Pulp & Paper Industry

‘Making Indian Pulp & Paper Industry World Class’
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June 2008
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FOREWORD

The paper industry in India is more than a century old. At present there are over 600 paper mills in the country manufacturing industrial grades, cultural grades and other specialty papers.

Reflecting the trend of GDP growth of 9 %, it is estimated that the paper industry would be growing at a CAGR of 7-8% over the next decade. It is estimated that the installed capacity in the country would grow to 11.2 MT / annum by 2010 from the current levels of 9 Million MT/ annum. The current per capita consumption of Paper in India is 8.3 Kg compared to the global average of 49.0 kg. Increasing literacy levels and current lower per capita consumption are compelling reasons to believe that the current rate of growth would continue for a long period.

The paper industry in India is fast adapting state-of-art technologies to reduce its production cost and to upgrade the technology to meet the international standards. The industry is also fast adapting ecologically sustainable practices.

CII-Godrej GBC has a vision of making India a Global Leader in Green Business by 2015. To fulfill the vision, the Centre has adopted several focus areas viz. Green Buildings, Energy Efficiency, Renewable Energy, Environment & Recycling, Water management and Climate change activities in India.

To advance energy efficiency in the industry, the Centre through the exclusive Energy Efficiency Council facilitates industries adopt best operational practices and thus become World Class Energy Efficient units.

We strongly believe that, to achieve the vision, it is necessary to demonstrate and achieve leadership status in each sector. We are now working towards creating "Islands of Excellence" in select sectors, including Pulp and Paper sector.

The organizing of the yearly event Papertech and this manual are efforts in this direction.

I would like to express my gratitude to all the CEOs of the various Pulp & Paper mills in the country for their contributions, guidance and support in shaping this initiative.

My congratulations to Mr K S Kasi Viswanathan, Chairman, Working group on 'Make Indian Pulp & Paper Industry World Class’ and all the members of the core working group for their efforts and contributions.

I am sure that this best practices manual would go a long way in facilitating quicker adoption of best practices in Indian Pulp and Paper industry.

Chairman, Energy Efficiency Council, CII – Godrej GBC
& Chief Executive, ITC - PSPD
Globally, India is one of the countries where the pulp and paper industry is witnessing rapid growth at a CAGR (Compounded Annual Growth Rate) of 7 - 8%. The industry is beginning to attract significant investments in terms of setting up state of the art plants and in expanding capacities.

With the increasing Globalization, the Indian paper industry is now looking into all ways and means of making itself more competitive. This has necessitated Indian paper industry to closely look at Efficient Global players operating outside India and elevate itself to International level in terms of Efficiency and Technology. The problems of the industry are being continuously addressed at many forums and macro level policy decisions are under consideration to make it’s operations competitive and sustainable.

The World Class Energy Efficiency initiative of CII – Sohrabji Godrej Green Business Centre is one such forum to enhance competitiveness and also focus on energy efficiency, good environmental performance, Global best practices and technology upgrades. The objective of this initiative, with respect to the paper sector is to facilitate in developing at least three world class Pulp and Paper mills in the country by the year 2010.

This initiative is driven by a core working group with participation from Paper Mills, consultants and equipment suppliers. The core group has collected data extensively and has visited many mills within the country in order to identify the best practices which have been documented in this manual.

The objective of this manual is to act as a catalyst to promote activities in Indian Pulp & Paper Plants towards continuously improving the performance of individual units and thereby move towards the target of “Making Indian Pulp and Paper Industry World Class”.


I take this opportunity to thank Mr Pradeep Dhobale, Chairman Energy Efficiency Council, CII - Godrej GBC for his unstinted support, CEOs of various Paper Mills for their encouragement and the core working group members for their untiring efforts, which has made this manual a reality.

My special thanks to Mr A R Thiagarajan, President, SPB Projects and Consultancy Ltd for his spontaneous help and guidance in developing this manual.
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K S Kasi Viswanathan,
Chairman,
Working Group on ‘Make Indian Pulp & Paper industry World Class’
& Deputy Managing Director, Seshasayee Paper & Boards Limited
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EXECUTIVE SUMMARY

India is the second most populous country in the world; however the per capita paper consumption is among the lowest at 7.0 kg, while Asian and global averages are 11.0 kg and 49.0 kg respectively. But the demand for paper is increasing given the rising disposable incomes particularly of the expanding middle income group. The literacy level in India which is on the increase is further set to improve the demand for paper in the future. The Government of India’s increased budget allocation for education sector is expected to further improve the literacy rates in both urban and rural areas, resulting in increased demand for writing paper. The Indian Pulp and paper industry is expected to grow at 7.4 % CAGR over the period 2008 – 10. With Indian economy in one of its best ever growth mode, the Indian paper industry continues to be a major beneficiary.

On the other hand, the paper industry is also highly energy intensive and is the sixth largest consumer of commercial energy in the country. The main fuel used in the pulp & paper industry is coal. Other fuels used are furnace oil, LSHS, rice husk and coffee husk. LDO and HSD are also used in diesel generators. Large Paper plants generate part of their own electrical power through cogeneration, while smaller plants depend exclusively on purchased power.

The energy cost, as a percentage of manufacturing cost, which was about 15% in presently about 25 - 30%. This is mainly due to the increase in energy prices.

In the present scenario, apart from capacity augmentation, there is an immense need to improve the Energy Efficiency of the individual units. Many of the Indian Paper mills are also working actively in the areas of water and environmental management not only to better the statutory norms but also to proactively move towards cleaner production.

The CII-Sohrabji Godrej Green Business Center (CII-Godrej GBC) under the leadership of Mr. Jamshyd Godrej, Chairman, CII Godrej GBC and Managing Director, Godrej & Boyce has adopted the vision of “Facilitating India to become a global leader in green business (environment) by 2015”.

Towards this objective, the Energy Efficiency Council of CII-Godrej GBC under the chairmanship of Mr Pradeep Dhopale, Divisional Chief Executive, ITC Ltd, PSPD has undertaken the development of “World Class Energy Efficient Units” in energy intensive sectors, such as Cement, Power Plant and Pulp & Paper Industry.

The Paper sector initiative through a project titled “Make Indian Pulp & Paper Industry world class” is guided by a working group chaired by Mr. K S Kasi Viswanathan, Deputy Managing Director, Seshasayee Paper & Boards Limited (SPB), Pallipalayam.
The activities were initiated in a CEO meet organized in conjunction with Paper Tech 2007 at Hyderabad, a national conference jointly done by CII-Godrej GBC and Indian Paper Manufactures Association (IPMA). The CEO’s meet is attended by 19 CEO’s (details of the CEO’s are given in the annexure A) representing all the major Pulp and Paper Manufactures in the country.

The CEO’s discussed and endorsed the following action plan to be taken up for developing World Class Energy Efficient Paper plants in the country.

**Core working Group**

A core working group was formulated with participation for Paper Mills, consultants and equipment supplier. The list of the working group members is given in the annexure B. The Paper Industry is sub divided into three groups namely Wood, Agro and Recycled fibre group. Each group is headed by respective group leaders as mentioned below:

**Wood Group** : Dr. T G Sunderaraman (SPB) & Mr. A Padmanabhan (ITC-PSPD)
**Agro Group** : Mr S K Sharma (Shreyans) & Mr. K Kuppusamy (TNPL)
**Recycled Fibre group** : Mr. Mihir Baruah (HNL)
Inter plant visits for sharing and identify best practices

The working group has decided to visit some of the Indian Pulp and Paper Industries in order to identify the best practices. The companies to be selected are identified based on a questionnaire circulated to the above mentioned companies.

The plants visited by the working group are:

1. APPM, Rajahmundry
2. Bilt, Bhigwan Unit
3. Delta Paper Mills Ltd., Vendra
4. Hindustan Newsprint Ltd., Kottayam
5. ITC – PSPD, Bhadrachalam
6. JKPM, Rayagada
7. Naini Tissues Limited, Kashipur
8. Rama Newsprints and Paper Ltd.
9. Shreyans Industries Ltd. (Ahmedgarh unit & Shree Rishab Paper)
10. Tamil Nadu Newsprint & Papers Ltd., Kagithapuram

About 6 to 10 working group members have visited each of the above mentioned plants which had resulted in a great learning experience both for the host plant and the working group members. The members of the working group are mostly Paper Manufactures, Equipment suppliers and Consultants.

The outcome of the working group plant visits is identification of 37 best practices from the Indian Pulp and Paper Industry.

Development of “National Best Practices Manual”

This manual was developed based on the leanings of the working group during the visits to individual plants. The information is collated in to a document which can be widely circulated through out Indian Pulp and Paper Industry.

This manual would benefit both the participating and the non participating companies. This would also initiate the process of sharing best practices among pulp and paper Industry.
The next steps in the process of “Making Indian Pulp & Paper Industry World Class” are

- Implementation of the best practices by participating plants
- Studying best practices in overseas installations
- Implementation of the international best practices
- Make at least three Indian paper mills world class in three years (by 2010)
HOW TO USE THIS MANUAL

The objective of this manual is to act as a catalyst to promote activities in Indian Pulp & Paper Plants towards continuously improving the performance of individual units and thereby achieving world class levels (with thrust on energy, water & environmental management).

- To set a clear goal for improving the performance and move towards the world class standards, the best practices adopted in nine Indian Pulp & Paper Plants have been included in this manual.

- These best practices may be considered for implementation after suitably fine tuning to meet the requirements of individual units.

- Suitable latest technologies may be considered for implementation in existing and future Pulp & Paper Plants for achieving the world class energy efficiency.

- The collated best operating parameters and the best practices identified from various plants need not necessarily be the ultimate solution. It is possible to achieve even better energy efficiency and develop better operation and maintenance practices.

Therefore, Indian Pulp & Paper Plants should view this manual positively and utilize the opportunity to improve the performance and “Make Indian Pulp and Paper Industry World Class”.
The Indian paper and paperboards industry is on the growth path. The Indian paper and paperboards industry grew by nearly 7.8 percent during the period 2000-2006. This is substantially higher than the Asian average of 5.1 percent. India’s paper manufacturing capacity is expected to grow at a Compounded Annual Growth Rate (CAGR) of 7.4 percent from 8.4 million MT per annum to 11.2 million MT per annum between 2008 and 2010.

The Indian per capita paper consumption is among the lowest at 7.0 kg, while Asian and global averages are 11.0 kg and 49.0 kg respectively. But the demand for paper is increasing given the rising disposable incomes particularly of the expanding middle income group. The literacy level in India which is on the increase is further set to improve the demand for paper in the future. The Government of India’s increased budget allocation for education sector is expected to further improve the literacy rates in both urban and rural areas, resulting in increased demand for writing paper. The Indian Pulp and paper industry is expected to grow at 7.4 % CAGR over the period 2008 – 10. With Indian economy in one of its best ever growth mode, the Indian paper industry continues to be a major beneficiary.

In the present scenario, apart from capacity augmentation, there is an immense need to improve the Energy Efficiency of the individual units. Many of the Indian Paper mills are also working actively in the areas of water and environmental management not only to better the statutory norms but also in a proactively move closer to cleaner production.

With the liberalization of the Indian economy leading to global competition as well as the growing emphasis on the environment, it is imperative for the Indian Pulp and Paper industry to become World class in operations, energy consumption and environmental impact.

It is against this back ground that this project of “Making Indian Pulp & Paper industry World Class” assumes significance.
WORLD CLASS ENERGY EFFICIENCY

Energy conservation practices have acquired top priority, in the present context of increasing energy prices, acute energy shortage and the ever-widening demand supply gap.

All industrial units have adopted several measures to optimize the energy costs. Significant reduction in power consumption and substantial reduction in cost has been achieved by these units.

On achieving significant reduction, some units reach complacency. The open mind to look forward to further avenues of improvement no longer exists.

Some units, not succumbing to complacency, continue to strive and achieve excellence in energy management.

This document attempts to bring out the subtle differences between these units which have achieved excellence in energy management (“World Class” units) and the other units (the “Good” units which have stopped without exploring full potential.

The various characteristics and the differences between world class units and good units are elaborated below:

Good units Vs World Class Units

Bench marking & Trend setting

‘Benchmarking’ is the approach adopted by the good units. They try to identify the best unit in its class, and plan to match themselves their performance in line with the best unit identified.

With the benchmarking approach, at the best, the good units can reach a performance level only closer to the best units, leaving them at the second level only.

On the other hand, the world class units adopt an approach of ‘trendsetting’. They start with a ‘zero’ base, look for innovative opportunities in each area of operation and implement them.

This approach facilitates the plant to look for the most efficient design / technology / operating practices without being bounded by the ‘Benchmark’. World class plants thus are trendsetters and emerge as leaders in the field.
Information Sharing

Information sharing could be a major differentiator between the good units & best units.

The information, either sourced within or obtained elsewhere, in good companies is shared only within the organization. It takes a long time for this information to percolate even to other group companies.

World Class companies, on the other hand, believe in information dissemination as quick as possible. The fact that the time lost due to delay in information transfer could result in a significant monetary (energy) loss is well appreciated.

Some units like Philips, Birla Group and Coca Cola share best practices across their units worldwide at a very quick pace and ensure its implementation to achieve the benefits at the earliest.

Implementation of latest technologies

A good unit plays a very conservative & defensive role in implementing latest technologies.

Good units are comfortable with proven technologies and are risk averse. These units want successful case studies of this technology implemented elsewhere, before considering implementation.

A World Class unit, on the other hand, sees this situation as opportunity to be a pioneer.

They are willing and have the capacity to take this risk at all levels of the organization. Several rewards accompany this risk. They become the technology developer’s first preference, and get the technology at a very low price. The technology developer also works hand-in-hand with the plant team in making the new technology successful.

Once the first few trials are successful, the technology supplier would then sell this to “good” units at a much higher price (than the best units) to recover the development costs of that technology and the subsidy offered to best units.
Ultimately, the good unit pays for the world class unit to get still “better”!! This competitive advantage accumulates in the world class plants and the gap between the world class and good plants increases with time.

**Energy wastage**

Energy wastages in a good unit are minimal but will be visible to a trained eye.

In a world class unit, these are not apparent. Further energy saving avenues need to be evolved after a detailed and exhaustive study.

**EnCon Culture**

Energy conservation activity in a good plant is driven by external factors. An increase in energy costs, cheaper imports, etc. generally drive the plant towards energy efficiency. The energy efficiency activities are therefore momentary and part of the management culture.

In a world class unit, it becomes a routine activity. Every top management is committed to energy conservation, but has different ways of expressing it and finally achieving benefits.

In good units, it could be setting targets or fixing budgets.

In a best unit, it works based on resource allocation. The top management allocates resources to each department. This mode of operation has 2 benefits – it ensures faster implementation of energy saving projects once technically proven and drives people to identify newer avenues for utilizing the resources allocated.

**Monitoring & energy scorecard**

Good units as well as the best units have an excellent energy monitoring system.

In a good unit, it stops with data generation.

On the other hand, the World Class unit compiles this data in a presentable format (Energy Scorecard) which could be used as a tool to evaluate the performance of the individual. In some excellent units, the yearly performance appraisal of an individual or departments is based on the energy scorecard.
EnCon activity

In a good unit, the energy manager tries to identify and implement all the energy saving projects himself. This not only results in reduced number of projects but also results in longer gestation time.

A World Class unit has a facilitator in an Energy Manager. The energy conservation culture is well entrenched in the organization, that the operation & maintenance team approach the energy manager with projects. He engages experts with domain expertise to identify newer areas. This results in more number of projects identified & faster implementation.

Approach to EnCon

In a Good Plant, Energy conservation is seen as an isolated activity which involves reduction of operating costs.

World Class units have a holistic approach to Energy conservation. The Life cycle cost of implementing Energy Conservation is considered.

Characteristics of World Class Energy Efficient Units

A World Class Energy Efficient unit is:

- A trend setter in specific energy consumption norms – the lowest in the world for similar industries
- A leader in implementing the latest technologies
- Has practically “nil” Energy Wastage
- Has adopted the Energy Scorecard
- Has made ENCON an “On-going activity” and incorporated as a part of the management system

Essentially, a World Class Energy Efficient unit will be operating with the world’s lowest specific energy consumption for similar industries (electrical & thermal).
Making Indian Pulp and Paper Industry World Class in Energy Efficiency - Activities carried out so far ...

The Making Indian Pulp Paper Industry World Class with thrust on Energy Efficiency initiative of CII – Godrej GBC has evoked tremendous response in the Indian pulp and paper sector.

CII-Godrej GBC has taken the responsibility of overall execution of the project under the able guidance of a working group chaired by **Mr. K S Kasi Viswanathan, Deputy Managing Director**, Seshasayee Paper & Boards Limited (SPB), Pallipalayam.

The activities were initiated in a CEO meet organized in conjunction with Paper Tech 2007 at Hyderabad, a national conference jointly done by CII-Godrej GBC and Indian Paper Manufactures Association (IPMA). The CEO’s meet was attended by 19 CEO’s (details of the CEO’s are given in the annexure A) representing all the major Pulp and Paper Manufactures in the country.

The CEOs discussed and endorsed the following action plan to be taken up for developing World Class Energy Efficient Paper plants in the country.

- Conduct an awareness program: PAPER TECH 2007
- Formation of Core working group (Paper Mills, Consultants, Equipment Suppliers)
- Inter plant visits and sharing of best practices
- Implementation by Plants
- Studying best practices in overseas installations
- Implementation & at-least 3 World Class paper plants– by 2010
Core Working Group

A core working group was formulated with participation for Paper Mills, consultants and equipment supplier. The list of the working group members is given in the annexure B. The Paper Industry is sub divided into three groups namely Wood, Agro and Recycled fibre group. Each group is headed by respective group leaders as mentioned below:

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Companies participating in this activity of “Making Indian Pulp & Paper Industry world Class” are divided in three main categories,

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<thead>
<tr>
<th>Wood</th>
<th>Agro</th>
<th>Recycled fibre</th>
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<tr>
<td>ITC – PSPD</td>
<td>TNPL, Kaghitapuram</td>
<td>EMAMI</td>
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<td>SPB</td>
<td>SHREYANS</td>
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<td>JKPM</td>
<td>SPB</td>
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<td>TNPL</td>
<td>CENTURY</td>
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<td>CENTURY</td>
<td>YASH</td>
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<td>WESTCOAST</td>
<td>NAINI TISSUES</td>
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<tr>
<td>APPM</td>
<td>DELTA</td>
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<td>PUDUMJEE</td>
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Inter Plant Visits for Sharing and Identify Best Practices

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The plants visited by the working group are:

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The out come of the working group plant visits is identification of 45 best practices from the Indian Pulp and Paper Industry.

**Development of “National Best Practices Manual”**

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This manual would benefit both the participating and the non participating companies. This would also initiate the process of sharing best practices among pulp and paper Industry.

Detailed observations and experiences of this mission are included as part of this manual.
BRIEF PROFILE OF PARTICIPATING COMPANIES
THE ANDHRA PRADESH PAPER MILLS LIMITED

Details about the group

The Andhra Pradesh Paper Mills Limited (APPM) belongings to well-known industrial house of the Bangurs of Kolkata. Other companies promoted by this group are Maharaja Shree Umaid Mills in Rajasthan and the Peria Karmalai Tea & Produce Co. Ltd. in Tamilnadu. Besides many other businesses in Finance & Investment and charitable trusts.

