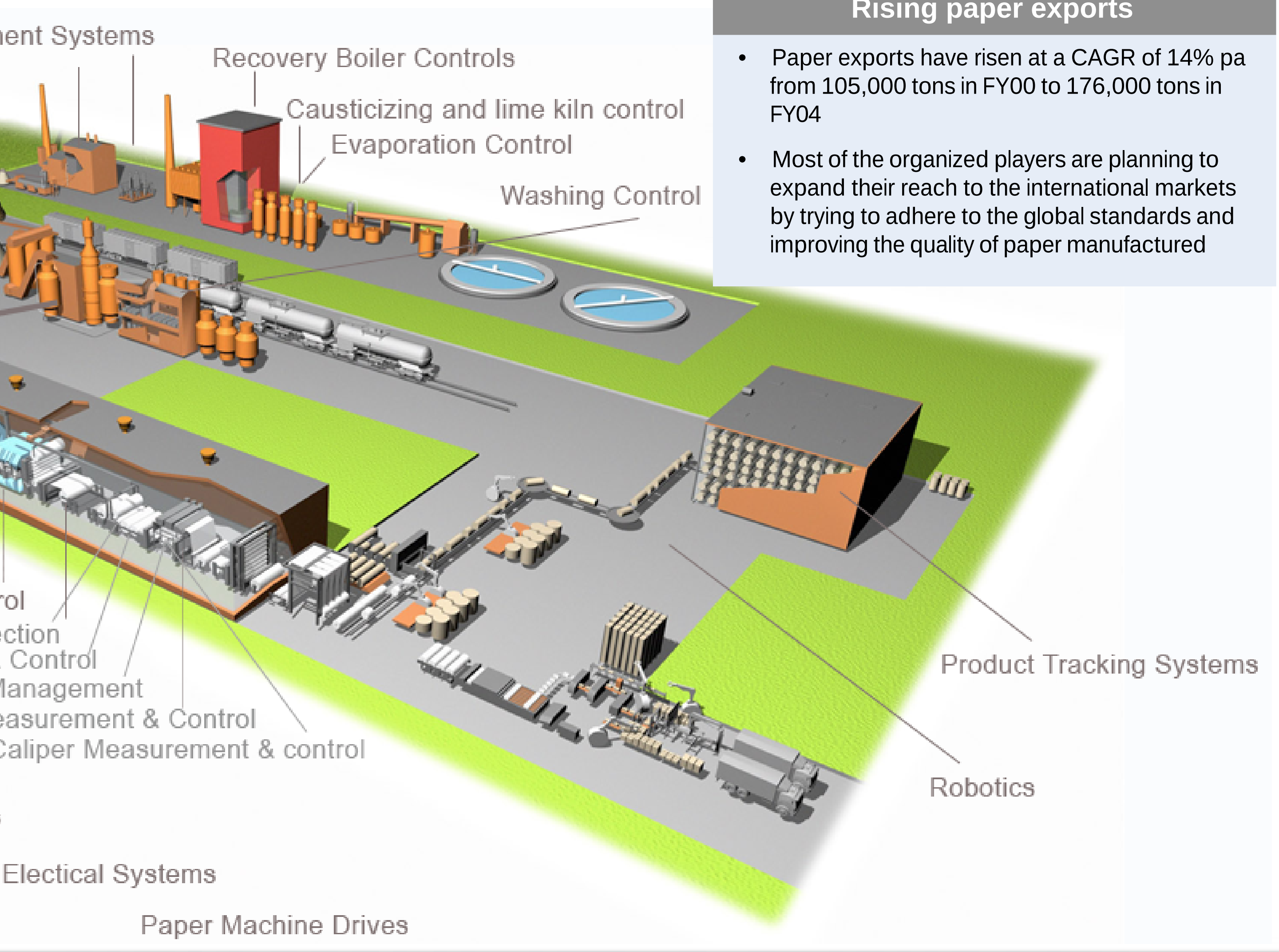
Facts & Figures

The global paper industry

- The global paper industry churns out around 310 million tonnes, with North America and Scandinavian countries such as Finland and Norway accounting for 55 per cent of the output. Asia accounts for a fourth of the world production
- While the European and American output is largely based on soft pulp and is of better quality, the Asian production is a mix of hard wood pulp, soft wood pulp and other agri-residues
- Writing and printing paper account for 33 per cent, industrial paper for 61 per cent and newsprint for around 6 per cent of the market
- The dominant theme in the global paper industry is one of consolidation. The number of ‘big’ players is shrinking, leading to a concentration of capacity in the hands of fewer companies
- World average of per capita consumption of paper is 48 kg (in India it is around 4 kg). In the US it is 312 kg while in Western Europe it is 160 kg
- As global paper majors have pursued growth through acquisitions and mergers, fresh capacity creation has been marginal and this trend is expected to continue over the next 4-3 years
- The effect of consolidation is evident from a look at the share of the top five players in different paper varieties. From 40-50 per cent, their shares have now moved up to 60-80 per cent
- Of the 27 players in North America, 14 have become part of an acquisition or merger by another company. International Paper, the world’s largest manufacturer, has spent around $22 billion in acquisitions in the last five years

Rising paper exports

- Paper exports have risen at a CAGR of 14% pa from 105,000 tons in FY00 to 176,000 tons in FY04
- Most of the organized players are planning to expand their reach to the international markets by trying to adhere to the global standards and improving the quality of paper manufactured



Integrated Paper Production and Energy Planning

Integrated paper production and Energy planning is a fresh approach to production and logistics optimisation, based on minimizing the overall enhanced schedule cost of paper production, while improving co-ordination of pulping and energy operations.

The most important variables here are:

- Direct production costs on different machines
- Cost of grade changes
- Cost of trim waste
- Cost of transporting finished product
- Cost of delayed customer orders
- Cost of warehousing (order produced too early)

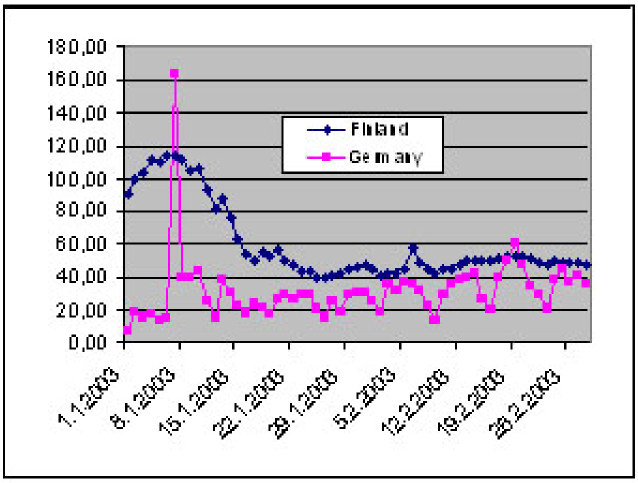


Figure 1. Daily Average Electricity Prices in 2003

Electricity market price variations play an important role in the enhanced cost model. Figure 1 shows the daily average electricity price development in Germany and Finland in 2003. At its highest, the energy price can account for up to 40% of the selling price of wood-containing paper. Fortunately, companies secure energy supply and prices with long-term contracts: energy secured at low prices can generate profits when sold during price peaks.