Details about the unit

The mill was established as the Carnatic Paper Mills Ltd. way back in 1921 at Rajahmundry on the banks of the River Godavari. It went into production in 1924 with a capacity of 3,000 TPA of paper.

It was renamed as The Andhra Paper Mills Company Ltd in 1956, when the states were reorganized. The newly formed Government of Andhra Pradesh took over the company with consequential change in its identity as The Andhra Paper Mills Ltd.

To help it grow and infuse adequate finances, a new Joint Stock Company under the name of The Andhra Pradesh Paper Mills Ltd was incorporated in the year 1964 which took over The Andhra Paper Mills Ltd.

The production grew over period of time and it now stands at a wood pulping capacity of 180,000 TPA and paper production of 107,000 TPA. An additional capacity of 55,000 was added in FY 00-01 through the acquisition of Coastal Papers Ltd. (presently called as Unit: CP)

Unit CP has a recycled paper based pulping capacity of 50000 TPA and an agro based pulping capacity of 6500 TPA. Paper production capacity at Unit CP is 67000 TPA.

Besides these two units APPM has an off-site conversion center with conversion capacity of 30,500 TPA at SN Palem near Vijayawada.

Brief description of the Process

The Mill under Mill Development plan (MDP) in the year 2004-06 has implemented environment friendly state of art technologies.

It has adopted down flow low solids continuous digester system for cooking the raw materials. The chips are pre-steamed in diamond back chip bin and the cooking chemical in the form of white liquor is added with weak black liquor (WBL) to the chips. Cooking
temperature is maintained at 155ºC – 160 ºC. The cooked material is fed to 2 a stage DD washer for washing. The washed pulp is then processed through a 2 stage oxygen delignification (ODL) system.

The weak black liquor separated in the wash plant containing dissolved organic & inorganic is concentrated in multiple effect evaporators to 75% solids, before firing in the recovery boiler. The inorganic coming in the form of smelt is dissolved in the weak white liquor, known as green liquor. This green liquor is treated with lime at causticising plant for making white liquor, a cooking chemical to use in digester house. The mill has lime kilns to burn the lime sludge for producing burnt lime.

The washed ODL treated pulp is screened and supplied to paper machines for making unbleached varieties of paper and also supplied to bleach plant. The ECF Bleaching sequence followed is $D_0 - E_{op} - D_1$, with single stage DD washers provided between stages.

The pulp thus received from pulp mill is subjected to refining in which the cutting and fibrillation takes place. In addition to this the stock is made by adding dyes and wet end additives suitable for making required quality papers.

The mill has installed Low Volume High Concentration (LVHC) Non Condensable Gases (NCG) handling system for collecting NCG from evaporation plant and incinerating in the lime kiln. Also, the mill has installed High Volume Low Concentration (HVLC) NCG handling system for collecting gases from tanks of evaporation plant, cooking and washing plants. This has helped in reduction of odor in and around the plant.

**Brief list of energy conservation projects implemented in last 3 years**

1. Installation of energy efficient pumps in paper machines resulted in power savings.
2. Installation of energy efficient free flow falling film evaporation plant resulting in increase in steam economy.
3. Installation of high Black Liquor solids firing chemical recovery boiler resulting in increase in specific steam generation.
4. Installation of energy efficient continuous Lo solids cooking system with reduction in specific steam consumption.
5. Installation of energy efficient TG set with increase in specific power generation.
BILT GRAPHIC PAPER PRODUCTS LIMITED

Ballarpur Industries Limited (BILT) is India’s largest manufacturer of writing and printing paper with leading market positions in the coated paper, hi-bright maplitho and business stationery markets and the second market position in the copier paper segment. It is also the only Indian company to rank amongst the top 100 pulp and paper companies worldwide.

BILT has a diversified production infrastructure with five manufacturing units spread across the country. The location of the manufacturing facilities gives BILT geographic coverage over most of the Indian market.

Bilt Graphic Paper Products Limited - unit Bhigwan is located at village Bhadalwadi in Pune District. It is an ISO 9001, ISO 14001 & OSHAS 18001 certified unit. Unit has the state-of-the art facility for manufacturing wood free coated paper of various grades based on 100% imported pulp, using double blade coating technology. Through a joint venture, the unit has been able to develop an indigenous source of supply for its ground calcium carbonate requirement which has resulted in significant savings for the company. The coated paper production has increased from 1,13,102 MT in year 03-04 to 1,24,303 MT in year 2006-07 against the installed capacity of 1,15,000 MT per anum.

The Bhigwan unit has a 30 MW cogeneration thermal power plant, which is equipped with high pressure CFBC boiler and extraction cum condensing turbine. The power plant caters for the unit steam & power requirement and feeds the power to the state grid after meeting the units power requirement.

Bilt-Bhigwan is committed toward Environment & Energy conservation

Since 02-03 BILT,s Bhigwan unit has implemented around 62 major energy saving projects by investing @ Rs.482 lakhs, which resulted into a total saving of around Rs.926 lakhs. The electrical energy saved through implementation of various energy conservation projects is exported to state grid. The efforts put in by the unit towards energy conservation are presented in the trends.
Energy Conservation Projects in last 3 years

1. Installation of Energy Conservation turbine at Deareator control valve (Investment Rs 67.73 Lacs / Savings Rs 35.19 Lacs)
2. Installation of HT VFD for Boiler PA Fan (Investment Rs 62.59 Lacs / Savings Rs 35.19 Lacs)
3. Installation of LT VFD mill wide for pumps & fans (Investment Rs 16.5 Lacs / Savings Rs 15.17 Lacs)
4. Reduction in mains water header pressure from 8 Kg/cm² to 5Kg/cm² (Investment Rs 19.75 Lacs / Savings Rs 11.04 Lacs)
5. Process optimization to reduce Electrical IR dryer power requirement (Investment Nil / Savings Rs 100 Lacs)
6. Installation of solar water heater system & solar lights (Investment Rs 5.4 Lacs / Savings Rs 1.38 Lacs)
7. Use of ETP waste sludge as fuel in boiler
8. Heat recovery from CBD flash steam (Investment Rs 67.73 Lacs / Savings Rs 35.19 Lacs)
9. Optimization of the furnish load on the refiners and stopping of one-two refiners in stock preparation area (Investment : Nil/Savings not considered)
10. Replacement of GRP blades with FRP blades for cooling tower fans (Investment Rs 1.61 Lacs / Savings Rs 4.08 Lacs)
11. Installation of Energy savers for street lights
In order to maintain, leading position in coated paper segment in India, BGPPL is now expanding its production capacity at unit – Bhigwan with the total capital investment of @Rs 1100 Crores by installing a state of the art paper machine with online line coating machine coating supplied by Voith Paper, Germany. To meet the enhanced power requirement of the new paper plant, a 30 MW power Plant with CFBC boiler is also being installed.

The total power generation of Bhigwan Unit will go up to 60 MW and the paper production will increase to 3,25,000 Tons per anum. The new machine will be in operation by year end 2008. This capacity expansion will improve the overall energy & operational performance of the unit.
HINDUSTAN NEWSPRINT LIMITED

Hindustan Newsprint Ltd, (HNL) is a Public Sector Undertaking under the administrative jurisdiction of the Department of Heavy Industries, Government of India.

HNL was incorporated as a wholly owned subsidiary of Hindustan Paper Corporation Limited (HPC) on June 07, 1983 with the main objective of taking over the business of Kerala Newsprint Project, a unit of Hindustan Paper Corporation Ltd. HNL has been achieving more than 110% capacity utilization while the industry average is below 60%.

HNL, Kottayam produces standard newsprint grades of 45 GSM and 48.8 GSM of quality which is at par with the best available in the market. It has share of about 16% of domestic newsprint production.

The Company has always put key focus on modernization and technological upgradations for efficiency improvements. Starting with an installed capacity of 80,000 MT per annum in the year 1982, the company invested Rs.70 crores during FY 1994-95 to increase the production capacity to 1,00,000 MT per annum. During FY 2002-2003, an investment of Rs.66 crores was made to raise the production potential to 1,10,000 MT. The Company has invested about Rs.26 crores during the FY 2004-2005 for schemes related to captive power augmentation, energy conservation and fibre recovery. The commissioning of the 7MW steam Turbo Generator by optimally utilizing the existing facilities is a significant step in controlling the energy cost and also in realizing the objective of self-sufficiency in the power front.

HNL meets a major portion of its requirement of fibrous raw materials from State Government forest sources. The Company also maintains Captive Plantation in about 4000 ha of forest land leased from Government of Kerala.

The Company has been encouraging pulp wood cultivation on agricultural and through Farm Forestry Scheme in which seedlings of Accacia, mangium etc., are distributed to farmers at subsidized rates.

The ‘Purchase at Gate’ scheme launched in the year 1998 complements the Farm Forestry Scheme. As per this scheme, pulp wood raw materials are purchased directly from farmers of Kerala and neighboring states at a very remunerative price at the Company gate doing away with middlemen and also avoiding procedural delays.
In line with the global shift towards recycled fibre in paper making, HNL operates a 100 TPD state-of-the-art, energy efficient and environment friendly De-inking Plant for the last three years to supplement its fibre requirements, reducing its dependence on forest based virgin resources to a considerable extent.

HNL’s credentials in pollution control and in piloting environment friendly methodologies for Newsprint production have been widely acknowledged. Besides bagging the Kerala State Pollution control awards in the past several years, HNL has been ranked with ‘Two Leaves’ rating in the green rating exercise conducted in the year 1999 and 2004 by Center for Science and Environment (CSE), New Delhi.

The Company has also been noted for its commendable performance in the areas of energy conservation and management. The Kerala State Energy conservation award for the year 2003-2004 was bagged by HNL. The Company has also been awarded as an ‘Excellent Energy Efficient Unit’ in the National Competition for Excellence in Energy Management conducted by Confederation of Indian Industries for the year 2005.


Fully Integrated Enterprise Resources Planning (ERP) system in vogue since the year 2001 has enabled the Company to streamline the processes and procedures and made HNL an agile user of IT.

Presently the Company has formulated a strategic business plan for expanding its capacities for the production of value added paper grades. The DPR prepared by Jaakkoo Poyrry, an international consultant envisages a new Paper Machine, a De-Inking Plant, a Power Boiler and a Turbo Generator with all the required associated facilities at a capital outlay of Rs.700 crores. It is expected that the realization of the expansion plan will position HNL as a leading player in the domestic maker, enabled with international competitiveness in cost and quality.
Company Profile

Paperboards & Specialty Papers Division (PSPD) is part of ITC Limited. During 2006-07, division has achieved turnover of Rs.1600 Crore with production of 4.1 Lac tons per annum with manufacturing facilities at Bhadrachalam with capacity of 2,80,000 TPA, Kovai with capacity of 70,000TPA, Tribeni with capacity of 30,000TPA and Bollaram with capacity of 25,000TPA as on March 2008.

Technology Adoption

Unit Bhadrachalam has installed state-of-art elemental chlorine free pulp mill in the year 2001-02 with capacity of 1,00,000TPA of bleached pulp, which is the first installation in India. During 2007-08, unit has installed another 800BD TPD Super Batch digesters with 400BD TPD capacity fiberline with ozone and chlorine dioxide bleaching, significantly reducing the pollution at the source of generation and reducing the energy requirement.

Installation of high solids free flow falling film evaporator with energy efficient soda recovery boilers increased the recovery and utilization of black liquor solids, improving biomass component in the unit’s energy mix.

Unit’s operations are automated with DCS along with advanced process control enabling precise control on quality of product, consistent production and monitoring resource consumption on real-time basis. Investments were made continuously to improve quality, productivity and reduce cost.

Climate Change Strategy

Unit actively pursues Green House Gas (GHG) emission reduction through energy efficiency & large scale tree plantation through social and farm forestry initiatives. These concerted efforts provide the company an opportunity to not only minimise the environmental foot print and energy cost but also gain from CDM by CER sale. Division has registered seven projects with UNFCCC.
Unit Bhadrachalam has consistently reduced the specific energy consumption through energy conservation and productivity improvement. Sp. energy consumption per ton of saleable production which was 38.4GJ/MT in 2004-05 was reduced to 34.5GJ/MT (05-06) and to 30.2GJ/MT (06-07) with 12.5% reduction compared to last year. At the primary energy level, black liquor solids contribute 33% of the energy in the energy mix which is climate neutral fuel. Efforts are continuously applied to increase the biomass component in the fuel mix to reduce carbon foot print.

Unit has continued to upscale farm and social forestry initiatives by adding another 24,000 hectares of plantation during 2006-07. Total farm and social forestry as on 31st March 2008, covered an area of nearly 65,000 hectares. Plantation initiative not only led to sustainable sources of raw material for paper & paperboard business, provided millions of mandays of employment for poor tribals and marginal farmers and helped to sequester 2025 kilotons of CO₂ thereby enabling ITC to become 177% carbon positive.

**Environmental Performance**

Lite ECF pulp mill with ozone and chlorine dioxide bleaching fiberline reduced AOX level in waste water to less than 0.1 to kg/ton against the National norm of 1kg/ton with significant reduction in colour of effluent. 100% of the fly ash generated in the unit is utilized for cement & brick manufacturing. More than 80% of the lime is recycled through lime kiln. Andhra Pradesh Control pollution Board has awarded certificate for the unit for practicing cleaner production technologies and climate mitigation measures during 2006-07, awarded on the occasion of World Environment Day, 5th June 2007.

**Awards**

Unit has won numbers of awards in the field of environmental improvement, energy conservation and productivity improvement. Unit has won CII National award for Excellence in Energy Management consistently for last six years. During 2006-07, unit Bhadrachalam was awarded IPMA Paper Mill of the year.
JK Paper Mills (earlier Straw Products Ltd.), a unit of JK Paper Ltd. a flagship company of JK Organization, an integrated Pulp & Paper Mill with installed capacity of 18000 TPA, was set up in the year 1962 at Jaykaypur, Dist. Rayagada, Orissa. The mill manufactures machine finished, machine glazed and surface sized quality writing and printing paper and paper board.

The mill has expanded in phases and at present it has five paper machines with the following production capacities and features.

- Finished paper making capacity of 121000 TPA
- Bleached pulp making capacity of 110000 TPA BD (bone dry)
- Coated paper & board making capacity of 42700 TPA
- Modern pulp mill with Rapid Displacement Heating (RDH) system for digestion
- Oxygen Delignification system
- CD-EOP-D bleaching sequence
- Two of 300 TPD BL solids firing capacity recovery boilers each
- Five coal fired boilers
- Three turbines with installed capacity of about 20 MW
- 4 MW DG Set
- Water Clarification & Treatment plant
- Effluent Treatment Plant.

The system and practices, introduced by the mill, has resulted in the following

- The first Indian Paper Mills to receive ISO 14001
- Environment Management Certification in the year 1998
Top 2 Paper Mill for getting three leaves award from CSE, New Delhi in 2004

It is also the first Indian Paper Mill to receive ISO-9001

Quality Management System (QMS) certification for design, development and manufacture of Paper, Board and related products from M/s DET NORSEK VERITAS QA LTD. under accreditation from National Accreditation of Certification bodies, London

It also received the Greenest Paper Mills award from Centre of Science & Technology (CSE), New Delhi.

VISION

To be a Dynamic Benchmark and Leader in the Indian Paper Industry

MISSION

To achieve growth and leadership through the JK brand equity, customer obsession, technological innovation and cost leadership, with a clear focus on environment, while continuously enhancing shareholder value.

ENERGY CONSUMPTION

Expansion / modernization / renovation is a way of life at JK Paper Mills. To be self sufficient in power demand w.r.t. expansion, the company has been putting up additional power generation plants without overburdening the grid demand and have been modernizing / discarding the old boilers and discarded old Pulp Mills (2 nos. of 80 TPD BD Bleached Pulp Production Capacity).

For the last three years specific energy consumption shown below, which indicates the continual reduction in energy consumption due to our sustained efforts to conserve energy with the implementation of various energy conservation projects & ideas for increasing the efficiency of the equipments/plant.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>UNIT</th>
<th>2004-05</th>
<th>2005-06</th>
<th>2006-07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Energy</td>
<td>Kwh/T</td>
<td>1333</td>
<td>1295</td>
<td>1185</td>
</tr>
<tr>
<td>Thermal Energy</td>
<td>M Kcal / T</td>
<td>5.619</td>
<td>5.577</td>
<td>5.402</td>
</tr>
<tr>
<td>Total Manufacturing Cost</td>
<td>Rs. lakhs</td>
<td>28917.04</td>
<td>31094.67</td>
<td>34074.66</td>
</tr>
<tr>
<td>Total Energy Bill</td>
<td>Rs. lakhs</td>
<td>3135.78</td>
<td>3104.11</td>
<td>3277.89</td>
</tr>
<tr>
<td>Energy Cost as % age of Manufacturing Cost</td>
<td>%</td>
<td>10.84</td>
<td>9.98</td>
<td>9.62</td>
</tr>
</tbody>
</table>
ENERGY CONSERVATION ACHIEVEMENTS

During the year 2004-07 a total of 79 numbers energy saving projects are done at Jaykaypur Unit which have resulted in a saving of Rs.580.11 Lakhs per annum by investment of Rs.345.72 Lakhs. It has resulted in percentage reduction of 11.10% in Electrical energy & 5.82% in Thermal energy during last three years shown below:

<table>
<thead>
<tr>
<th>Years</th>
<th>Product</th>
<th>KWH/TON</th>
<th>% Reduction Over 2004-07</th>
<th>MKCAL/TON</th>
<th>% Reduction Over 2004-07</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>Papers</td>
<td>1333</td>
<td>0.596</td>
<td>5.619</td>
<td>3.685</td>
</tr>
<tr>
<td>2005-2006</td>
<td>Papers</td>
<td>1295</td>
<td>2.850</td>
<td>5.577</td>
<td>0.747</td>
</tr>
</tbody>
</table>

Few of major energy saving projects discussed here.

...
<table>
<thead>
<tr>
<th>Sl No</th>
<th>Energy saving projects</th>
<th>Saving in (Rs. Lakh/Yr)</th>
<th>Investment in (Rs. Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improvement of own generation by improving Power factor from 0.80 to 0.93</td>
<td>27.50</td>
<td>140.16</td>
</tr>
<tr>
<td>2</td>
<td>Running of 12MW TG set at 49Hz instead of 50Hz</td>
<td>60.00</td>
<td>122.64</td>
</tr>
<tr>
<td>3</td>
<td>Avoiding day light by providing translucent sheet in Paper Godowns</td>
<td>2.35</td>
<td>1.23</td>
</tr>
<tr>
<td>4</td>
<td>Flash condensing system at General condensate tank installed at DM Plant</td>
<td>0.37</td>
<td>38.34</td>
</tr>
<tr>
<td>5</td>
<td>Flash steam recovery system installed for Pulp Mill</td>
<td>16.80</td>
<td>76.68</td>
</tr>
<tr>
<td>6</td>
<td>Reduction in Unburnt carbon in Flyash</td>
<td>15.00</td>
<td>24.60</td>
</tr>
<tr>
<td>7</td>
<td>By providing ON/OFF switch at entrance of all the Substations</td>
<td>0.26</td>
<td>1.69</td>
</tr>
<tr>
<td>8</td>
<td>Installation of Energy Efficient light fittings-T5</td>
<td>1.89</td>
<td>3.75</td>
</tr>
<tr>
<td>9</td>
<td>Replacement of old air conditioners with energy efficient air conditioners in plant &amp; colony</td>
<td>4.20</td>
<td>9.24</td>
</tr>
</tbody>
</table>
NAINI TISSUES LIMITED

Brief Company Profile

The group is in the business of writing & printing grade of paper and chemicals manufacturing. The plant campus is situated in Kashipur, Uttarakhand.