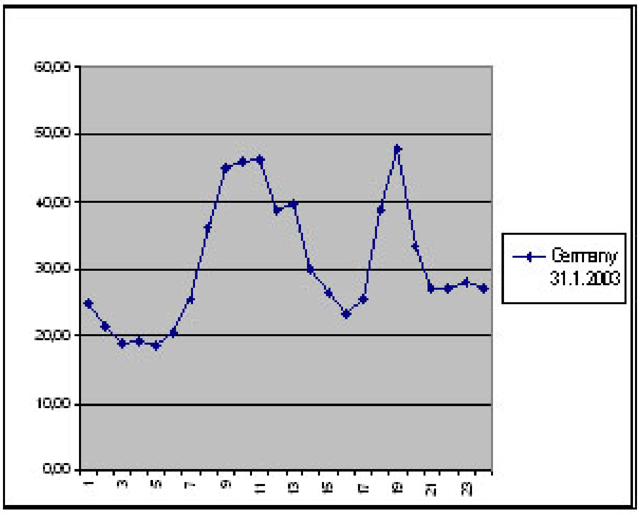


Figure 2. Hour-to-hour Electricity Market Price in Germany 31.1.2003

Electricity Market Prices Behaviour

Market electricity prices vary according to season, particularly extremes of hot or cold. But electricity price variation is seldom in sync across regions - see Figure 1. Another dimension is cyclical patterns during a single day, illustrated in Figure 2, which offer an opportunity for short-term energy optimisation. In India, the non-availability of power during peak hours and the opportunity to sell excess power to electricity boards can be a comparable opportunity.

New Optimization Algorithms

The key difference between the new optimization approaches and traditional point solutions is that it considers all the relevant cost contributing factors.

Multi-machine/Multi-mill Production Planning and Optimization

Typically, the first part of the new optimization toolkits available - commonly referred to as Multi-mill and Multi-machine Production Planning and Optimization - takes into account the total cost of production. This includes production and energy costs on paper machines in different locations, simultaneous calculation of trim efficiency, inventory, and transportation costs. It then assigns the order to the mill which contributes the highest supply chain profit.

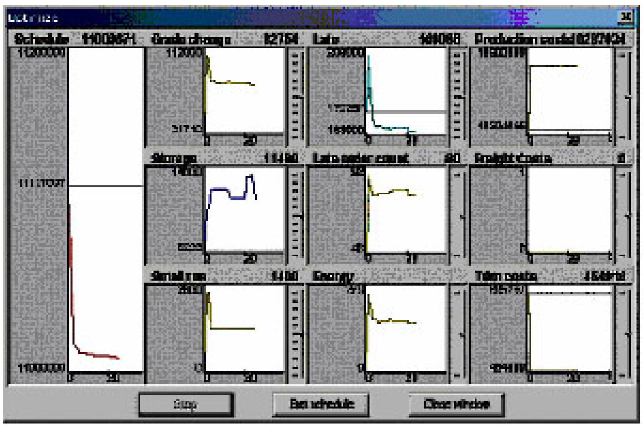


Figure 3. Multi-machine / Multi-mill Production Optimizer

The solution for this global production scheduling problem is a combination of mathematical methods, including algorithms, which re-sequence orders periodically or to reflect a significant change in costs.

In situations with significant cost base differences between mills producing the same product, global profitability might best be served by switching production temporarily to a lower cost mill.

Dynamic Profitable-to-Promise (PTP) evaluations

Before accepting a new order, it is important to know that it can be fulfilled on time. Using production allocation data and available information along with the real time schedules from Multi-mill Production Planning, a commitment can be made with confidence.

In Central Europe it is common to accept orders just hours before production, yet hard to calculate their bottom line contribution. But the Profitable-To-Promise (PTP) evaluation can assess the impact of a new order on the dynamic production schedule. This complements traditional Capable-to-Promise (CTP) analysis with enhanced schedule cost information. The calculation provides a list and associated costs of possible shipping dates from each available production line.

Pulp Production Planning

An accurate energy balance forecast for pulp production is essential for accurate energy management resource planning and cost optimization.

As part of the Pulp Production Planning solution, pulp consumption is forecast from paper and board production schedules. Pulp production is then planned line by line, and forecasts for process variables made. Real-time

integration of these factors within paper and board planning also provides feedback for the PTP check and Multi-machine/Multi-mill Production Planning.

Energy Management and Optimization

Energy Management and Optimization completes production chain integration. The real-time demand forecast is based on production plans for both paper and pulp, and viewed against current supply side structure and market prices. The model is then optimized to minimize energy costs.

Results and Discussion

Multi-machine/multi-mill Optimization benefits

One such commercially available algorithm has been benchmarked against three paper machines with combined annual production of 400,000 tons. Real production plans and corresponding customer orders for one month were fed into the system. After this, the optimization was left to re-organize production and sequence orders (results in Figure 4). The annual savings from using the new algorithm in this case can be estimated at $ 1,980 000.