The two units situated in the campus are Naini Papers Limited and Naini Tissues Limited. The total production capacity of both the units is 66000 TPA. Naini Papers Limited was established in the year 1998 whereas Naini Tissues Limited in 2005.

Naini Tissues Limited is the flagship company of the “Naini Group” and is well known about its process & utility parameters, quality and customer satisfaction in the market. The agriculture residue, i.e., bagasse and wheat straw are used as raw materials.

The Naini Tissues Limited is an ISO 9001:2000 company and is looking forward for ISO 14001 and OHSAS 18001 systems. The company has its reputation in the region for environment preservation and got “Environment Award – 2005” from state pollution control board. It was also awarded with National Award for Excellence in Water Management – 2007" from CII, Hyderabad. The environment friendly process installation, i.e., oxygen de-lignification is under progress.
RAMA NEWSPRINT AND PAPER LTD

Rama Newprint and Paper Ltd was established in the year 1992 which came into commercial production in the year 1996. The plant was taken over by the Bangur Group in the year 2004. It is situated 15 KM away from city of Surat. The installed capacity of the mill is 1,32,000 MT/Annum. Raw-material used is 100% waste paper which makes the plant eco-friendly.

Out of the total raw material used 40-45% of the raw-material is sourced from nearby areas and 40% of the total product is sold in Gujarat state itself.

The raw material storage yard covers an area of 16972 m². The details of the major areas in the plant are given below:

<table>
<thead>
<tr>
<th></th>
<th>Flotation (New)</th>
<th>Flotation (Old)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (MT/day)</td>
<td>250</td>
<td>170</td>
</tr>
<tr>
<td>Pulping</td>
<td>Enzymatic</td>
<td>Enzymatic</td>
</tr>
<tr>
<td>Bleaching</td>
<td>H₂O₂, Na₂S₂O₄</td>
<td>H₂O₂, Na₂S₂O₄</td>
</tr>
<tr>
<td>Final pulp Brightness (%ISO)</td>
<td>57 + 1</td>
<td>57 + 1</td>
</tr>
</tbody>
</table>

**Paper machine**

<table>
<thead>
<tr>
<th></th>
<th>PM#1</th>
<th>PM#2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deckle (Meter)</td>
<td>5.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Speed (mpm)</td>
<td>620</td>
<td>620</td>
</tr>
<tr>
<td>Capacity (MT/Annum)</td>
<td>70,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Newsprint (gsm)</td>
<td>48.8, 45</td>
<td>44 – 45</td>
</tr>
<tr>
<td>Writing &amp; Printing Paper (gsm)</td>
<td>-</td>
<td>47 – 90</td>
</tr>
<tr>
<td>Online quality assurance by DCS / ABB, USA</td>
<td>ABB, USA</td>
<td>ABB, USA</td>
</tr>
<tr>
<td>QCS (gsm, caliper &amp; moisture)</td>
<td>No size press</td>
<td>Inclined type</td>
</tr>
<tr>
<td>Size press</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Utility

The source of water river Tapi situated at about 17 Km from mill premises. Coal used is both Indigenous & imported boiler and turbine specifications are given below.

Boilers

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Design pressure (bar)</th>
<th>Design Temp. (°C)</th>
<th>Max. Continuous rating (TPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A.F.B.C Boiler (AP-2)</td>
<td>84</td>
<td>483</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>A.F.B.C Boiler (CE-4)</td>
<td>84</td>
<td>483</td>
<td>107</td>
</tr>
<tr>
<td>3</td>
<td>C.F.B.C. Boiler (New Proposed)</td>
<td>84</td>
<td>490</td>
<td>190</td>
</tr>
</tbody>
</table>

Turbines

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Inlet steam pressure (bar)</th>
<th>Inlet steam Temp. (°C)</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AEG TG</td>
<td>82</td>
<td>480</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Siemens TG</td>
<td>35</td>
<td>410</td>
<td>8.0</td>
</tr>
<tr>
<td>3</td>
<td>BHEL TG</td>
<td>81</td>
<td>470</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>Turbine (New proposed)</td>
<td>81</td>
<td>470</td>
<td>25</td>
</tr>
</tbody>
</table>

Environment

- Full fledged effluent treatment plant with two stage activated sludge process meets the statutory norms
- Capacity is being upgraded for taking care of future expansion
- ESP installed to minimize stack emission to meet statutory norms
- Solid waste handling / disposal
  - Sludge is converted to board for captive consumption & Partly disposed off
  - Fly ash is used for land filling and brick manufacturing
  - Plastic incineration by approved authority
Improvements

After taking over by the Bangur group, continuous technical upgradation & process modifications were carried out as follows:

- Both Paper Machines speed increased from 530 of 630 m/min
- Installation of stationary siphons and turbulator bar on both machines for improving condensate removal.
- Ceramic drainage elements & trivac are installed on both machines.
- Ink carryover & stickies are reduced by installation of Krofta in PM#1 & 2.
- Uninterrupted power supply by new 23 MW turbine.
- Online brightness tester for uniform brightness of pulp.
- Enzymatic deinking process established – Cleaner technology.
- Brightness of Newsprint improved continually (From 52 to 56%ISO).
- Successful trials taken to re-launch manufacture of writing & printing Papers in October, 2007.
Shreyans Industries, the flagship company of Shreyans Group was incorporated in 1979. The company commenced the commercial production of writing and printing papers in 1982 using agricultural residues with an installed capacity of 10,000 MTs per annum.

The installed capacity of Shreyans Papers unit was increased to the present capacity of 33,000 MTs per annum through a number of modernization-cum-expansion plans. The unit is considered as a market leader in agro based paper mills of the country and is one of the most modern plant & machinery set up. This unit has been the recipient of Productivity Awards instituted by National Productivity Council for five consecutive years. On the environmental front this unit was the first in Asia to set up a Chemical Recovery Plant suitable for agro based units, which was part financed by USAID. This unit meets all the standards laid down by various environmental laws and produces Eco-friendly paper without cutting a tree.

Company took over a paper division of M/s Zenith Limited (A Ashok Birla Group Company) in February 1994. At the time of take over, the capacity of this unit was 9,000 MTs per annum which has been raised to 25,000 MTs per annum now.

Shreyans produces different varieties of writing and printing papers for different uses including watermark papers for various state Governments and Education Boards. Shreyans also produces the inland letter and envelope papers to be used by the postal dept. and special papers for railways for their computerized tickets. The Hi-brite super printing paper and Rishabh Gold paper is well accepted in the market.
Manufacturing process

Wheat straw is washed to remove silica and chloride before cooking in the continuous digester. Cooked pulp is screened, washed, screened, bleached (CEopHH) to 85% ISO brightness to make paper from it. Paper is made on fourdriner machine equipped with pressurized head box, binip press followed by straight through process, dryers and calendar. A quality control system is provided for monitoring and controlling substance, ash and moisture content in paper. Furnish contains about 5% wood pulp/waste paper for which a waste paper line is provided.

The black liquor is concentrated and burnt in Fluidized bed reactor to produce Soda ash which is sold as a product.

To meet the requirement of energy there is a 44 TPH, 45 kg/cm² pressure rice husk fired boiler equipped with ESP to control air emission and two nos TG sets (2.5 MW and 3.5 MW capacity each).

There are two effluent treatment plants. One for straw wash water to treat an aerobically through UASB system and other for the combined mill’s effluent by activated sludge process.

Energy Conservation Steps

Apart from the energy conservation steps described in the case study presentation, following steps were also taken.

- VFD’s were provided at required places.
- Energy inefficient equipment and lighting system were replaced by efficient ones.
- Four numbers of boilers were replaced by one boiler of high capacity and efficiency.
- Hotlines were lagged and
- Capacitors as well as APFC system were provided to improve Power factor.
*There have been some deviation in power and steam consumptions as oxygen stage is run only while manufacturing High Bright quality paper.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raw material handling and preparation</td>
<td>24</td>
<td>0</td>
<td>12.8</td>
<td>34</td>
<td>0</td>
<td>13</td>
<td>38</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Chemical pulping &amp; bleaching</td>
<td>276</td>
<td>2.5</td>
<td>25.9</td>
<td>281</td>
<td>2.252</td>
<td>26</td>
<td>279</td>
<td>2.175</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>Waste paper/purchased pulp prep.</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>33</td>
<td>0.023</td>
<td>0</td>
<td>23</td>
<td>0.009</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>stock prep. and paper machine</td>
<td>429</td>
<td>2.6</td>
<td>56.5</td>
<td>432</td>
<td>2.898</td>
<td>58</td>
<td>413</td>
<td>2.793</td>
<td>57</td>
</tr>
<tr>
<td>5</td>
<td>Chemical recovery</td>
<td>116</td>
<td>1.7</td>
<td>7.6</td>
<td>111</td>
<td>1.741</td>
<td>8</td>
<td>118</td>
<td>1.878</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Power house</td>
<td>143</td>
<td>0.7</td>
<td>6.5</td>
<td>152</td>
<td>0.624</td>
<td>7</td>
<td>131</td>
<td>0.538</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>Water treatment and supply</td>
<td>59</td>
<td>0</td>
<td>0</td>
<td>41</td>
<td>0</td>
<td>0</td>
<td>41</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Effluent treatment</td>
<td>43</td>
<td>0</td>
<td>3.3</td>
<td>49</td>
<td>0</td>
<td>3</td>
<td>51</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Miscellaneous</td>
<td>33</td>
<td>0</td>
<td>1.4</td>
<td>60</td>
<td>0.309</td>
<td>1.5</td>
<td>66</td>
<td>0.496</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td><strong>Total</strong></td>
<td><strong>1147</strong></td>
<td><strong>7.5</strong></td>
<td><strong>114</strong></td>
<td><strong>1193</strong></td>
<td><strong>7.847</strong></td>
<td><strong>116.5</strong></td>
<td><strong>1160</strong></td>
<td><strong>7.889</strong></td>
<td><strong>115</strong></td>
</tr>
</tbody>
</table>
TAMIL NADU NEWSPRINT AND PAPERS LIMITED

India’s premier Newsprint producer, Tamil Nadu’s 180,000 tonnes per year mill Tamil Nadu Newsprint and Papers Limited - better known as TNPL, was incorporated on April 16, 1979 by the Government of Tamil Nadu for manufacture of Newsprint and Printing and Writing Papers using bagasse as the principal fibre source which is otherwise burnt as in-house fuel in the sugar mill boilers to generate steam.

MILL DESCRIPTION

The Mill is situated at Pugalur, an industrially backward area in Karur District. The mill’s production capacity now stands at 2,30,000 tpa.

TNPL was procuring the raw material requirement from the 5 tied-up Sugar Mills located within a range of 5 - 140 Km from the Factory, in exchange of steam for the supply of which TNPL had installed coal-fired boilers at these Sugar Mills.

During 2005-07, the mill development plan (MDP) was conceptualized to change the bleaching technology to Elemental Chlorine Free (ECF) involving Chlorine-di-oxide as the principal bleaching chemical with a capital outlay of 600 Crores.

The specific benefits of MDP are:

- The technology of the existing mill operations is upgraded.
- Outdated and environmentally obsolete pulping and chemical recovery equipment are phased out.
- Eco-friendly and state of art process technology is introduced by way of ECF bleaching based on Chlorine di oxide for sustainable pulp and paper manufacturing.
- Quality of pulp in terms of strength, run ability of the paper machines and brightness are improved.
- Competitiveness shall be improved on account of higher usage of improved quality of wood pulp in the furnish
- Improved overall environmental compliance is achieved in respect of the liquid effluent, air emissions and the solid waste discharges.
PROCESS DESCRIPTION

PULP MILL

The paper production capacity of 2,30,000 tpa is supported by the following 4 pulp lines.

- Chemical bagasse pulp line #1  180 TPD
- Chemical bagasse pulp line #2  230 TPD
- Chemical bagasse pulp line (only for newsprint)

The chemical pulping lines employ conventional bleaching sequence involving elemental chlorine and calcium hypochlorite. After MDP the existing two Chemical Bagasse Pulp bleaching lines were converted into ECF pulping line of the capacity 500 TPD and a new 300 TPD ECF hardwood pulping facility has been installed.

PAPER MACHINE

The mill has 2 nos. dual purpose paper machines capable of producing newsprint/writing and printing paper. The Paper Machine #1 (PM1) has a trim width of 6.8 M at a continuous operating maximum speed of 750 m/min, while the PM2 has a trim width of 6.6 M, capable of operating at speed around 850 m/min. The machine also incorporated several improved features to support higher percentage of weak bagasse pulp in the furnish.

CHEMICAL RECOVERY PLANT

The Black Liquor received from Pulp Mill is concentrated in the Black Liquor Evaporation plant. The recovery plant has two streets of seven effects tubular type falling film evaporator. One street has a capacity of 170TPH evaporation capacity at output concentration of 45-48%. The second new plant has a water evaporation capacity of 350tph at 70% solids output. A new Recovery boiler with a capacity of 1300 TPD, 465 oC at 65 kg/cm² has been commissioned in 2007 and is in operation. The liquor is fired in the Recovery Boiler at 70% concentration.

The Causticizing Plant had a capacity to produce 850 m³/day of white liquor (NaOH + Na2S), has been augmented to 2000 m³/day. The augmented recausticizing plant has a two stage slaking, which is introduced to overcome the problem of high silica bagasse liquor. This capacity was again augmented under MDP to 3600 m³/day with the installation of claridisc filter. The smelt of inorganics from Recovery Boilers is dissolved in weak white liquor and causticized with burnt lime to convert back to active alkali and the lime sludge generated from the precoat filter. A new Lime mud claridiac filter has been installed to improve the dryness of the mud which is fed to lime kiln. A Lime mud reburning kiln of 170 tpd capacity has been installed to recycle this lime sludge and re-generate burnt lime.
required for the causticizing process. Under MDP a second kiln with same capacity has been installed.

**UTILITIES**

The mill has five Service Boilers, four each of 60 T/hr steam generation capacity at 44 Kg/cm² and one 90 t/hr steam generation capacity at 64 Kg/cm². The Mill has 5 turbines to facilities for captive power generation of 81.12 MW.

During 1993, TNPL has diversified into the field of Non-conventional energy sources, for generation of electricity, mainly to reduce dependence on grid power. Under this programme, the company has set up a 15 MW Wind Farm in Tamil Nadu at a total capital outlay of Rs.50 crores. The power generated from the wind farm is being sold to the TNEB.

The mill has a modern Effluent Treatment Plant designed to treat 20 MGD of effluent generated from various sections of the mills. TNPL commissioned a Bio-methanation plant during June 2003 to treat the high BOD/COD stream and generate biogas upto 20,000 m³/day, which is utilised in Lime Kiln, to partly substitute Furnace oil.
LIST OF BEST PRACTICES IDENTIFIED

Pulp mill
1. Installation of energy efficient high capacity chippers (ITC – PSPD, Bhadrachalam)
2. Installation of extended delignification cooking system (APPM, JKPM, ITC- PSPD-Bhadrachalam, TNPL)
3. Installation of ECF bleaching with Oxygen Delignification system (2 stage ODL) to reduce consumption of ClO₂ (APPM, ITC – PSPD, TNPL)
4. Installation of Lite-ECF bleaching system (ITC – PSPD, Bhadrachalam)
5. Modification of pulp mill washers in order to avoid the usage of vacuum pumps (Naini Tissues)
6. Installation of advance control system for pulp mill section (ITC – PSPD, Bhadrachalam)

Stock Preparation & Paper Machine
7. Replacement of centrifugal screen with pressure screen in stock preparation. (Shreyans Industries Limited)
8. Installation of high efficiency refiners (APPM)
9. Installation of Specific Energy Consumption (SEC) control for refiners (TNPL)
10. Avoiding the operation of silo level control pump in paper machine area (RNPL)
11. Elimination of vacuum for couch roll (Shreyans Industries Limited)
12. Installation of high efficiency vacuum pump (APPM, Shreyans Industries Limited)
13. Reduction of vacuum pumps power consumption by cooling the seal water (TNPL)
14. Installation of vacuum blower(s) instead of vacuum pumps (BILT-Bhigwan)
15. Replacement of rotary siphons with stationary siphons for lesser Dp between dryers. (TNPL)

Soda Recovery & Power Block
16. Installation of evaporator with high steam economy (APPM, TNPL)
17. Utilization of non-condensable gases (NCG) by firing high volume - low concentration (HVLC) in boiler and high concentration - low volume (HCLV) in lime kiln. (APPM)
18. Installation of a high efficiency recovery boiler and fire black liquor at 75 % solids (APPM)
19. Installation of CFBC Boiler to utilize agro waste (& sludge) as fuel (BILT – Bhigwan)
20. Installation of back pressure turbine in place of PRDS to generate power from steam at 5.5 bar and supply the exhaust steam at 2.5 bar to deaerator (BILT-Bhigwan)
21. Replacing mechanical governor with electronic governor for the steam turbine (HNL, JKPM)
22. Improvement of generator efficiency by improving the generator Power Factor (PF) from 0.8 to 0.93 (JKPM)
23. Installation of Ultra Filtration unit (ITC)
24. Energy management through advanced boiler feed water conditioning. (RNPL)

Utilities & Other areas
25. Bio-methanation from waste water discharge of agro based pulp mill (Shreyans Industries Limited & TNPL)
26. Installation of centrifugal compressor for compressed air generation (HNL, TNPL, ITC – PSPD)
27. Installation of VAM chiller for increased co-generation opportunity (ITC, TNPL)
28. Installation of energy efficient agitators (HNL)
29. Installation of high efficiency pumps (Naini Tissues, HNL)
30. Installation of Variable Frequency Drives (HNL, ITC)
31. Installation of centralized monitoring system for energy and raw materials (HNL)
32. Utilization of ETP water as pump seal water (RNPL)
33. Installation of diffused aeration system in ETP (APPM)
34. Reduction of water consumption by better water management (Naini Tissues)
35. Rain water harvesting (JKPM)
36. Provision made for secure landfills (HNL)
37. Afforestation as a strategy to increase fiber security (JKPM, ITC, TNPL)
   a. Afforestation at ITC
   b. Afforestation at JKPM
   c. Afforestation at TNPL
IDENTIFIED

BEST PRACTICES
BEST PRACTICE NO. 1

Installation of Energy Efficient High Capacity Chippers

UNIT: ITC – PSPD, Bhadrachalam

Background

The first wood chippers, which are still made today, were drum-based. The drum also serves as the feed mechanism, drawing the material through as it chips it. These chippers have many downsides. The drum-style chipper is not as safe as newer designs. If an operator becomes snagged on material being fed into the machine, injury or death is almost certain. These chippers are also very loud. The chips produced can be very large, and if thin material is inserted, it may be cut into slivers rather than chips. Finally, since the drum cannot be disengaged from the engine (or motor), if too large or too long material is fed through the machine, it will stall, usually with the material stuck firmly in the drum. In addition, drum-style chippers produce inconsistently sized wood chips. Materials can also become easily stuck in the drum.

Some of the features of the drum type chippers are as follows.