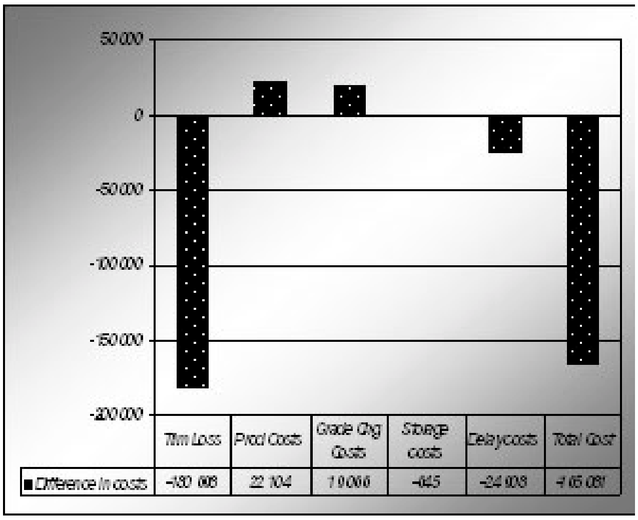


Figure 4. Savings from Multi-machine / Multi-mill Optimization

Pulp Production Planning and Energy Management benefits

Benefits of integrating paper or board production planning with energy management depend on factors such as the type of pulp, and the mill's complexity.

Our example considers energy saving potential. The test case is a 600,000 ton integrated mechanical pulp and paper mill. Accurate electricity consumption and steam production forecasting decreases energy costs, and halves the penalty fee for using settlement electricity. The standing charge related to peak electricity purchase is reduced by 2.5 MW, because better planning allows a lower safety margin. Energy consumption per produced ton (SEC) of pulp is down more than 1%, as performance of key components is accurately monitored and maintenance operations better timed. The annual electricity cost savings estimate is $700,000.

Conclusion

Integrated Pulp and Paper Production and Energy Planning solutions can handle the entire chain from order fulfilment to energy contracting. These can be deployed at a single site or extended to cover multiple mills.

Fast re-scheduling offers the tools to manage orders in the most cost efficient way, provides flexibility and visibility in the supply chain, and helps reduce production costs.

Pulp Production Planning integrates paper and board production planning with energy management and provides real-time forecasts for pulp, water, chemicals, and energy balances.

Based on dynamic production plans, integrated energy management and optimization functions forecast the total real-time demand for different energy resources and optimise energy production, purchase and sales operations for the mill or the entire corporation.

The resulting solution releases additional profit potential in today's typical industrial environment.

– Simo Saynevirta

Use of variable speed AC Drives for speed control and Energy saving in Pulp & Paper

Abstract

This paper describes use of **"VARIABLE SPEED AC DRIVES"** for Energy Saving by controlling speed of squirrel Cage Induction motor for applications like Fans, Pumps & Compressors in Pulp & Paper Industry.