- Chips easier than the competition because of its oversized drum
- Larger opening
- Collapse limbs easier
- Chip more material at one time
- Process most fibrous materials common in warmer climates
Disc type wood chippers rely on energy stored in a heavy flywheel or drum to do their work. The chipping blades are mounted on the face of the flywheel, and the flywheel is accelerated by an electric motor. Some of the features of the disc type chippers are as follows.

- Better all-around machines
- Chips easier because of their fixed 45 degree angle feed

**Before implementation of the project**

ITC – PSPD, Bhadrachalam had three chippers of 20 TPH each (aggregate capacity 700 TPD). In addition to this, chipping activity for around 200 TPD was outsourced to meet the demand of chips to the pulp mill. The quality of chips obtained is not optimal due to oversize of chips and excessive dust. The desired standard size of the chips is between 17 mm to 22 mm. However, some chips were bigger, requiring re-chipping. The existing capacity of the re-chipper of 2 TPH, is not adequate to take care of the off-standard long chips and hence, the long chips find their way into accepted chips and get into the cooking process. Due to poor chip quality, the alkali percentage is required to be maintained at a higher level resulting in higher chemical consumption.

Also, due to the operation of multiple small chippers, power consumption for chippers was high resulting in higher specific power consumption.

**Details of the identified best practice**

Wood chipping can be done using either the drum chipper or disc chipper technology. In India, generally drum chipper are used, considering the quality and size of the wood. Internationally, both drum and disc chippers are used. ITC – PSPD has installed drum chippers.

Disc chipper gives lesser dust generation and consistent uniform sized chips with less sliver generations, resulting in lower alkali percentage for cooking.

ITC – PSPD has recently installed a disc chipper of capacity 80 TPH consuming average power of 560 - 640 kW with specific power consumption of 7 – 8 kWhr / BDMT of chips.

**Benefits of the project**

- Disc chippers generate uniform sized chips, which resulted in reduction in alkali percentage from 20% to 18%.
- Dust generation reduced from 3% to 1%, which resulted in more fiber/ton of wood chipped.
Replacement of multiple chippers by single energy efficient high capacity chipper resulted in reduction in power consumption and specific power consumption.

Less number of equipment for chipping

Financials

The overall cost of the equipment and its installation is about Rs. 1600 Lakhs. This includes Rs. 444 Lakhs (EURO 0.74 million) for the chipper, rechipper & vibrating screen, Rs. 300 lakhs for the feeding system, Rs. 330 Lakhs for electrical system, Rs. 200 Lakhs for the civil work.

Replication potential

Technology is proven for the purpose. Potential for replication is high due to usage of similar species of wood in majority of Indian mills for making pulp.
BEST PRACTICE NO. 2

Installation of extended De-lignification cooking system

UNIT: APPM, ITC – PSPD, JKPM, TNPL

Background:

In the conventional cooking process, the wood chips are subjected to high temperature (170°C) (using steam at 8.5 bar) and white liquor that dissolves the lignin in the pulp in a batch process. Some of the agro based mills use continuous digesters for cooking bagasse.

The following timeline indicates the typically steps and approximated time involved in the batch cooking process.

- Filling time: 20 min
- Heating time: 90 min
- Cooking time: 120 min
- Blow time: 12 min

After a certain period of time (residence time – in case of continuous cooking), pulp and other ingredients are blown to the blow tank using the vapour pressure of water vapour in the digesters. Because of the change in pressure, a lot of water vapour flashes out and large portion of its heat content is not recovered.

Salient features

JKPM & TNPL: Both these mills have installed Rapid Displacement heating (RDH) cooking system supplied by GL&V. While JKPM has installed it about 13 years ago, TNPL has installed and commissioned it less than a year ago.

APPM: Under a Mill Development Plan (MDP), Down flow Lo - solids continuous cooking system was selected and installed at APPM. The system comprises of Turbo feed digester feed system and Downflow Lo-solids Cooking process.

Turbo feed system contains diamond back chip bin which ensures even distribution of chips to make sure all chips subjected to pre steaming with LP steam generated from reboiler and effective air removal. The steamed chips from diamond back chip are pumped to digester top by means of three chip pumps installed in series.
Lo-Solids cooking is to minimize the concentration of dissolved organics throughout the bulk phase of delignification while maintaining an “even” alkali profile, minimum cooking temperatures, and minimum concentrations of dissolved lignin at the end of the cook.

To achieve this objective, multiple extractions, split white liquor additions and split filtrate additions adopted. MP steam is used to maintain the top digester temperature and cooking temperature of 150-155 °C.

**ITC – PSPD:** ITC has chosen Super Batch technology from Metso with a cooking capacity of 800 BD MT per day which includes 4 x 350 m³ digesters. The super batch cooking concept includes the following sequence.

1. **Combined chip and impregnation liquor fill**

   During the chip fill, impregnation liquor fill is started as well by pumping black liquor into the digester from the displacement liquor tank, i.e washing filtrate is used for impregnation. Thus the chips are preheated and pre-impregnated at this stage. The minimized excess amount of the black liquor is taken into the digester and the overflow is returned into the displacement liquor tank. Air is removed from the digester through the displacement screen by using air evacuation fans. At the end of this stage the digester is pressurized with a liquor pump and the digester is hydraulically full. The residual alkali level of impregnation liquor can be adjusted by introducing white liquor during the fill.

2. **Hot black liquor treatment**

   At this stage, hot black liquor from the HBL accumulator displaces the black liquor in the displacement liquor tank. The displaced liquor with temperature more than 100°C is led into the HBL accumulator. The residual alkali of HBL can be adjusted to the desired level with white liquor.

3. **Heating and cooking**

   Heating is done by introducing MP steam into the circulation line. No heat exchanger is needed due to small steam amount required. At the cooking phase, the digester is kept at a desired cooking temperature and pressure until the target H-factor is reached. Part of the hot white liquor is introduced during the pressure phase (White liquor split). Extra liquor from the digester during white liquor split is led to the HBL accumulator.
4. Terminal displacement

At the end of the cooking stage, when the cooking conditions are still prevailing, terminal displacement is done by pumping black liquor from the displacement liquor tank. Hot cooking liquor is displaced into the HBL accumulator thus terminating the cooking reactions. The amount of the displacement liquor corresponds to the total volume of the brown stock washing filtrate. As a result, the pulp temperature is below 100°C.

5. Pump discharge

The digester is discharged with pump at a low pressure to an atmospheric storage tank. During the discharge, pulp is diluted in the digester bottom with liquor from the displacement liquor tank. Pulp temperature is preferably below 90°C in order to enable preferred fiber line temperature for pulp quality. The discharge method effectively prevents malodorousTRS emissions.

Issues & mitigating measures

APPM: No major problems faced with the system. The operation of the plant is easy and simple. Continuous cooking system is simple and easy to operate. Pulp quality is good and the kappa number is more uniform. Knots have reduced. No LVHC (Low Volume High Concentration) gas generation in the plant. HVLC (High Volume Low Concentration) gases are also collected and burnt in recovery boiler. As a result of these, there is no odor in the plant.

Benefits of the project

APPM:

- Specific steam consumption reduced from 1.48 Tons/ton of unbleached pulp (for conventional cooking) to 0.66T/ton of unbleached pulp.
- Average Kappa number is now 18±1, as against 20±2 for the conventional cooking.
- Knots content have been observed to be less than that of conventional cooking
- No odour in the plant
- Uniform and good quality of pulp
- High yield
ITC- PSPD

- MP steam consumption for the cooking process is reduced to 560 kg/BD MT of pulp and LP steam consumption is 180 kg/BD MT of pulp
- Unbleached pulp yield across the digesters is 48.2%
- Specific power consumption for unbleached pulp from digesters is 25 kWh/ BD MT of pulp.

Financials

**APPM:** For the continuous cooking process installed at APPM, the cost of equipment and its installation was about Rs. 5,000 Lakhs.

**ITC – PSPD:** For the ‘Superbatch’ cooking process installed at ITC - PSPD, the cost of equipment and its installation was about Rs. 6,000 Lakhs.

Replication Potential

For mills using conventional cooking system, installation of extended de-lignification system is a good way of reducing their operating cost.
BEST PRACTICE NO. 3

Installation of ECF bleaching with Oxygen Delignification system (2 Stage ODL) to reduce consumption of ClO₂

MILL : APPM, ITC – PSPD, JKPM, TNPL

Background

Cellulosic raw material used for pulp & paper making contains Lignin which is responsible for brownish color of pulp. At pulping stage, the lignin content reduced to almost 5%, but for high quality paper manufacturing further removal of lignin to less than 1% is a must.

In bleaching process for chemical pulp, selectively bleaching chemicals remove the lignin remaining in the pulp and brighten the brown, unbleached pulp to a white pulp with the desired brightness level.

Elemental Chlorine Bleaching is the process currently in place at some existing bleaching plants, and uses chlorine (Cl₂) and hypochlorite (hypo) to brighten the pulp. When elemental chlorine and hypochlorite react with the lignin, they form pollutants such as chloroform, dioxins, and furans in the wastewater stream.

Generally, the pulp passes through 3 – 5 stages in order to dissolve the degraded lignin and separate it from the fibers. The sequence followed is C-EP-H. ‘C’ stands for elemental chlorine stage, ‘EP’ stands for alkaline peroxide (caustic and hydrogen peroxide) stage and ‘H’ stands for hypochlorite stage.

All the bleaching chemicals give the same global reaction on lignin, as shown by the following figure. This global reaction is an oxidation involving four electrons per aromatic ring.

Details of Identified best practice

Elemental Chlorine Free (ECF) bleaching replaces chlorine with chlorine dioxide as a bleaching agent and hypochlorite in no longer used. The use of ECF bleaching results in reduced levels of chlorinated pollutants in the wastewater stream.
Chlorine is formed and is responsible for part of the delignification.

Pulp bleaching at APPM is elemental chlorine free with D_0 – EOP – D_1 sequence. (D_0 and D_1 stand for Chlorine-di-oxide stage, E for Extraction (by caustic), O for oxidation (by the use of oxygen) and P for (hydrogen peroxide).

To reduce the chemical consumption in the bleaching section, two stage Oxygen De-\textit{L}ignification (ODL) system is used to achieve a kappa reduction of 40 – 45%. In general for the Kraft pulping system using sulphite process, the pulp viscosity drops only if the kappa reduction is done to 50% with ODL. Apart from cost reduction, the non corrosive and non – toxic process of ODL has other advantages. It improves the quality of pulp and reduces the color of the bleached effluent.

**Other advantages of ODL**

- Unbleached pulp brightness increased by 40%
- AOX in Pulp Mill effluent reduced by 86%
- Mill effluent AOX level has reduced from 0.54kg/T to 0.09kg/T of paper
- BOD and COD has reduced by 10-15%
- Pulp mill water consumption reduced from 60m$^3$/ton to 18 – 20 m$^3$/ton.

Typical figures of energy and chemical consumption in the fibreline in a conventional bleaching sequence (C-EP–H) and that in ECF bleaching to get an ISO brightness of 88, are as follows.
Prior to the ‘D’ Stage, Pulp pH is controlled with addition of sulphuric acid. Operating parameters of bleach plant are as shown in the following table.

<table>
<thead>
<tr>
<th></th>
<th>ECF bleaching with two stage ODL (consumption at ITC)</th>
<th>ECF bleaching with two stage ODL (consumption at APPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (fibre line)</td>
<td>175 kWhr/ton</td>
<td>75</td>
</tr>
<tr>
<td>Steam (LP + MP for fibre line)</td>
<td>417 kg/ton</td>
<td>500 kg/ton</td>
</tr>
<tr>
<td>Water Usage (in fibre line)</td>
<td>20 m³/ton</td>
<td>30</td>
</tr>
<tr>
<td>Cl₂</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Hypochlorite</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>ClO₂</td>
<td>48 kg/ton</td>
<td>52.0</td>
</tr>
<tr>
<td>NaOH</td>
<td>15 kg/ton</td>
<td>17.5</td>
</tr>
<tr>
<td>Oxygen (ODL + EOP)</td>
<td>23 kg/ton</td>
<td>7.5</td>
</tr>
<tr>
<td>H₂O₂</td>
<td>3 kg/ton</td>
<td>12.8</td>
</tr>
<tr>
<td>H₂SO₄</td>
<td>6 kg/ton</td>
<td>19.7</td>
</tr>
<tr>
<td>Effluent generation</td>
<td>18 m³/ton</td>
<td></td>
</tr>
<tr>
<td>AOX</td>
<td>&lt; 38 kg/ton</td>
<td></td>
</tr>
<tr>
<td>BOD</td>
<td>Reduced by 15%</td>
<td></td>
</tr>
<tr>
<td>COD</td>
<td>Reduced by 15%</td>
<td></td>
</tr>
</tbody>
</table>

Prior to the ‘D’ Stage, Pulp pH is controlled with addition of sulphuric acid. Operating parameters of bleach plant are as shown in the following table.

<table>
<thead>
<tr>
<th>Bleaching Stage</th>
<th>D₀</th>
<th>EOP</th>
<th>D₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention, min</td>
<td>20</td>
<td>65</td>
<td>180</td>
</tr>
<tr>
<td>Consistency,%</td>
<td>9</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Temperature°C</td>
<td>60</td>
<td>85</td>
<td>75</td>
</tr>
</tbody>
</table>

**Oxygen Delignification conditions at JKPM (Single stage ODL)**

Temperature maintained : 95-105°C
Retention Time : 1.5-2.0 Hrs
Oxygen Dosing : 28-30 kg/MT of pulp
Salient Features

- By treating with oxygen at pre bleaching stages in a Chlorine compound based bleach plant, oxidizing chemicals requirement in further stages reduces drastically which in turn lowers bleaching chemical cost.

- The chemicals used for delignification when removed from pulp in later stage are compatible with Kraft chemical recovery system. This enables recycling of O₂ Stage effluent to recovery system through BSW system. This makes system further closure (for water and chemicals) as well increases organic % in black liquor solid which helps increase in steam generation during recovery.

- Pulp quality become comparatively better in terms of brightness stability and further improvement in brightness could be achieved with out hampering the pulp strength to a great extent.

- The introduction of oxygen delignification before pulp bleaching leads to a reduced kappa number, which is beneficial for pollution abatement. Effluent parameters like BOD, COD, AOX colour etc are directly correlated to the kappa number of the pulp bleached.

Benefits Achieved (at JKPM, Rayagada)

Chemical consumption Trend

<table>
<thead>
<tr>
<th>Period</th>
<th>Chemical consumption in kg per MT of Pulp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W/L (TTA)</td>
</tr>
<tr>
<td>2003-04</td>
<td>545</td>
</tr>
<tr>
<td>2004-05</td>
<td>525</td>
</tr>
<tr>
<td>2005-06</td>
<td>572</td>
</tr>
<tr>
<td>2006-07</td>
<td>539</td>
</tr>
<tr>
<td>2007-08</td>
<td>569</td>
</tr>
<tr>
<td>(Till Mar’08)</td>
<td></td>
</tr>
</tbody>
</table>
Effect on pollution load

<table>
<thead>
<tr>
<th>Period</th>
<th>Effluent Parameters (Kg/Mt of Paper)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BOD</td>
</tr>
<tr>
<td>2003-04</td>
<td>1.3</td>
</tr>
<tr>
<td>2004-05</td>
<td>1.2</td>
</tr>
<tr>
<td>2005-06</td>
<td>1.1</td>
</tr>
<tr>
<td>2006-07</td>
<td>1.1</td>
</tr>
<tr>
<td>2007-08 (Till Mar’08)</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Issues & Mitigating Measures

- High Capital Investment can be seen as one of the drawbacks.
- Increase in load on recovery in terms extra solid handling & extra requirement of white liquor for oxidized delignification.
- Oxygen Delignification at 95-105°C (Normally maintained for single stage Oxygen Delignification), is non selective at high degree of delignification which means carbohydrate chains are attacked to a greater extent than in comparison to conventional bleaching method. This caused decrease in fibre length i.e. viscosity loss. However several experiments show that although there is a drop in viscosity, but over all strength properties are comparable.

Scenario prior to Oxygen De-Lignification at JKPM

- Prior to installation of the new State of Art Technology RDH Cooking & New Fibre Line Bleaching Street, at JKPM, 40-50% Bamboo and rest of Hard wood were used for pulping in conventional cooking and bleaching sequence (CEHH) to final brightness of 83-84% ISO with viscosity 6-7cps could be achieved.
- Further increase in brightness led to drop in viscosity. With RDH Cooking technology and Fiber line, the mill could achieve 89-90% ISO brightness pulp of viscosity of 7-9 cps.
- Further increase in brightness by 2-3 %ISO has many disadvantages like yield loss, higher chemical consumption for bleaching and more pollution load. However, looking at the grades of paper JKPM manufacturers, this increase was felt necessary.
Safe and technically feasible way is to go for more oxygen delignification, but the constraint was the low amount of oxygen generation. Hence, one more plant of 6.0 TPD capacity was installed in the year 2006-07.

Financials (JKPM, Rayagada)

The total cost of this project at JKPM was approximately Rs. 3,000 Lakhs. This investment resulted in reducing the production cost of pulp by Rs. 60 per ton with a recurring net annual saving of Rs 60 lakhs.

Replication Potential

Replication potential is high for other paper mills having conventional bleaching system.

Scope for Further Development

Conversion of single stage ODL to two stages ODL can reduce the consumption of oxygen without affecting the delignification of pulp.
Installation of Lite-ECF Bleaching System

UNIT : ITC – PSPD, Bhadrachalam

Background

- ITC - PSPD has ECF fiberline of capacity 330 (BD) TPD. The introduction of oxygen delignification before pulp bleaching leads to a reduced kappa number, which is beneficial for pollution abatement. Effluent parameters like BOD, COD, AOX color etc are directly correlated to the kappa number of the pulp bleached. Of the two oxygen delignification systems operating at either high or medium pulp consistency, the medium pulp consistency system dominates the market. For bleaching, ECF sequence (D0-EOP-D1) has been considered.

- Unit in the proposal to install 400 BD TPD fiberline. In the TEFR study, it was found at equal bleaching power, ozone approximately equals to 1.5 times of chlorine dioxide (1 kg of ozone is equivalent 1.5 kg of ClO₂).

- ECF sequence that combines ozone with chlorine dioxide are most cost effective that ECF sequence using only chlorine dioxide. The fact that ozone is finding growing acceptance with regard as a bleaching chemical results from a combination of advances with regard to the bleaching process and associated equipment on the one hand and ozone production and handling on the other.

- Recent advances in ozone generation as well as the lowering of oxygen cost by means of on-site production have established ozone as highly competitive bleaching chemical.

- Industrial scale comparison of ECF bleaching using only chlorine dioxide on the one hand and a combination of ozone and ClO₂ on the other has shown the application of 1 kg of ozone to be equivalent to about 1.5kg of ClO₂. Thus new ECF bleaching lines will be most competitive when combining ozone and ClO₂.

Details of the identified best practice

- On contacting some reputed suppliers, ITC – PSPD was offered ECF with chlorine dioxide bleaching and alternate offer of Lite-ECF which is with a combination of ozone and chlorine dioxide.

- The new fiberline for 400 BD TPD bleached pulp is based on state-of-art technologies, which makes it energy efficient, environmentally friendly and capable of delivering screened oxygen delignified pulp and bleached pulp of uniform quality. The new fiberline includes OxyTrac™ oxygen delignification and Lite-ECF bleaching (ECF with
ZeTrac™ ozone bleaching). The bleaching sequence is (Ze)(DP). The existing ECF bleach plant is now supplemented with ozone bleaching sequence to convert to Lite-ECF process.

**Salient features**

The following are part of the fibre line.

**Deknotting and screening**

Deknotting and screening is done through DeltaCombi™, which is a combined knotter and screen. Accepts go to brown stock washing stage. Rejects are passed through coarse screen KFA-50, where knots are separated from fibers. The accepts from the coarse screen are sent to the reject tank, thickened in a thickener type DT4 and returned to LC tank. The fine reject from DeltaCombi screen is fed to the secondary and tertiary screens. The reject from the tertiary screen is further screened in a tailscreen TS-50 to reduce the good fiber content in the reject, and the remaining reject is dewatered in a screw press and taken away from the system.

**Brown stock washing**

First brown stock washing takes place on a TwinRoll™ press, type TRPA-940. The discharged pulp from the press is diluted to 12% and fed to standpipe. From standpipe, it is fed to another twinRoll press, type TRPB-924. Washing is performed counter currently using wash filtrate from oxygen stage on the press.

**Two stage oxygen delignification**

A two stage oxygen delignification system process conditions in each stage (time, pressure and temperature) are as follows.
Identified Best Practices - Pulp Mill

Bleaching

The bleaching plant of the new line comprises an ozone stage followed by a small alkaline extraction stage (without intermediate washing), a chlorine dioxide stage (D) and a final peroxide stage (P) without intermediate washing.

<table>
<thead>
<tr>
<th>Description</th>
<th>Stage - 1</th>
<th>Stage - 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (min)</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Pressure at top of reactor (bar)</td>
<td>8</td>
<td>3.0 – 3.5</td>
</tr>
<tr>
<td>Temperature(°C)</td>
<td>85</td>
<td>95</td>
</tr>
</tbody>
</table>

Benefits of the project

- The chosen Lite-ECF bleaching sequence will significantly reduce color, AOX and COD levels in the effluent reducing load on ETP.
- There is reduction of BOD and COD from the bleach plant by recycling the effluent to the black liquor recovery system and reduction of lignin content of the pulp.
- High brightness pulp

Comments from the plant team

Ozone can be purchased on an over-the-fence basis, avoiding capital expenditure for additional ClO₂ generation equipment. This option also has the benefit of improved cost profitability, as it reduces exposure to fluctuations in ClO₂ raw material costs, Sodium chlorate and methanol in particular.
Financials

The overall cost of equipment and its installation is about Rs. 13,024 Lakhs. This includes Rs. 7,073 Lakhs (EURO 11.79 million) for the imported equipment, Rs. 600 Lakhs plus taxes (EURO 1.0 million) as service charges, Rs. 2,050 Lakhs plus taxes for indigenous equipment, Rs. 161 Lakhs plus taxes as erection charges, Rs. 1,580 Lakhs plus taxes for electricals, Rs. 460 Lakhs plus taxes for civil works and Rs. 1,100 Lakhs plus taxes for instrumentation.

Replication potential

- Significant reduction in Color of effluent, AOX, BOD and COD.
- This may turn mandatory for compliance with legislations in the future.
UNIT : NAINI TISSUES LIMITED

Background

During commissioning of the pulp mill, the old washers (8 nos.) were installed in multistage bleaching plant (4 nos. of size 8’ dia. X 10’ face) and for brown stock washing (4 nos. of size 9.5’ dia. X 10’ face). These second hand washers were procured from APPM and Century Pulp & Papers Ltd.

These washers were deck-wire type which is old technology. Deck-wire of the washers was not in good condition and it was not possible to fulfill the pulp demand of 90-95 TPD to produce 115 TPD of finished paper.

Only 100 - 150 mm of Hg vacuum was available in these washers resulting in poor washing & low output. To overcome this drawback, vacuum pumps were installed on both the streets but the improvement was not significant. So, it was decided to modify these washers.

Details of Identified best practice:

The following modifications were done to take required output:

- Old deck-wire and deck-wire supporting plates/ baffles were replaced by new one (modification performed in-house).

- Old vacuum heads (3-point suspension valve) were replaced with new ones (2-point suspension valves) for three washers (vacuum heads were procured from Emerald Enterprises and installed in-house). Overhauling of the remaining five washers’ vacuum head was done in Naini workshop.

- Chlorine washer deck-wire supporting baffles were found to be badly damaged. Deck wire with baffles was replaced by ripple deck (in Emerald Enterprises workshop).

- A 6-inch dia. and 1.5 meters long ventury were fitted in 8” dia. barometric leg of each washer just above the seal pit (one meter above).

After completion of the above jobs, the vacuum pumps were taken out and excellent performance was observed in each washer.
Salient Features & Benefits of the project:

Most of the modifications were done in-house. The following benefits are observed:

- Gain in throughput of washer (from 70 TPD to 90 TPD) i.e., approx. 28.5%.
- Increase in output consistency i.e., from the range of 6-8% to the range of 12-13%.
- Reduction in bleaching chemicals consumption as a result of increased output consistency
- Gain in brightness of pulp.
- Slight gain in strength properties of pulp.
- Gain in black liquor concentration (approx. from 8.0-8.5% to 9.0%) resulting in saving in steam consumption in evaporators.
- Saving in power consumption i.e., approx. 5100 units per day by removing vacuum pumps.

Issues:

Naini Tissues did not face any major issues during the implementation of this scheme.

Financial:

- Total investment incurred: Rs. 26.82 lakhs
- Total calculated savings: Rs. 2.30 Lakhs per day
- Payback Period: 11.7 days

Replication Potential:

Replication potential is high for mills which have the washer output consistencies of less than 10%.

Also, the same modifications can be done in a sister concern of Naini Tissues Limited where the mill is planning to diversify from kraft paper to writing & printing grade of paper manufacturing.
Installation of Advanced Process Control (APC) System for the Pulp Mill Section

UNIT : ITC – PSPD, Bhadrachalam

Background

The pulp mill in ITC PSPD, Bhadrachalam is the first mill in India to adopt ECF technology and was commissioned in September 2002 with a capacity to process 330 MT of blown pulp per day. Several focused improvement projects have been taken up in due course for debottle-necking to enhance productivity and quality. Frequent minor shutdowns in the washing section due to tripping of BSW’s and variations in final brightness of bleached pulp due to fluctuations at the back-end have been a concern and the driving force for the installation of Advanced Process Control (APC) system. The block diagram of the process is given below:
While many components of the Paper industry have rapidly exploited model-based methods for improved operation, the pulp mill operation has lagged behind.

**Details of Identified Best Practice**

The traditional control philosophy is based on single-loop control (sometimes called SISO - single input, single output). A process plant has thousands of such control loops and the controllers usually have little or no logic circuitry to tie the many loops together. As a consequence the operators must perform some of the operations with the control valves switched to “manual”, and has to implement process logic by switching in and out of “automatic” mode.

To avoid the limitations of single loop design and to provide more flexible and sophisticated process operating logic than can be implemented by human operators, an approach called "multivariable control” is used. A multivariable control or APC, is one that has the built-in intelligence to look simultaneously at two or more process variables and to choose, in a given situation, the best of several programmed strategies (algorithms) for manipulating one or more control valves (or other final control elements).

APC can be defined as "Use of logic, predictive algorithms, thermodynamics, calculations, real-time control models and other control techniques to achieve economically related plant operating targets”.

**Salient Features**

**Smother operation**: The Multi-variable controller (MVPC) or Advanced Process Control (APC) enables handling of process disturbances smoothly, reduction of transient time and at the same time keeping the product qualities within the specifications (constraints). Instead of having operators manually adjust control units for specific variables, APC provides generalized models that automate regulatory and constraint control.

**Predictive Models**: These models are dynamic models of the process that can predict how the process will respond over time to changes in basic operating conditions. They allow operators to prepare in advance for possible violations of operating limits, to take advantage of constraint relaxation to maintain process conditions as close as possible to their optimum.

**Automation**: Hardware permits APC to automate the process control with speed, precision, and reliability that are completely beyond the capabilities of human operators.
The advantages of implementing Advance process control techniques are manifold, few of which are as follows:

- The advance control techniques push the processes to their constraints and extract the maximum from the process unit without compromising on product quality and safety.
- The advanced control algorithm balances performance and robustness objectives against process economics to minimize costly process movement.
- Advanced control techniques allow tailoring of control performance to meet process needs.
- Advanced control algorithms provide optimum control performance for changes in both control targets and process disturbances.
- Advanced control implementation reduces stabilization time during furnish change, which in turn results in minimum off-quality product.
- The feed forward action of the advance control algorithms helps to save the plant from possible damage by adjusting the operating parameters before the disturbance actually reaches downstream.
- Advanced control algorithms allow applying dead time compensation techniques to compensate for long delays in process response, permitting tighter control.
APC objectives for pulp mill operation

Washing section
- To maximize the plant through-put
- To reduce the variations in LC tank consistency
- To maintain the blow tank dilution ratios
- To maintain the BSW1 motor load and vat pressures of all the three BSW’s and reduce the through-put, if it exceeds the max limit
- To operate the plant to the optimum set of operating limits

Oxygen De-Lignification section
- To maximize the pressure in both the ODL reactors
- To maintain the BSW3 (Brown Stock Washer) standpipe level and reduce the reactor-1 pressure if the level reaches the max limit
- To minimize the steam usage by maintaining the reactor-2 temp to the lower side of the limit
- To maintain PO1 (Post oxygen) pH and minimize the caustic consumption by keeping the pH towards the lower limit
- To maintain the PO1 vat pressure

Bleaching section
- To maximize the through-put from PO2 press
- To maintain all the vat pressures of PO2, D0 (ClO2 first stage), EOP (Extraction, Oxidation and peroxide addition) and D1 presses
- To maintain EOP tower level
- To maximize pulp consistency from the unbleached tower
- To maintain pH and brightness of the pulp at D0, EOP and D1 stages
- To reduce the chemical consumption while maintaining pH and brightness at each stage

Results

APC implementation has significantly improved the performance of the fiber-line. Due to the improvement in process control and the operational convenience, the APC strategy
has been well received by the operating crew. A post implementation audit was conducted during October 2007 and the results can be summarized as follows.

- 8 TPD of throughput increase in washing section
- 35% reduction in standard deviation of PO1 pH
- There is a net reduction of 2.5% or 0.6 kg/T of NaOH during APC-ON period. (In this case NaOH is used to control the pH at PO1 stage.)
- 11% reduction in standard deviation of D0 Brightness
- Standard deviation of D1 Brightness and D1 pH reduced by 22%
- For example: The below figure shows the PO1 pH with one week data in each case – APC-ON & APC-OFF.

![Graph showing PO1 pH comparison]

**Financials**

The software, procured from a reputed supplier costed Rs. 60 Lakhs. Training and implementation support was given by the supplier.

**Replication Potential**

The comprehensive and flexible optimization opportunities provided by the APC has proven to result in improved productivity, reduced standard deviation of pulp brightness. This has high potential for replication in other paper mills.

The recently commissioned project (pulp mill& PM6) ADOPTED foundation field bus, first time in India resulted in immense benefits and on quantum of I/Os dealing with foundation field bus is the largest in the world.
Replacement of Centrifugal Screen with Pressure Screen in Stock Preparation

UNIT : Shreyans Industries Limited (SIL)

Background
To remove impurities unbleached pulp is screened after washing in pulp mill. At SIL there were four centrifugal screens for the purpose to screen 80 TPD pulp. These screens were replaced by a single pressure screen to handle entire pulp for saving power as well as maintenance cost.

Details of project and salient features
Out of the four centrifugal screens, one or the other screen was always under maintenance leaving only three screens available for operation. Also, as there were four screens requiring maintenance, the work load on the maintenance department was also heavy. It was decided to replace all the centrifugal screens by a single pressure screen of matching capacity.

Centrifugal screens have 2 mm dia hole for screening where as pressure screen has got 0.3 mm slot. Centrifugal screens consumed around 55 kW (100 Amps) and that in case of pressure screen was 39 kW (70 Amps).

Benefit of the project
1. Power consumption had reduced by about 16 kW (30 Amps).
2. As the screening is done with 0.3 mm slot in the pressure screen, quality of screened pulp has improved compared to that from centrifugal screen.

Comments from the plant team
The pressure screen takes less foot print area compared to centrifugal screen and also it can be placed on working floor level. Hence, working is easier with pressure screen. The centrifugal screens are placed on elevated platform to facilitate gravity flow of screened pulp.

Replication potential
It can be easily replicated in other mills having centrifugal screens.

Financial
The total annual energy savings because of the is project amounts to Rs. 6.03 lakhs. The cost of the pressure screen installed at SIL is Rs.16.00 lakhs.
BEST PRACTICE NO. 8

Installation of High Efficiency Refiners

UNIT : Andhra Pradesh Paper mills (APPM)

Background

Refiners are the key equipment for making paper with required formation & strength properties. This is possible only when required fabrillation & cutting actions were given to virgin raw pulp. Refiners are also one of the major energy consuming equipment in the Paper Machine area. Hence selection of Refiners plays an important role. New refiners were selected on the basis of lower Refining Energy Consumption, lower no load power and required cutting edge length suitable to the pulp produced at APPM.

Details of Identified best practice

APPM has five Paper Machines with independent Refining systems for each machine. When APPM planned for New Fiber Line, which envisages higher strength properties of pulp, the question of adequacy of existing refiners for each machine was raised, as nearly all refiners were in operation in each machine. Instead of adding new refiner(s) in each and every machine it was proposed to have a Central Refining System, to refine the pulp up to a particular level of refining. There after further refining was proposed at each machine according to the requirement with some of the existing refiners.

Three high efficiency 38" Double Disc Refiners from M/s GL&V were procured and installed, out of which two refiners are being operated and one is used as stand by. APPM was able to stop half of the refiners in each machine with the above arrangement of Central Refining System and the installation of High Efficiency Refiners

Financing of the Project

Installed project cost of the Central Refining System is around Rs.5.60 Crores.

Comments from the plant team

Implementation and commissioning of the Central Refining System was smooth & trouble free. As there was no problem with strength properties and less maintenance except tackles / fillings change after installation of Central Refining System, there were no specific comments from the plant team.
Benefits of the Project

- Reduction in project cost, when compared to installation of refiners in individual machines.
- The power saving of 290 kW had been envisaged and realized.
- Less maintenance.
- Consistent quality of refining.
- Improved & consistent strength properties.

Replication Potential

Paper mills with multiple paper machines with the same feed can install the centralized refining system with energy efficient refiners.
BEST PRACTICE NO. 9

Installation of Specific Energy Consumption (SEC) Control for Refiners

UNIT : TamilNadu Newsprint and Papers Limited (TNPL)

Background

For refining pulp with varying flow and consistencies, by adjusting the refiner load manually, the freeness of the pulp would vary at the outlet of the refiner. Because of this variation, as an inherent problem in the refining system, it is a common practice to set a higher freeness for the pulp. Thus by reducing this variation in freeness, the potential for energy saving was spotted by the plant team.

Details of the Identified Best Practice

Monitoring of specific power consumption of refiners for different qualities of pulp was being practiced at TNPL. Based on this data, the values of energy required (kWhr) for refining a certain grade of pulp by a given oSR was estimated.

SEC (Specific Energy Control) mode was implemented to enable the operator to set the energy required per metric ton of stock and the loading device will operate in accordance with the set-point taking into account variations in flow and consistencies.

SEC is calculated as below:

\[
SEC = \frac{Pm - Po}{k \times Cs \times F}
\]

Where

SEC = Specific energy consumption (kWh/t)
Pm = Refiner power measurement (kW)
Po = No Load power with water (kW)
Cs = Refiner feed consistency, measured value (%)
F = Forward flow from refining (l/min)
k = Factor (0.0006) unit scaling factor

The SEC controller calculates the instantaneous SEC using the real time measured values from the volumetric flow meter, consistency meter and power meter. By adjusting the gap...
between the refining elements, the power load on the refiner is varied so as to match the SEC set point.

**Salient Features**

By this method variations in flow and consistencies are taken care and the refiner load is adjusted accordingly. Thus manual intervention is eliminated for the variations in flow and consistency.

**Benefits**

- Consistent quality in refining due to automation of control
- Uniform loading and flow
- More flexible in operation
- By maintaining uniform freeness of pulp (at required level), the paper properties are maintained within the specification for each grade.

**Financials**

Power transducer was installed. Flow and consistency readings were taken from the already installed transmitters.

**Replication Potential**

The replication potential of this practice is very high for the paper mills having different grades of paper as products.

At present this SEC mode is used only for the conical refiners installed at TNPL. This can be replicated for other refiners.
Avoiding Silo Level Control Pump in Paper Machine

UNIT: Rama Newsprint & Papers Limited (RNPL)

Background

In most of the paper machines, silo in the wet-end of the paper machine is provided with a silo level makeup pump from the back water tank. This pump normally runs continuously to maintain constant level in the silo; which is a process requirement.

Under regular operating conditions, the water in the silo overflows to the back water tank and the excess water from the back water tank is taken to fibre and water recovery plant. The silo level make up water pump consumes appreciable amount of power which can be avoided if the water balance can ensure level in silo without the need of running the silo level pump at the back water tank.

Details of the identified best practice

In a 200 TPD newsprint machine under stabilized conditions a detailed water balance is carried out for the silo system. The summary of the water balance are given below:

**Silo Inlet (Approx.)**

<table>
<thead>
<tr>
<th>Point</th>
<th>Key</th>
<th>Water (LPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Reject</td>
<td>A</td>
<td>2010</td>
</tr>
<tr>
<td>Wire Table</td>
<td>B</td>
<td>29466</td>
</tr>
<tr>
<td>Head Box</td>
<td>C</td>
<td>315</td>
</tr>
</tbody>
</table>

**Silo Outlet (Approx.)**

<table>
<thead>
<tr>
<th>Point</th>
<th>Key</th>
<th>Water (LPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen dilution</td>
<td>D</td>
<td>5977</td>
</tr>
<tr>
<td>Centri Cleaner dilution</td>
<td>E</td>
<td>18862</td>
</tr>
<tr>
<td>Excess to B/W Tank</td>
<td>F</td>
<td>6952</td>
</tr>
<tr>
<td>TOTAL</td>
<td>D+E+F</td>
<td>31791</td>
</tr>
</tbody>
</table>
As per the water balance, silo input from various points is always more than silo output to various points ensuring some silo overflow. Thus, some silo overflow is always ensured and silo level is maintained without running silo level pump.

The system has been implemented as part of original scheme of the plant.

**Benefits of the project**

Typically, in a similar sized machine, a pump maintaining silo level - if used - would be consuming about 30 kW of power (about 720 kWh/day).

**Issues**

The water balance across silo and back water tank is to be so designed to ensure, silo level is always maintained even during machine run disturbances. For emergency times, back water can be added separately to maintain level using a pump or otherwise. Extra care has to be taken during machine start up.

**Financials**

The system has been implemented as part of original scheme of the plant. Hence, separate cost of implementation is not available. However, the investment required for this may be varying for different paper machines depending upon the analysis of the water balance.

**Replication potential**

Under similar water balance conditions, replication potential is good. However, each machine is a separate case and for the same machine, water balance may change with change of GSM, Furnish and Speeds etc. It has to be examined meticulously for each case by thorough water balance over entire range of machine operation for varying Quality, GSM and Speeds etc.
BEST PRACTICE NO. 11

Elimination of vacuum for couch roll

UNIT : Shreyans Industries Limited (SIL)

Background

From the year 1994 to 1995, vacuum was applied in the couch roll of paper machine at SIL. Dryness after suction boxes at 350 m/min machine speed was about 18-19% for furnish of 85-90% wheat straw bleached pulp and rest long fibered pulp. Incremental dryness after suction couch was only about 0.7 to 1.5%.