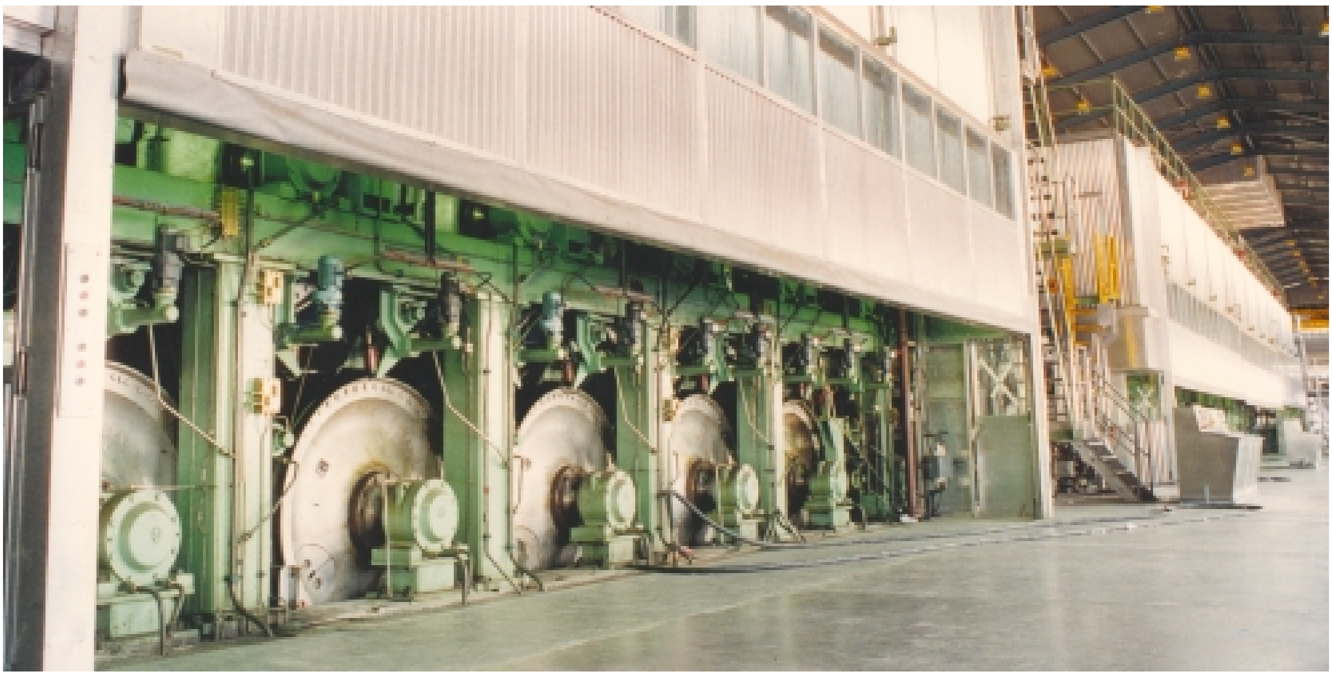
Introduction

Energy Conservation Act, 2003 has identified Pulp & Paper Industry as one of the key industries which need to implement energy savings, with an energy saving potential as high as 15%. Pumps and fans are among the major consuming applications in the paper making process. They are used to transport liquid/air by establishing necessary draught. The volume of liquid/air needs to be varied as per the requirement of process. Conventionally, a louver damper or throttling valve is provided in the duct. The Pump/fan is always run at rated speed and volume of liquid/air is controlled by increasing or decreasing the damper/throttling valve opening. As the damper/throttling valve opening decreases, pressure drop across the same increases, resulting in loss of some amount of energy across it.

The volume of air/gas/liquid can also be varied by changing the speed of Pump/fan drive which will avoid damper/throttling valve losses. Speed of a Cage Induction Motor can be varied by varying the supply frequency to the motor using a variable speed drive.

Energy saving by speed control:

Fig. 1 shows typical performance characteristics of a centrifugal Pump/fan (i) at rated speed & (ii) at reduced speed. Fig. 1 also shows typical system curves (comprising of duct, fan etc.) (A) with damper control & (B) without damper control. As air volume increases, the resistance caused by increasing turbulence & friction in the fan/duct system results in rapid increase in the pressure that must be developed by the Pump/fan. The pressure is proportional to square of the flow (volume).



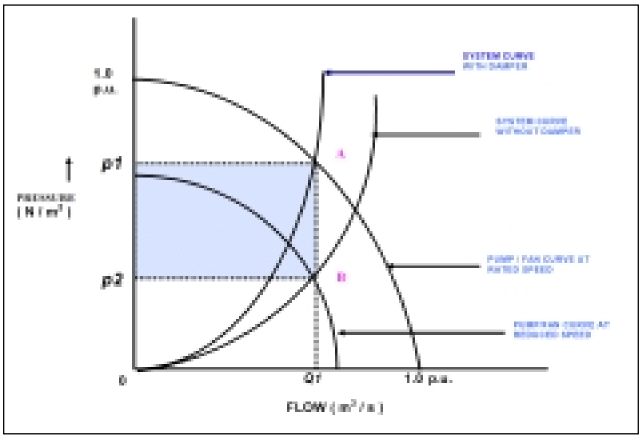


Figure 2. Typical system curves

The point of intersection of the system curve & the Pump/fan characteristics is the operating point. With damper control employed, system will operate at point "A" where volume requirement is "Q1" and corresponding pressure developed in the duct will be "p1". Then power requirement of the Pump/fan at operating point "A" will be "P1".