Detail of the identified project

After installation of binip press resulting in close transfer this incremental dryness due to suction couch was offset by the press section without affecting the performance. This encouraged the decision to replace suction couch by solid couch.

Further, while commissioning binip press it was experienced that sheet adherence to the felt is by the capillary action and the sheet drop off problem not faced even if no suction is applied at holding zone. Based on observation, the vacuum pump was removed and no problem was experienced, and the same machine is now running at 500 m/min without any problem.

Operation of binip press without holding zone vacuum pump is successful up to 150 gsm paper. In higher gsm initial pick up of sheet is done with water hose. The pick up is continued after wards by capillary action and due to small time lag between the zones owing to speed.

Benefits from the project

By replacing the couch by solid couch and avoiding the operation of holding zone vacuum pump, about 225 kW of electrical power is being saved. Also, this saved the maintenance cost of two vacuum pumps.

Comments from the plant team

No problem was faced till date with above system and on contrary machine speed gradually increased up to present level of 500 m/min on wire.
Replication potential

This system can easily be replicated on similar machine.

The application of this scheme is limited to paper machines operating with agro based pulp and running at speed more than 350 m/min.

Financials

The annual savings is Rs. 81.00 lakhs without any significant investment.
Installation of High Efficiency Vacuum Pumps

UNIT: Andhra Pradesh Paper mills (APPM) and Shreyans Industries Limited (SIL)

Details of Identified best practice

Vacuum pumps are the one of the major energy consuming equipment in Paper Machines. Vacuum pumps have to perform their duty conditions with minimum power consumption, to make paper at lower production costs.

APPM: As an energy saving measure, APPM has changed all the six old energy inefficient vacuum pumps for paper machine # 5 with 5 nos. of new energy efficient vacuum pumps in December 1999.

SIL: The vacuum pump PPI-1250 type A connected to 2 vacuum boxes of suction pickup felt used to consume 66 kW (120 Amp.) for 270 and 250 mmHg vacuum in both tubes. It was replaced by a new energy efficient vacuum pump of the same capacity which consumes 55 kW (95 - 100 Amp) for 270 and 290 mm HG vacuum.

Salient Features & Benefits of the project

The following benefits can be realized by implementing this scheme.

- Reduction in Power.
- Less maintenance
- Consistent availability of Vacuum capacity

Issues & Mitigating Measures

No major problems were faced with this modification. Implementation and commissioning of these Vacuum pumps was very smooth.

Financials

APPM: As envisaged by the plant team, they were able to save 5200 kWhr/day of electric energy which corresponded to Rs. 36.4 Lakhs. Additionally, because of consistent availability of vacuum capacity, the performance of the paper machine improved drastically. The total cost incurred for the project was about Rs. 200 Lakhs.
**SIL:** Replacement of the old vacuum pump with an energy efficient vacuum pump has resulted in an annual savings of about Rs. 4.00 Lakhs. This required an investment of Rs. 3.90 Lakhs.

**Comments from the plant team**

The APPM team is satisfied with the new vacuum pumps, as the duty conditions are being maintained constantly and the maintenance is comparatively lower.

**Replication Potential**

The replication potential of this project in many of the old mills is high. A preliminary estimate of the saving potential in a given plant can be arrived at by comparing the power consumptions of the existing vacuum pumps with new energy efficient vacuum pumps of the same flow rate and vacuum.
BEST PRACTICE NO. 13

Reduction of Vacuum Pump Power Consumption by Cooling the Seal Water

UNIT : Tamil Nadu Newsprint & Papers Limited (TNPL)

Background

It was proposed to introduce a cooling tower in Paper machine#2 Vacuum Pump sealing water system to chill the sealing water so that make up water which was required to maintain the temperature of the sealing water will be reduced.

Details of the identified best practice

A fan-less cooling tower was installed for bringing down the temperature of sealing water and a temperature drop of 7 – 10 degree Celsius was achieved.

Salient features

By reducing the cooling water temperature the efficiency of vacuum system is improved, resulting in better run-ability of machine.

Benefits of the Project

After installing the cooling tower, zero make up is achieved for the sealing water and raw water consumption was reduced.

Issues

Cooling tower has to be cleaned during shut downs periodically.

Financials

Cost of the Cooling Tower and additional pump for pumping.

Replication Potential

This can be implemented for any vacuum system. It is proposed to install the cooling tower in Paper machine#1 vacuum system.
BEST PRACTICE NO. 14

Installation of Vacuum Blower instead of Vacuum Pumps

UNIT: BILT, Bhigwan

Background

With the increased cost of coal & high power export potential available, BILT, Bhigwan decided to install a Circulating Fluidised Bed Combustion (CFBC) boiler-first of its kind in pulp & paper mills in this sub-continent. The 30 MW Captive Cogeneration plant had installed the CFBC unit (with steaming conditions of 175 TPH, 105 kscg, 510ÚC), with the highest operating steam pressure in this country as of date. This is integrated with Extraction Condensing Steam Turbine, to facilitate maximising Power export to the grid after meeting the process steam and power demand. Any energy saved means energy available for export to the grid.

Details of identified Best Practice

In the paper machine section, BILT had installed a large 1500 kW Turbo-air (vacuum) blower, instead of opting for conventional Vacuum Pump. The Turbo-Air Blower unit had been procured from Mantel-Voith, Germany.

Salient Features

- Single unit instead of Battery of units.
- Minimal Maintenance Problems & Reduced downtime & hence High availability.

Benefits

- Saving in Valuable Electrical Power

Financials

BILT, Bhigwan procured the blower together with the paper machine in its entirety and thus the investment required only for the vacuum blower was not available.
Issues

No major/minor issues were encountered.

Replication Potential

All Premium mills can go in for Turbo-blowers, especially where the Power costs are quite high.

Scope For Further Improvement

BILT is planning to install a heat recovery system from the exhaust air of the Turbo-Blower unit.
BEST PRACTICE NO. 15

Replacement of rotary siphons with stationary siphons

UNIT : Tamil Nadu Newsprint & Papers Limited (TNPL)

Background

Steam is used in paper machine dryer part to remove the residual moisture after press. Steam enters the dryer in a saturated state. As heat is conducted through the dryer shell and onto the sheet, steam is condensed to liquid by giving up its latent heat. The condensate has to be removed from the rotating dryer with a siphon by maintaining the condensate layer as thin as possible. The two types of siphons are:

Stationary siphon: Cantilevered through the journal from outside the drying cylinder, does not rotate with the dryer when the dryer is rotating.

Rotary siphon: Fixed to the dryer shell, rotates along with the dryer.

Details of the identified best practice

Paper machine #1 was originally installed with rotary siphons and the rotary siphons were in operation since inception till 2002. In the year 2002, the rotary siphons were replaced with stationary siphons to improve the drying efficiency. Spoiler bars & thermo rims were also installed during rebuild to improve the condensation of steam efficiently.

Paper machine #1 dryer part consists of five drying groups having 10,10,10,4,9 drying cylinders. All these dryers were installed with stationary siphons at front side to remove the condensate from the dryers.

Salient features

- Low differential pressure requirement, presently operating at 0.2 bar.
- Dryer flooding is minimized
- More suitable for high speed > 600mpm (meters per minute)

Benefits of the project

Consumption of steam per ton of paper was reduced from 2.25 to 2.10 tons. The operating speed of the machine also improved due to efficient condensation & removal of condensate. The power requirement to run the dryers has marginally come down.
Replication potential

Paper machine no: 2 was already installed with stationary siphons and the same can be replicated in other mills.

However, speed of the paper machine can be a constraint; the stability of the system is high for speeds more than 600 m/min.
Installation of Evaporator Plant with High Steam Economy

UNIT : Andhra Pradesh Paper Mills (APPM)

Background

Weak Black Liquor (WBL) from the pulp mill is concentrated in the evaporators to reduce the amount of moisture content (from about 15% solids concentration) and make the Black Liquor (BL) combustible (concentration about 50% solids). To evaporate the water contained in the WBL, LP steam (low pressure) is utilized as heat source.

The water that is emanated from WBL contains heat energy and can be used to evaporate more water. This reutilization of heat energy is done in a multi effect evaporator, to reduce the steam consumed in the evaporator.

APPM had one street of evaporation plant with 120 tph water evaporation capacity. The plant was designed to concentrate black liquor upto 50% total solids. Steam economy of the plant is 5.90. Steam ejectors are used to develop the desired vacuum in the evaporator plant.

When TNPL was initially commissioned in 1985, two Evaporators with a water evaporation capacity of 60 TPH each were installed. These plants were of raising film type with an average steam economy of 5 T of water evaporation per ton of steam. During expansion in 1995, one more evaporation (Make: Alfa laval) with a Evaporation capacity of 170TPH, output concentration of 45% solids was installed with a steam economy of 6.45 T/T. In 2007, during mill development program a second falling film evaporator plant with a water evaporation capacity of 350 TPH, output concentration of 70% and steam economy o 6.45 T/T was installed and the less economical raising film plants were phased out.
Details of the Identified Best Practice

Under MDP, a seven effect Free Flow Falling Film evaporation plant was installed with the following features.

- The plant consists of three bodies for the first effect, two bodies each for the second and third effects and one body each for the remaining effects.
- The plant is provided with plate type lamellas for operational convenience and improved steam economy.
- Vacuum pump with a stand by ejector is provided for developing the desired vacuum.
- Online washing is provided for the first effect.
- Crystallization technology was adopted to keep the concentrator body’s lamellas clean and thereby achieve increased steam economy and improvement in operation. The crystallization technology consists of mixing boiler & ESP ash and make up chemical of sodium sulphate with concentrated black liquor. This liquor is added between second effect and first effect thereby scaling in finisher is avoided. This helped in improvement of the operation and increment in steam economy.

WBL from Pulp Mill

\[\text{WBL storage tanks} \rightarrow \text{WBL flashing in three stages} \rightarrow \text{VII effect} \rightarrow \text{VI effect} \rightarrow \text{V effect} \rightarrow \text{IV effect}\]

\[\text{Concentrated BL storage tank} \leftarrow \text{I effect (Three Bodies)} \rightarrow \text{II effect (Two Bodies)} \rightarrow \text{III effect (Two Bodies)}\]

\[\text{Mixing tank in recovery boiler} \rightarrow \text{Concentrated Black Liquor for firing in the boiler}\]
LVHC NCG generated in the plant are incinerated in the lime kiln. (LVHC NCG stands for Low Volatile High Concentration Non Condensable Gasses)

HVLC NCG from black liquor tanks are collected and incinerated in Recovery Boiler. (HVLC NCG stands for High Volatile Low Concentration Non Condensable Gasses)

**Benefits of the Project**

- By increasing the concentration of the black liquor fired in the boiler, the output steam of the soda recovery boiler increases for the same amount of Black Liquor fired (in terms of total solids fired).

- Reduction in steam consumption of 2.2 TPH in evaporation plant.

- Power saving of 100 kW because of energy efficient vacuum pump

- Improvement in steam economy from 5.9 to 6.2.

- Energy efficient vacuum pump results in energy / power saving.

- High solids in black liquor help in increased steam generation in Recovery Boiler.

**Comments from the plant team**

- Storage of concentrated black liquor requires pressurized tank. Suitable tank with adequate instrumentation are provided for safe and trouble free operation of the plant.

- No odor in the plant with installation of LVHC and HVLC NCG handling systems.

- No major problems are faced in the plant. The operation of the plant from DCS is easy and simple.

**Financials**

Total investment for evaporation plant is about Rs. 51 crores.

**Replication Potential**

Replication potential of this project is high for integrated paper mills with low steam economy in their evaporators.

The amount of water vapour in the flue gases of the soda recovery boiler would be reduced considerably and so will the white colour of the flue gasses coming out of the stack.
BEST PRACTICE NO. 17

Utilization of non-condensable gases (NCG) by firing high volume - low concentration (HVLC) in boiler and high concentration - low volume (HCLV) in lime kiln

UNIT : Andhra Pradesh Paper Mill (APPM)

Background

APPM has implemented Mill Development Programme (MDP) during 2004-06. For odor control, LVHC NCG handling system with incineration in limekiln and HVLC NCG firing in recovery boiler are installed as a part of MDP.

Details of the identified practice

LVHC NCG and HVLC NCG systems

The installed LVHC NCG and HVLC NCG handling systems at APPM have the following features.

- No generation of LVHC NCG in pulping section with Lo solids continuous digester.
- LVHC NCG is generated in evaporation plant only. These gases are incinerated in any one of the two limekilns. Dedicated incinerator is not in use.
- HVLC NCG is generated in cooking plant (diamond back chip bin) and tanks in washing plant. These gases are condensed, scrubbed and transported to recovery boiler.
- The HVLC NCG collected from black liquor tanks in evaporation plant are also fed to recovery boiler.
- All these gases are mixed with tertiary air of the boiler and incinerated.
- Necessary instrumentation and controls are provided for safe and trouble free operation.

Salient features

- Incineration of LVHC and HVLC NCGs helps to counter the age old odor problem in the Paper mill.
- LVHC and HVLC have substantial calorific values and thus can offset a part of the fossil fuel consumption.
Financing of the project

Total investment for LVHC NCG handling system is about Rs. 2.5 crores (existing LVHC system equipment are partly used) and HVLC handling system is about Rs. 4.5 crores.

Issues faced during implementation

No major problems faced in the plant. The HVLC system has to operate under pressure and vacuum conditions, adequate care is to be taken by providing necessary instrumentation and controls for safe and trouble free operation.

Results of the project

- State of art technology of Lo solids cooking plant helped to avoid generation of LVHC NCGs at source it self.
- Incineration of the odor causing NCGs helped in control of odor in and around the plant and improvement in environment.

Benefits of the project

The projects are installed for improvement in environment and no return in on investments.

Comments from the plant:

- Cleaner Environment.
BEST PRACTICE NO. 18

Installation of High Efficiency Recovery Boiler and Fire Black Liquor at 75% Solids Concentration

UNIT: Andhra Pradesh Paper mills (APPM)

Background

The mill has three chemical recovery boilers of 127 TPD, 270 TPD and 170 TPD black liquor solids firing capacity. These are designed for firing concentrated black liquor of 50% total solids from evaporation plant. The boilers are provided with direct contact evaporators to concentrate the liquor further to 65% and then fire in the boilers. This results in increased sulphur compounds emission into atmosphere. Also average steam generation was 2.6 T/T of BL solids at 32 kg/cm² pressure and 420°C temperature. The boilers are provided with low efficiency ESPs with stack emission of around 100 mg/Nm³.

Details of Identified Best Practice

Under a mill development project (MDP), a high efficiency and low odor chemical recovery boiler was installed. The following are some of its features.

- Single drum boiler capable of firing black liquor at 75% solids concentration, which helps in improved runnability.
- Steam generation of 3.4 T/T of BL solids there by increase in self power generation.
- Steam generation at higher pressure of 64 kg/cm² and temperature of 460°C temperature also helps in increased power generation.
- No direct contract evaporator, which avoids sulphur compounds emission in to atmosphere.
- High efficiency ESPs with reduced stack emission of less than 50 mg/Nm³ minimized air pollution.
- Chain less soot blowers are provided for improved operational convenience and reduced maintenance.
- HVLC NCG from black liquor tanks of pulp mill and evaporation plant are incinerated in Recovery Boiler for environment management.

Benefits

Increase of the firing BL concentration from 65% to 75% will reduce the amount of moisture vapourised in the combustion chamber. This results in additional heat availability for
generating more steam. This is one of the factors that increase the steam generation from 2.6 tons/ton of BL fired to 3.4 tons/ton of BL fired.

**Financials**

The annual energy savings solely on account of increased steam generation in the recovery boiler from 2.6 T/T to 3.4 T/T will generate an additional revenue of Rs. 27 crores (assuming 1100 TPD of solids fired, generation of 220 kWhr/ton of steam and Rs. 4/kWhr).

The total cost of the new recovery boiler and its installation was about Rs. 70 Crores. (Information not available – estimated)

**Issues**

For the operation of the recovery boiler with BL firing at 75% solids concentration the evaporator plant must be capable of delivering BL at such concentration.

**Replication Potential**

This project has very high potential for replication in integrated pulp & paper mills having a recovery boiler with low steam to BL solids ratio.
Installation of the CFBC Boiler to utilize Agro waste as fuel

UNIT : Bilt Graphic Paper Products Limited - unit Bhigwan (BILT)

Background

With the increased cost of coal & the clear cut mandate for reducing GHG emission, BILT, Bigwan has gone in for CFBC boiler first of its kind in pulp & paper mills in this sub-continent. The 30 MW Captive Cogeneration plant had gone in for CFBC unit (175 TPH, 105 kscg ,510 ÚC) supplied and engineered by BHEL, with the highest operating steam pressure in this country.

High Cycle efficiency had been achieved through high feed water temperature (170ÚC) to the boiler and high main steam pressure & temperature with matching extraction condensing steam turbine.

Details of the Identified Best Practices

In order to reduce the specific fossil fuel consumption, BILT had experimented with paper culm ( effluent waste ) firing along with coal in the Power Boiler.

The effluent sludge as such is extremely wet and hence has to be solar dried. After sun dry, the sludge is being blended with coal (primary fuel) at the coal yard with the help of chain dozer.

After blending, the same is fed in to the crushing and screening system and finally led to the coal bunker. From the coal bunker, blended coal and paper culm is fed to the Circulating Fluidised Bed Combustion Boiler by drag and chain conveyor.

Proximate Analysis  ETP Sludge ( Paper Culm) [Solar Dried]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Moisture</td>
<td>28 to 40 %</td>
</tr>
<tr>
<td>Inherent Moisture</td>
<td>1 %</td>
</tr>
<tr>
<td>Ash</td>
<td>35 to 39 %</td>
</tr>
<tr>
<td>Volatile Matter</td>
<td>19 to 21 %</td>
</tr>
<tr>
<td>Fixed Carbon ( Balance )</td>
<td>41 to 43 %</td>
</tr>
<tr>
<td>Gross Calorific Value</td>
<td>550 to 600 kcal/kg</td>
</tr>
</tbody>
</table>
Benefits of Project

- Quantity of sludge fired 20 TPD
- Equivalent Coal saved 4.5 TPD
- Environment friendly scheme as ETP sludge discharge as effluent is avoided through conversion as fuel for boiler.
- SOx reduction through desulphurization in FBC chamber.

Issues

BILT, Bhigwan has not faced any major issues during the implementation of GL & V the schema.

Financials

The investment required for the scheme is marginal as compared to fossil fuel savings.
BEST PRACTICE NO. 20

Installation of Back Pressure Turbine in Place of PRV

UNIT : Bilt Graphic Paper Products Limited - Unit Bhigwan (BILT)

Background

With the increased cost of coal & high power export potential available, BILT, Bigwan thought it fit to install a Circulating Fluidised Bed Combustion (CFBC) boiler- the first of its kind in pulp & paper mills in this sub-continent - with a matching 30 MW Extraction Condensing Steam Turbine (with steaming conditions of 175 TPH, 105 kscg, 510ÚC) supplied and engineered by Alsthom.