$$P1 = \frac{p1 * Q1}{\eta_F} * 10^{-3} \text{ kW}$$

where η_F = Pump/fan efficiency

Similarly, power requirement for operating point "B" for same volume "Q1" with Pump/fan running at reduced speed i.e. with damper fully open will be "P2".

$$P2 = \frac{p2 * Q1}{\eta_F} * 10^{-3} \text{ kW}$$

Therefore power saving achieved by running the Pump/ fan at lower speed without damper control is equal to "(P1-P2)" kW and is approximately equal to the area of rectangle " p1ABp2" (refer fig. 1).
Net power saving for the system is equal to

$$P3 = \frac{(p1 - p2) * Q1}{\eta_F * \eta_M} * 10^{-3} \text{ kW}$$

where η_M= Motor efficiency

Total energy saved per annum when you run the Pump/ fan at lower speed is equal to

P3 * *H* kWHr
where H = Annual run time of Pump/fan in hours

In most of the cases, need for running the Pump/fan at lower speed arises because of following reasons.

(i) Requirement to run the process at lower than designed capacities

(ii) Cumulative safety margins built during various design stages like duct design, Pump/fan design etc.

Hence there is always a good potential for energy saving.

Speed control of cage induction motor by varying frequency:

Adjustable speed drives offer the optimum method for matching pump and Pump/fan flow rates to system requirements. The Variable Speed AC drive converts standard plant Power (220 or 415 V, 50 Hz) to adjustable voltage and frequency to power the AC motor. The frequency applied to the AC motor determines the motor speed.

Estimation of energy saving:

As an example, typical case is discussed here for estimating energy saving.

Relations between various system parameters

$p \propto Q^2$	**where**	p **= Pressure,** Q **= Flow**
$Q \propto N$		N **= Motor Speed**
$p_o \propto p*Q$		p_o **= Motor Output Power**

As an example, typical case is discussed here for estimating energy saving.

DATA Case Study Data
Motor Rating = 360 kW
Application = Pump

Sample Calculation

Rated Parameters:
Rated flow: 231 M3/HR
Discharge Pressure: 37.27kg/cm2
Suction Pressure : 2.87 kg/cm2
Differential Pressure: 34.4 kg/cm2
Pump efficiency: 72%
Present Running Parameters: (As measured)
Flow: 280 MT/HR (Specific Gravity: 1.37) i.e. 204 M3/HR
Suction Pressure: 2.4 kg/cm2
Discharge Pressure: 42.5kg/cm2
Differential Pressure: 40.1kg/cm2
Valve Opening: 24.1%
Pump efficiency at 204 M3/HR: 68%
Motor efficiency (assumed): 90%
Input Power to the Motor P= (40.1*9.81*10)*(204/3600)/ (0.68*0.90)= 364kW
(The effect of static head is not considered, as it will be same for the next case with variable speed drive)
Ratio (Actual Flow / Rated Flow) = 204/231= 0.8847

If the pump speed is reduced by the same proportion, using variable speed AC Drive, the differential pressure will reduce by square of the same ratio. Hence, new differential pressure will be =34.4* (204/231) 2 = 26.92 kg/cm2

Revised Input Power to the Motor P' = (26.92*9.81*10)*(204/3600)/(0.68*0.90)= 244 kW
Net Savings = 364-244= 120 kW
If VSD losses are = 10 kW (96% efficiency),
Net Power saved is 110 kW
With Unit Power rate of Rs 4.00, Total savings per year will be 110*8760*4.0 = Rs 38.5 L

Note: It is assumed that the monitoring points of suction & discharge pressures are such that the difference in these two pressures eliminates the effect of static pressure. However, if actual static head is given, the calculations can be refined further. Similarly, resistive drop in the piping is neglected.

Key considerations for selection of inverter

A. Temperature :-
The AC Drives are designed to operate at certain ambient condition and they need to be derated if operated at higher ambient temperature. Further, the design temperature should be "Site Maximum Ambient Temperature plus additional minimum 5o C" to take care of temperature rise inside the panel.

B. Overload Requirement in AC Drives :-
Overload i.e. to deliver more than its capacity for a small duration is always desired to overcome known & unknown loading conditions in the process. Specify the overload as the application demands.

C. Harmonics :-
Like any other switching device, AC Drives is one of the culprit of generating harmonics. Every AC Drive addition will lead to increase in net Total Harmonic Distortion of the plant.

Possible solutions to reduce harmonics generated by AC Drives are :

- Install a DC or AC input reactor. This is must irrespective of ratings.
- Go for 12 pulse or higher input rectification configuration. The harmonics generated by this system will be of the order of 12n 1. Thus, most predominant harmonics like 5th, 7th, 17th, 19th …… , are eliminated on the HV side of transformer. Thus, 12-pulse rectification configuration drastically reduces harmonics current. Hence for higher kW ratings 12-pulse rectification scheme helps in addressing the problem of harmonics.

D. Is your AC Motor, General Purpose or Inverter Grade ???

Most of us use general-purpose motors with inverters. When motor to inverter panel cable distances are long (in excess of 30m), due to standing wave phenomenon, high voltage spikes are generated at motor terminals. General-purpose motors are not designed for such voltage spikes and results into premature burn out / failure of their winding. To safe guard motor against this voltage spike, appropriate protection device needs to be provided at output of the inverter e.g. output reactor, sinusoidal filter.

Thus it is very important to install output reactor or sinusoidal filter at the output of inverter.

Conclusion:
Use of Variable Speed Drive for Pump/fan results in significant energy saving. Other benefits, which accrue, are precise speed control, less wear & tear of mechanical system etc.

– Chirag Shah

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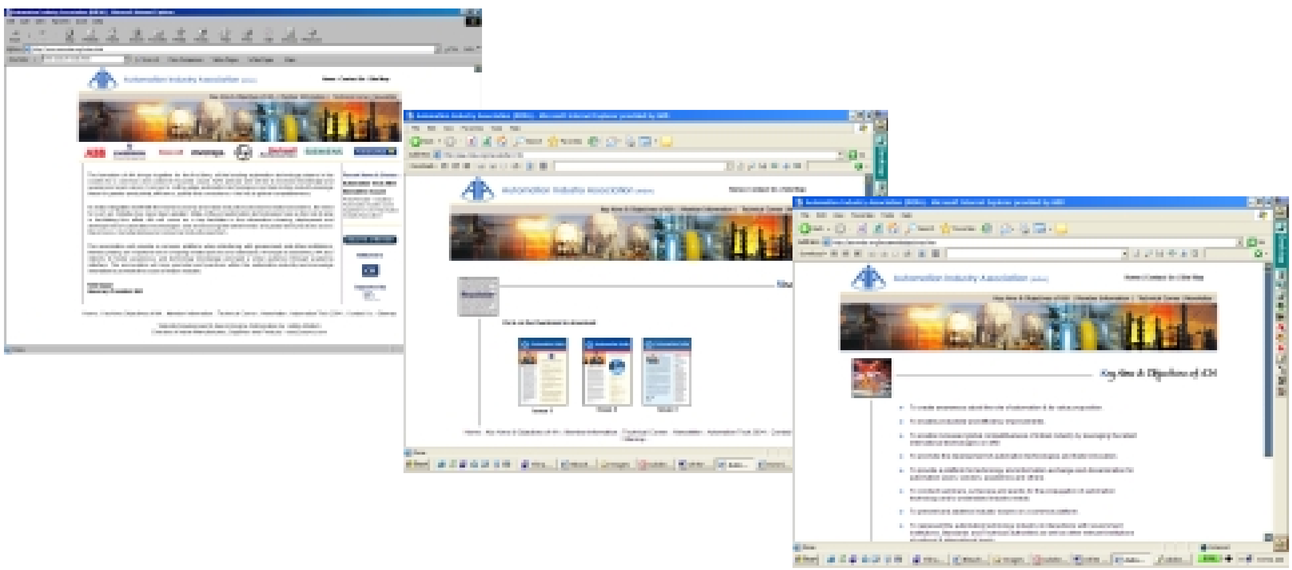

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