Boiler feed water is heated from 85 0C to 135 0C in deaerator by utilizing LP steam. LP steam is available at pressure of 5.5 - 6.0 bar and steam pressure required for deaerator is 2.5 bar. The opportunity to generate power is lost by losing the steam pressure across the pressure regulating valve (PRV).

Details of the Identified Best Practice

Installed a back pressure mini turbine in place of PRDS to generate power form steam at 5.5 bar and supply the exhaust steam at 2.5 bar to deaerator. It is a small cogeneration turbine catering to steam flow from 1.5 tons per hour and upwards. It is a back pressure steam turbine used in parallel to an existing Pressure Reducing Valve (PRV). Steam is expanded in the backpressure turbine, thus converting heat energy of steam to electrical power. This is a single stage impulse type, backpressure steam turbine with an integral speed reduction gear box coupled to an induction generator of 425 KWh Capacity.

Back pressure control for an induction generator based system consists of an inlet control valve, which is used to control the back pressure to the process, and a back pressure transmitter.

The pressure transmitter takes the pressure sense from the exhaust of the turbine and sends a signal to the PLC. If the process requirement of steam drops then the back pressure increases which is communicated to the control valve through the PLC and the
control valve throttles the inlet steam to maintain the back pressure. Similar procedure is followed when the withdrawal of process steam increases. In this case the control valve opens to allow more flow to make up the pressure.

![Diagram of Inlet Control Valve]

A schematic of the full operating system of an Induction Generator based control for back pressure is depicted below for clarity.

This system does not require a governor as the speed is controlled by the grid frequency. When the Induction Generator is locked on to the local grid using the reactive power of the grid, the voltage frequency and the phase angles are matched to the grid levels. Hence the need of a governor is eliminated.

Moreover, this is the most efficient way of harnessing power from steam as the generation continues so long as steam flows through the turbine and the amount of steam flowing through the turbine (that is used for the process) governs the generation of power. This is in contrary to the scheme followed in an alternator based system, where the governor controls speed based on electrical load on the alternator and controls the steam flow into the turbine and process. This could affect the process since the steam flow depends on electrical load.

The turbine is first ramped up in speed and the grid frequency is measured and compared with the speed generated by the turbine. The turbine speed is then matched up to the speed required as per the grid frequency. The PLC then gives a signal to the contactor to latch the system to the grid. This system is highly reliable and requires very low latching current.
Benefits

**Generation of additional power of 143 units per hour** this adds up to the export power to the state electricity grid.

Financials

The cost of procuring and installing the steam turbine was about Rs. 68 Lakhs. The additional annual revenue generated due to the increase in export power is about Rs. 37 Lakhs.

Replication Potential

Based on the success of the above, BILT placed a repeat order for the second unit with identical economics.

This scheme can certainly be replicated in other pulp & paper mills, where in there is a flow steam through the Pressure Reducing Valve (PRV). The higher cost of self generation of power and higher price of export power makes the project more attractive.
BEST PRACTICE NO. 21

Replacement of Mechanical Governor by Electronic Governor for Steam Turbine

UNIT : JKPM, Rayagada

Background

There are three no. of TG Sets at JK Paper Mills, Jaykaypur, (Rayagada) rating 2.5 MW, 5.4 MW & 12 MW. 80% of the total power requirement is met through own generation and 20% through purchased power from Orissa Grid. Initially the 12 MW TG set was having old Mechanical Governor which was giving frequent problem of speed variation when operated above 10.5 MW. Additionally there was voltage fluctuation sometimes at these higher loads.

Details of the Identified Best Practices

To overcome the above problem of speed variation & voltage fluctuation when operating at higher loads, it was decided to replace the old Mechanical Governor by Electronic Governor, which result in batter capacity utilization of the 12 MW TG Set. By increasing the power generation from their captive power plant, JKPM was able to reduce the import of electrical power from Orissa state power grid.

Salient features

1. TG Sets are being operated at different frequencies.
2. Energy saving is possible at lower frequencies. Presently, we are operating at 49.00 Hz.
3. The new Electronic Governor is user friendly and easy for operation.
Benefits of the Best Practice

As a result of increased stability of the captive power generation, the set is being operated at 49Hz frequency instead of 50Hz. Decreasing the frequency by 2% has reduced the power consumption by about 4% because of the centrifugal and linear loads. The power savings achieved was measured to be 450 kW.

Issues

Presently, the turbine is operating with single speed sensing probe. In case of malfunctioning in single probe, the turbine will trip. We are planning to install second speed sensing probe during the earliest opportunity.

Financials

The annual energy savings achieved by this scheme is about Rs. 124.42 Lakhs. The cost of replacing the mechanical governor with an electronic was Rs. 60.00 Lakhs.

Replication Potential

The 5.4 MW TG set obsolete Electronic Governor is planned to be replaced by a new Electronic Governor in the month of September 2008.

This project has high potential for implementation in other paper mills having steam turbine based captive power plant.
Improvement the generator efficiency by improving the generator Power Factor (PF)

UNIT: J.K. Paper Mills, Jaykaypur (JKPM)

Background

There are three nos. of TG Sets at JK Paper Mills, Jaykaypur with a rating of 2.5 MW, 5.4 MW & 12 MW respectively. Eighty percent of the total power requirement is being met through self-generation and the rest through purchased power from Orissa grid. Initially 12 MW turbo generator (TG) set was running with a power factor of 0.8 lag resulting in higher current and hence higher losses in the TG set.

Alternators are normally designed for operation at a power factor of 0.85 lag. They operate in their best efficiency zone when operated at unity power factor. The operating efficiency of an alternator at any load condition varies with power factor. Improving the TG set power factor close to unity improves the operating efficiency of the alternators thereby reducing the losses in it.

Details of the Identified Best Practice

The efficiency of alternator has been improved by improving the power factor with excitation control. The reduction in reactive power generation has been compensated with kVAR compensation scheme on the H.T side.

Attention has been paid towards power quality by installing appropriate filter systems for minimizing harmonics at the generation end.

Issues

The project has been implemented successfully with no major difficulty. The major aspect is to prepare suitable kVAR compensation scheme at the project design stage.

Salient Features
A compensation system which addresses both PF correction and harmonic correction has been installed.

**Benefits**

- Power Factor is maintained at 0.93 lag
- Current is much less than the generator rated current
- Improved generator operating efficiency

**Financial**

JKPM has invested about 27.5 Lakhs for implementing the scheme and savings achieved is equivalent to 140.16 Lakhs/annum.

**Replication Potential**

This has high replication potential in all the power plants.
BEST PRACTICE NO. 23

Installation of Ultra-Filtration Unit

UNIT : ITC – PSPD

Background

Need for going in for high steam pressure cogeneration plants is the order of the day. Unlike thermal power plants, Cogeneration power plants in the pulp & paper industries do require substantial treated make-up water for the boiler, because of direct steam usage & contaminated condensates in the process.

High Steam purity dictates the need for quality feed water. Steam purity of Conductivity <0.3 μS/cm & total Silica <0.02 ppm (as SiO₂) calls for advanced D.M. water quality as boiler feed.

Pretreatment is given more importance in recent times. Choice of going in for conventional D.M. plant instead of Ultra-Filtration-Reverse Osmosis – Mixed Bed combine unit is related to TDS level in the pretreated water.

Details of Identified Best Practice

Total silica constitutes both reactive (dissolved) as well as non-reactive (colloidal) silica. With need for total silica content <0.02 ppm in boiler feed water, pretreatment alone would not ensure non-reactive silica removal in toto. DM plant would only take care of Reactive silica removal.

Where the source of raw water is river, the turbidity is expected to be high. Presence of colloidal silica in river water is unavoidable (more so during the rainy season, when the turbidity level also goes up).

Advanced technology in water treatment (as being successfully practiced in SPB & ITC) is one of Ultra-filtration scheme followed by Reverse Osmosis unit. The finer colloidal particles (silt, colloids etc) shall be removed through Ultra-filtration membrane unit. This is ensured through continuous monitoring of silt level in the product water using SDI (Silt Density Index) as parameter. SDI in water leaving UF unit of < 2 should be OK.
**View of U.F. Skid**

**View of R.O system**

**Salient Features**

Total Silica in Boiler feed water : \(<0.02\) ppm (as SiO₂)

Silica in Downcomer boiler water is lowered; Boiler Blow-down is reduced

**Benefits**

- Saving in equivalent Steam through reduced blow-down.
- Saving in treated high quality water.
✓ Saving in Chemical cost.
✓ Ensuring longer availability of high pressure Steam turbines.

**Issues & Mitigating Measures**

No major issue except that care has to be taken with UF membranes not getting fouled. Back-flushing should be regular without fail. Any slip in SDI would affect RO performance & longevity. Slip of colloidal silica would affect performance and availability of Boiler as well as Steam turbine.

**Financials**

The cost of equipment and installation was around Rs. 100 Lakhs. The cost savings on counts of energy and condensate is Rs. 16 Lakhs. In addition to this, there will be a reduction in the cost of chemicals used in the boiler feed water treatment system.

**Replication Potential**

This scheme can certainly be replicated in other pulp & paper mills, where in the river water associated with High pressure Cogeneration plants are in use.
Energy management through advanced boiler feed water conditioning

UNIT: Rama Newsprint & Papers Limited (RNPL)

Background

In order to enhance specific fuel consumption in their High Pressure atmospheric bubbling fluidized bed combustion (AFBC) boiler, Rama Newsprint & Papers Ltd., [RNPL] had gone in for Advanced Boiler feed water conditioning scheme. Steaming conditions of the AFBC boiler are as under:

- Steam Evaporation rate (MCR): 107 TPH
- Steam Pressure: 84 kscg
- Steam Temperature: 470°C
- Feed water temperature: 170°C
- Fuel: Coal

Project Brief

Advanced chemical dosing in the form of Polyamine based component, under the trade name of Eloguard-86 [/HELAMIN], is being used for Boiler Feed water conditioning all these years, on a continuous basis. Only L.P. dosing of the reagent is being practiced. Unlike in conventional system, there had been no need for H.P dosing.

Salient Features

- TDS (Total dissolved Solids) & other impurities addition are negated.
- Single point dosing
- Steam/condensate wetted surfaces are protected with the formation of very thin protective film.
- Boiler Blow down is reduced.
- The reagent is non-carcinogenic, as compared to Hydrazine hydrate of conventional dosing.
Benefits of Project

- Blow down reduction by ½ to 1 % is affected –as compared to conventional chemical dosing.

- Process condensate return need not be Polished before being sent to Boiler as feed water –as there is no pick-up of crud ( iron particles).

Issues & Mitigating Measures

No issue as it had been decisively proved that there is no dissociation of the reagent at high pressure & temperature.

Financials

The annual cost savings on counts of energy and condensate recovery is around Rs. 20 Lakhs. In addition, this will also avoid the operation of condensate polishing unit. Though there is no significant initial investment, one has to procure the dosing chemicals on a regular basis.

Replication Potential

This Polyamine based scheme (Eloguard-86 & HELAMIN) has already been successfully used in other Premium paper mills having High pressure boilers for their Cogeneration plant (TNPL & SPB). It is being strongly recommended for all the pulp & paper mills having their own Cogeneration plants.

Scope for Further Development

Research activity is under way for the polyamine based reagent to be continuously used for all Boilers operating beyond 105 kscg steam pressures.
Bio-methanation from waste water discharge of Agro based Pulp Mill

UNIT : Shreyans Industries Limited (SIL) & TamilNadu Newsprint and papers Limited (TNPL)

Background

Bagasse and wheat straw are the main sources of fibre based on agro feed stock. Bagasse contains some residual sugar which increases the BOD (Biological Oxygen demand) of the wash water. These residual sugars and other biodegradable material can be used as a nutrient source for a particular type of microbes which release methane gas as part of their metabolic activity.

Wheat straw wash water is easily bio degradable. It produces methane gas when treated an aerobically. Methane gas, having high calorific value, can be used as fuel in the boiler to produce steam and thus power from steam. Thus, saving fuel used for making steam as well as power.

Detail of identified best practice

Prior to pulping, wheat straw is washed to remove chlorides and other impurities which hinder the working of Fluidized Bed reactor for chemical recovery based on Copeland process. The wash water contains high COD and hence, it was treated in anaerobic lagoon before being mixed with the combined mill’s effluent for treatment in ETP working on activated sludge process. The methane gas generated during anaerobic treatment was wasted as there was no recovery from lagoon. Thus, not only energy was wasted through lagoon but methane gas released in to atmosphere creates GHG effect. Hence, it was decided to treat this effluent into UASB reactor and recover methane to burn in to Rice husk fired boiler for generating steam and power. Methane gas substitutes Rice husk partially in the boiler.

UASB system

Wash water is treated on filter to remove floating material. The suspended solids in filtrate are allowed to settle in clarifier before being taken to buffer tank. In buffer tank lime is added to maintain pH and buffer stock is kept to feed reactor even in the case of disrupted effluent supply. From buffer tank effluent is fed to UASB reactor, where the effluent comes
into contact with sludge bed maintained in the Reactor. The anaerobically treated effluent is mixed with mill’s combined effluent for further treatment.

### Biogas Potential / Ton of Washed Bagasse at TNPL

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>COD potential/ T of Bagasse.</td>
<td>25 kg</td>
</tr>
<tr>
<td>Gas generation potential per kg CODr (@ 85% COD redn.)</td>
<td>10.6 m³</td>
</tr>
<tr>
<td>Furnace oil equivalent</td>
<td>6.4 L</td>
</tr>
<tr>
<td>Revenue equivalent to F. oil</td>
<td>Rs 127.50 Lakhs</td>
</tr>
</tbody>
</table>

### Plant design data (TNPL)

- COD Load : 57.6 T/Day
- Hydraulic Retention Time : 20 hrs
- Reactor Volume : 2 X 5,000 m³
- Volumetric Loading Rate : 6.0 kg COD/m³/Day
- COD Reduction : 85%
- Gas Production Factor : 0.47 M³/kg CODr
- Gas Production : 23,000 m³/Day
- Flow : 12,000 m³/Day
- Retention time : 20 hrs

### Salient features

- If helps in maintaining clean environment by reducing pollution load viz. C.O.D and by restricting release of methane gas in to atmosphere, thereby reducing Green House Gas effect.
- It helps in co-generation of power and steam for use in the paper mill and substitututing Rice husk partially thereby adding to the economy.
- It helps in the economics of the company by carbon trading under CDM projects.

### Benefits of the project (TNPL)

Environmental Benefits from Aug. 03 to Dec. 06
- COD Reduced : 34,580 Tons
- GHG Reduced : 1.20 million Tons of CO₂ equivalent
Economical Benefits from Aug. 03 to Dec. 06

- Biogas generated : 15.65 million m³
- Furnace oil saving : 9320 tons

**Issues**

The process is based on wheat straw wash water. Wheat straw washing is shut intermittently as per the requirement of pulp mill and capacity of washing plant. The UASB reactors works on microorganism and needs constant feeding. This requires sufficient holding capacity for wash water. However, storage of wash water acts as a lagoon and COD reduction takes place by partial biomethanation during storage.

Some of the other characteristics of this technology that has to be considered are as follows.

- Long start-up time due to low biomass yield
- Long recovery time due to low biomass yield
- Specific nutrients (trace metal) requirements
- More susceptible to pH, temperature and redox potential
- Quality of treated wastewater

**Financials**

**SIL**

The total cost of procurement and installation of UASB reactor system at SIL was Rs. 235.1 Lakhs. The nett annual energy saved based on the methane generation is about Rs. 40.15 Lakhs.

**TNPL**

The total cost of equipment and installation of UASB reactor system at TNPL was Rs. 440 Lakhs. The nett annual energy saved based on the methane generation offsetting the furnace oil consumption is about Rs. 530 Lakhs.

**Replication potential**

The project can be easily replicated. Certain Wheat straw based industries have started/ completed erection work after observing our experience
BEST PRACTICE NO. 26

Installation of Centrifugal Compressor for Compressed Air Generation

UNIT: ITC – PSPD (ITC), TamilNadu Newsprint & Papers Limited (TNPL)

Background

Compressed air systems are one of the most expensive of all plant utilities. Most systems typically have efficiencies in the range of 15 to 25 percent. One of the ways of improving this efficiency is by the proper selection of the compressor for a particular application.

Reciprocating, rotary screw, and centrifugal compressors are the most common types of compressors used in industrial and commercial facilities.

Reciprocating compressors work like bicycle pumps. A piston, driven by an electric motor, through a crankshaft and connecting rod, reduces the air volume in the cylinder, compressing it to a higher pressure.

The most common type of rotary compressor is the helical twin screw-type, also known as rotary screw or helical lobe. Meshing male and female screw-rotors rotate in opposite directions and trap air reducing the volume of the air along the rotors to the air discharge point.

TNPL had seven reciprocating (six working + one stand-by) compressors each of 2000 m³/hr at 7 kg/cm² (g) caters to compressed air needs of the mill. Out of 7 reciprocating compressors, four nos are 24 years old, two nos are 15 years old and the remaining one is 11 years old.

Reciprocating compressors have lot of moving parts and consume more electrical energy to overcome the frictional force. It required regular maintenance such as piston rings, gland packing and valve plates. Hence it resulted in high operational & maintenance cost and significant machine down time.
Centrifugal compressors are dynamic compressors. which raise the pressure of air by imparting velocity energy, using a rotating impeller, and converting it to pressure energy.

ITC had 8 numbers of reciprocating compressors in operation with 2 standby compressors to meet instrument and service air demand with HOC (Heat of compression) dryer. Power consumption, maintenance cost and manpower requirement was high for operating the compressors.

Details of the Best Practice

The centrifugal compressors is a state of art source of oil free air, simple but rugged mechanical design which combines the best features of aerodynamic technology to achieve optimum energy efficiency and also it delivers lower horsepower to cubic feet per minute

Considering the above, TNPL decided to phase out reciprocating compressors with centrifugal air compressors. During the mill development plan in the year 2006-07, two (2) centrifugal air compressors each of 4500 m³/hr were installed

Salient features

Rugged mechanical design which combines the best features of aerodynamic technology to achieve optimum energy efficiency and also it delivers lower horsepower to cubic feet per minute

Centrifugal compressors are oil-free by design and have few moving parts hence decreasing maintenance requirements and costs. Centrifugal compressors are designed to handle a base or continuous load in compressed air systems because they have limited turn-down or reduced output capability.

Benefits

TNPL : The operational data for 31 days operation between Reciprocating compressors and centrifugal compressors at TNPL are as below
From the above table an energy savings of 5,700 kWh per day (around 17%) is evident. In addition to this, the maintenance cost for the centrifugal compressors is lower and occupies less built up area.

**ITC :** After installing 1 x 95 Nm³/min capacity centrifugal compressor by replacing 10 x 14.7 m³/min reciprocating compressors, ITC was able to achieve the following benefits.

- Reduction in 150 kW of power consumption
- Reduction in O&M manpower & cost.
- Installed compressor operates with other centrifugal compressor in coordinated control mode using microprocessor based controls.
- Reduction in floor area.

**Financials**

Cost of one number centrifugal compressor (installed at TNPL) with a capacity of 4500 Nm³/hr is around Rs. 45 Lakhs. Annual savings achieved on counts of energy and maintenance is Rs. 137 Lakhs.

**Issues & Concerns**
• Centrifugal compressor operates on continuous basis, however in the event of tripping or unplanned maintenance, total plant is stopped. However, in view of self generation is highly reliable inadvertent TG tripping is eliminated.

• Centrifugal compressors control output with inlet valves or inlet guide vanes similar to the throttling inlet valve control on a rotary screw compressor. This is not efficient.

• Because of the surge problem associated with centrifugal compressors, they can only be partially throttled down to about 80 percent flow capacity with inlet valve control. When a centrifugal compressor needs to provide flow less than 80 percent capacity it will “blow-off” or vent the compressed air directly to the atmosphere or the surroundings.

• Running a centrifugal compressor in “blow-off” mode wastes a lot of energy. For this reason, centrifugal compressors should be base-load compressors that operate at near 100 percent capacity at all times.

• A reciprocating compressor or screw compressor with efficient unloading such as rotor shortening or a variable speed drive should be used as a trim compressor to meet the remaining load.

**Replication potential**

This project can easily be replicated in all the paper mills operating with reciprocating compressors.
Installation of Vapour Absorption Machine (VAM) Chillers for increased Cogeneration Opportunity

UNIT: ITC – PSPD (ITC), Tamil Nadu Newsprint & Papers Limited (TNPL)

Background

**ITC:** At ITC, the heat released from the process of ozone conversion needs to be removed by chilled water, hence chillers have to be installed to generate chilled water.

**TNPL:** TNPL had been operating vapour compression system (VCS) of capacity 300 TR to meet the requirement of mill-wide air conditioning. As this is maintenance prone and not environment friendly (using Freon – 22 as refrigerant), a VAM chiller of capacity 300 TR was installed.

Details of the identified Best Practice

VAM chillers use heat instead of mechanical energy to provide cooling. A thermal compressor consists of an absorber, a generator, a pump, and a throttling device, and replaces the mechanical vapor compressor.

In the chiller, refrigerant vapor from the evaporator is absorbed by a solution mixture in the absorber. This solution is then pumped to the generator. There the refrigerant re-vaporizes using a waste steam heat source. The refrigerant-depleted solution then returns to the absorber via a throttling device. The two most common refrigerant/absorbent mixtures used in absorption chillers are water/lithium bromide and ammonia/water.

Compared with mechanical chillers, absorption chillers have a low coefficient of performance (COP = chiller heat load / energy input). However, absorption chillers can substantially reduce operating costs because they are powered by low-grade heat (low cost heat source).

Low-pressure, steam-driven absorption chillers are available in capacities ranging from 100 to 1,500
Absorption chillers come in two commercially available designs: single-effect and double-effect. Single-effect machines provide a thermal COP of 0.7 requiring about 8 kg of 1 bar (g) steam per ton-hour of cooling. Double-effect machines are about 40% more efficient, but require a higher grade of thermal input, using about 4.5 kg of 6 - 10 bar (g) steam per ton-hour.

A single-effect absorption machine means all condensing heat cools and condenses in the condenser. From there it is released to the cooling water. A double-effect machine adopts a higher heat efficiency of condensation and divides the generator into a high-temperature and a low-temperature generator.

**Salient Features**

In VAM machine heat transfer is carried out in vacuum chamber and refrigerant vapour is absorbed by Lithium Bromide. Refrigerant and Lithium Bromide are separated at various heat exchangers and taken back to the system.

**ITC**

- Air conditioning requirements in the entire plant is also met through the VAM chillers.
- Process steam is used to operate the VAM chiller.
- Specific steam consumption of the chiller is about 4.0 kg/(TR.hr)

**TNPL**

VAM is environment friendly and maintenance free. The chiller in TNPL consumes 3.7 TPH of LP Steam (per 1000 TR).
VAM chillers are proposed where waste heat or process steam (low grade heat) is available to produce chilled water, which is also environmentally friendly compared to other electrical energy based systems.

**Benefits**

**Summary of advantages of VAM over vapour compression chiller**

<table>
<thead>
<tr>
<th></th>
<th>Vapour Compression System</th>
<th>VAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operating cost</td>
<td>Rs. 4.32 / TR</td>
<td>Rs. 3.03 / TR</td>
</tr>
<tr>
<td>2. Maintenance cost</td>
<td>Rs. 10,00,000/year</td>
<td>Rs. 1,00,000/Year</td>
</tr>
<tr>
<td>3. Load</td>
<td>Fixed</td>
<td>Variable</td>
</tr>
<tr>
<td>4. down time</td>
<td>30 days / year</td>
<td>3 days / year</td>
</tr>
<tr>
<td>5. Environment friendly</td>
<td>Cause ozone depletion,</td>
<td>Eco Friendly</td>
</tr>
<tr>
<td></td>
<td>Global Warming</td>
<td></td>
</tr>
<tr>
<td>6. Noise level</td>
<td>80 db (A)</td>
<td>20 db (A)</td>
</tr>
<tr>
<td>7. Vibration</td>
<td>High</td>
<td>Nil</td>
</tr>
<tr>
<td>8. Space requirement</td>
<td>More area</td>
<td>¼ of VCS</td>
</tr>
<tr>
<td>9. Operational convenience</td>
<td>Manually Operated /</td>
<td>PLC based</td>
</tr>
<tr>
<td></td>
<td>Controlled</td>
<td></td>
</tr>
</tbody>
</table>

**Financials**

**ITC:** The Landed cost of the 600 TR VAM chiller was Rs. 200 Lakhs including accessories.

**TNPL:** The total annual cost saving achieved at TNPL by installing a 1000 TR VAM chiller (in lieu of VCs chiller) is about Rs. 113 Lakhs. For this, the plant invested about Rs. 128 Lakhs towards the cost and installation of the equipment. On the other hand, in 2004, the 300 TR VAM chiller costed about Rs. 27 Lakhs.

The following table gives the comparison of cost incurred during operation of VCS and VAM chillers for one hour (at TNPL).
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>System</th>
<th>Power Consumption</th>
<th>Steam Consumption</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total / machine</td>
<td>Rs./TR @ Rs.4/ kWhr</td>
<td>MT Per TR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>kWhr</td>
<td>Per TR</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>300 TR Vapour Compression System</td>
<td>324.3</td>
<td>324.3/300 =1.08</td>
<td>1.08 x 4 =4.32</td>
</tr>
<tr>
<td>2</td>
<td>300 TR Vapour Absorption Machine</td>
<td>8.9</td>
<td>8.9/300 =0.03</td>
<td>0.03 x 4 =0.12</td>
</tr>
<tr>
<td>3</td>
<td>1000 TR Vapour Absorption Machine</td>
<td>17.35 /1000 =0.017</td>
<td>0.017 x 4 =0.07</td>
<td>3.7/100 =0.003/ 7 =2.96</td>
</tr>
<tr>
<td>4</td>
<td>Cost economy of VAM over Vapour Compression System / TR / Hour</td>
<td>1.29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Issues**

Care needs to be taken to avoid crystallization in the chiller.

**Replication Potential**

Technology & equipment is available to produce chilled water from waste heat or process steam with low energy cost and thus this project has high potential for replication wherever the availability of such heat sources exists.
BEST PRACTICE NO. 28

Installation of Energy Efficient Agitator Impeller

UNIT : Hindustan Newsprint, Kottayam (HNL)

Background

Agitators are one of the major power consumers in the pulp mill and stock preparation areas. They are installed in almost all the chests in the plant. The power consumption of the impeller depends on various factors like type of fluid, temperature, shape of the chest, impeller design etc. Impeller plays an important role in determining the power consumption of the agitator.

With the objective of minimizing the specific power consumption of the plant explored the opportunity of replacing the existing impellers with energy efficient impellers.

Details of the Identified Best Practices

The plant has replaced the existing impeller of the LD bleached sulphate chest agitator in paper machine with energy efficiency impeller. The impeller was supplied by GL & V. The operation of the impeller is satisfactory and had resulted in saving good amount of energy. The plant team is looking at replicating this success in other areas.

Benefits of Project

The scheme had resulted in an energy savings of 16 kW, in terms of units it is 1.30 Lakh kWh/annum.

Issues

HNL, kottayam has not faced any major issue during the implementation of the scheme.

Financials

The total investment for the scheme is Rs. 3.5 Lakhs which has resulted in power savings equivalent to Rs.4.55 Lakhs/annum.

Replication Potential
Background

Pumps are the important equipments used through out the plant for fluid transfer. Pumps are distributed through out the plant both in the process and utility areas. The pumps used in the Pulp and Paper Industry are pulps, water pumps, waste water pumps, boiler feed, water pumps, cooling water pumps etc.

Pumps are the major power consumer in a pulp and paper Industry; they offer huge potential for energy savings. Pump operating efficiency is an important parameter as far as energy consumption is concerned; any improvement in energy efficiency will go a long way in saving energy.

Project Description

Pump energy audit has been conducted throughout the plant. The major pumps in the plant were identified and the operating efficiency estimated. Based on the operating efficiency; the pumps with lower operating efficiency has be identified.

This activity has been taken up in quite a good number of plants. This case study covers action taken up by Hindustan Newsprints, Kottayam.

The details of the pump replacement were as follows.

<table>
<thead>
<tr>
<th>Section 1.01 Equipment</th>
<th>Old Pump power</th>
<th>New EE Pump power</th>
<th>Power Saving: kW</th>
<th>Energy Cost Saving Rs Lakhs</th>
<th>Investment Rs Lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Stock Pump of Refiner: 3 in</td>
<td>110 KW</td>
<td>90 KW</td>
<td>13</td>
<td>2.65</td>
<td>3.5</td>
</tr>
<tr>
<td>2 Chlorine Washer Feed Pump in</td>
<td>55 KW</td>
<td>37KW</td>
<td>12</td>
<td>1.71</td>
<td>3.96</td>
</tr>
<tr>
<td>3 Washer Dilution Pump in CP</td>
<td>75 KW</td>
<td>55 KW</td>
<td>14</td>
<td>1.99</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td></td>
<td>6.35</td>
<td>9.46</td>
<td></td>
</tr>
</tbody>
</table>
Salient Features

Operating efficiency of the pumps estimated based on the measured parameters of operating flow, head, and power consumption and assumed motor efficiency.

Pumps selected so as to operate the pump at the best operating point for majority of the time.

Benefits & Financials

The project has resulted in a savings of 6.35 Lakhs/annum with an investment of 9.46 Lakhs for the Variable Frequency drives.

Replication Potential

Potential exists in all Indian pulp and paper plants. Our experience indicates that at 5% reduction in energy consumption of the pumps is possible by implementing the project.

A pump audit will indicate the exact potential for energy savings by replacing the lower efficiency pumps with higher efficiency pumps.
BEST PRACTICE NO. 30

Installation of Variable Frequency Drives

UNIT: ITC – PSPD, Bhadrachalam (ITC) and Hindustan Newsprint, Kottayam (HNL)

Background

It is normal practice to design the equipments for 100% - 120% of the requirement to meet future demand. Also, it is normal in process plant to vary the flow and head based on the operating conditions. The combination of the above offers potential for significant power saving. In a pulp & paper mill, centrifugal load account for more than 50% of the power demand.

Details of the Identified Best Practice

ITC – PSPD, Bhadrachalam

The unit has been continuously installing VFD through a capital scheme and through continuous improvement projects to reduce the power consumption at all feasible applications. The equipment where VFDs have been installed include water pumps, stock pumps, fans, Boiler fans etc. The following is the list of VFDs installed as on March 2007.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Location</th>
<th>No of VFD’s installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PM1</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>PM2 &amp; 3</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>PM4 &amp; Finishing House</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>PM5</td>
<td>118</td>
</tr>
<tr>
<td>5</td>
<td>Utility</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>Pulp Mill</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Pulp sheeting Machine</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>SRB</td>
<td>45</td>
</tr>
<tr>
<td>9</td>
<td>SFT – A, B, C, D</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>Chippers</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>487</td>
</tr>
</tbody>
</table>
*By June 2008, when new pulp mill and PM6 is commissioned, the total VFDs in the plant will be of the order of 700

**HNL, Kottayam**

HNL has installed Variable Frequency Drives (VFD) for pumps and fans extensively throughout the plant. The project was executed in three phases. The details of the no. of VFD installed in each phase and the investment and savings both in terms of kW and rupees is given below.

<table>
<thead>
<tr>
<th>Phase</th>
<th>No. of VFD’s</th>
<th>Invest. (Rs. Lakhs)</th>
<th>Power Saving (KW)</th>
<th>Annual Energy Saving (Lakh kWh)</th>
<th>Cost Saving (Rs. Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>14</td>
<td>95</td>
<td>344</td>
<td>29</td>
<td>101</td>
</tr>
<tr>
<td>II</td>
<td>31</td>
<td>152</td>
<td>556</td>
<td>38</td>
<td>133</td>
</tr>
<tr>
<td>III</td>
<td>46</td>
<td>132</td>
<td>510</td>
<td>28</td>
<td>97</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>379</td>
<td>1410</td>
<td>95</td>
<td>331</td>
</tr>
</tbody>
</table>

**Benefits**

- Reduction in total and specific power consumption.
- Control through DCS

**Issues**

The two plants have not faced any major issue during the implementation of this scheme.

**Financials (HNL, Kottayam)**

The investment for the Variable Frequency Drive installed through out the three phases is Rs. 379.00 Lakhs and annual saving achieved is Rs. 331.00 Lakhs/annum.

**Replication Potential**

This scheme can be replicated in almost all the pulp and paper units after a detailed study of the process requirements in individual equipment.
Installation of Centralized Monitoring System for Energy and Raw Materials

UNIT: Hindustan Newsprint Limited (HNL)

Background

Being an integrated paper mill with multiple fibre sources, HNL has numerous equipment adding up to the total energy requirement. As the energy cost is about 30% of the production cost, the plant team felt that there was a need for improved monitoring system for energy consumed in different areas of the plant.

Details of the identified best practice

116 energy meters spread across the plant were linked to one central computer. Real time monitoring of the energy usage of any equipment could be done from one location. Moreover, the system can generate reports in various forms of energy consumption pattern on hourly, daily, monthly, yearly basis or for any given period of time.

Additionally, the implemented system also integrates the data of water consumption, amounts of different chemicals and other raw materials used. Trend patterns from the data stored in the computer system can be generated to evaluate the effects of any particular modification done in the plant.

Salient Features

The monitoring system installed at HNL has been supplied by Conserve India ltd.

Following are some of the reports related to energy that can be generated.

- Electrical Energy Consumption – area wise
- Specific Energy for Newsprint & Pulp grades
- Generated Power/MT of Newsprint
- Grid Power/MT of Newsprint
- Coal Consumption/MT of Newsprint
- CV of Coal mix fed to FBC Boilers
- Steam Coal Ratio
- Specific Steam Consumption
- Specific Furnace Oil Consumption
- Specific Water Consumption
- Energy for Compressed Air System

Benefits

This monitoring system enabled the plant team to monitor the energy consumption patterns of various equipment easily and thereby providing the opportunity to reduce energy usage and the total specific energy consumption per tonne of output.

Financials

The cost of implementation of the monitoring system at HNL was about Rs. 25 Lakhs.

Replication Potential

This scheme has high potential of replication in other paper mills.
BEST PRACTICE NO. 32

Utilisation of ETP Water for Pump Seal Water and other Uses

UNIT : Rama Newsprint & Papers Limited

Background

This project has been implemented at Rama Newsprint & Papers Limited (RNPL). The fresh water for this unit is drawn from river Tapi. Due to high government levies and other operating cost, the cost of fresh water for RNPL is about Rs.12/- per Cubic Meter. This also includes the long distance pumping cost of river water for approx. seventeen kilometers to the mill site. To reduce the cost of use of fresh water and also to conserve fresh water, RNPL has implemented this scheme to use treated ETP water for various selective uses in the mill including seal water for pumps.

Details of the Identified Best Practice

RNPL is manufacturing mainly newsprint based on use of recycled waste paper. The process plants include Deinking Plants and Paper Machines with installed capacity of 1,32,000 MT/Annum. By virtue of the process used and compelled by high cost of fresh water, this scheme has been implemented to use treated ETP water selectively at various points. This has helped to reduce net intake of fresh water and thus reduce net discharge of effluent. The effluent is treated using Primary Clarifier, two-stage activated sludge treatment and Secondary Clarifier. The treated ETP water is passed through sand filters before using in the plant at selective points.

Salient features

- Newsprint Production (Approx.) : 400 TPD
- Fresh Water intake (Approx.) : 12500 m³/day
- Treated ETP water use (Approx.) : 6500 m³/day
- Quality of treated ETP Water
  - Turbidity : 30 to 40 NTU
  - pH : 7.5 to 7.8
  - TSS : 20 - 30 ppm
  - TDS : 1100 - 1200 ppm
  - Colour : 40 - 60 Co. Pt. Units
Benefits of the Project

- RNPL has been able to reduce intake of net fresh water which is costly.
- RNPL has been able to reduce discharge of effluent.

Issues

While making use of sand filtered treated ETP water, main issues to be kept in mind are build up for solids, both TSS (Total Suspended Solids) and TDS (Total Dissolved Solids), temperature rise, problems with regards to slime, stickies etc. Colour of ETP water is not a major issue for RNPL as it is waste paper based mill without any chemical pulping and the product is Newsprint. The colour of sand filtered ETP water is approx. 40 - 60 Co.Pt. units which is permissible for use at the selective points.

Financials

On use of approx. 6500 m$^3$/day of sand filtered ETP water replacing the fresh water, the saving is approx. Rs. 60,000 / day. The investment needed is only for installation and operation of sand filters.

Replication Potential

Under similar conditions of product type, fibre source and quality of effluent water, replication potential is good. Other mills can try with a similar approach to reduce water consumption.
BEST PRACTICE NO. 33

Installation of Diffused Aeration System in ETP

UNIT : Andhra Pradesh Paper Mills (APPM)

Background

All discharges from a paper mill are monitored and controlled for legal compliance. The boilers are provided with ESPs to contain the suspended particulate emission within the standards / norms. For odor control, the mill has installed LVHC NCG incineration in limekiln with a stand by dedicated incinerator.

APPM has a full fledged effluent treatment plant to meet the norms as per statutory requirement. Activated sludge process is followed in the ETP and eleven numbers of surface aerators are provided in the aeration basin.

Diffused Aeration System

Under a Mill Development Plan (MDP), the mill has installed diffused aeration system which has high oxygen transfer efficiency.

Brief details of the system before and the modifications done are as under:

- The size of aeration basin is 85 Meters x 85 Meters. Previously the basin was provided with 11 numbers of mechanical surface aerators (each 75 HP). The number of aerators operated depends on the requirement. Statutory norms were just met by the plant.
- High efficiency diffused aeration system was installed utilizing the existing aeration basin. The basin size could be reduced to 85 Meters x 60 Meters. The height was increased by 0.9 meters to meet the depth required for diffused aerator system.
- The system installed consists of seven numbers of air blowers (each 75 HP), air distribution piping and diffusers (1748). The number of blowers operated is varied as per requirement. Statutory norms could be easily met with operation of 4 or 5 blowers.
- The diffuser can be cleaned by simply taking out the diffuser pipe with block from the basin and flushing with compressed air / water.
Results of the Project

- Meeting statutory norms of BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) in effluent even during the surges in inflow to the plant.
- Ease of operation and maintenance as the diffuser cleaning is easy.
- Reduction in power consumption.

<table>
<thead>
<tr>
<th></th>
<th>Before aeration</th>
<th>After surface aeration</th>
<th>after diffused aeration</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD (mg/lit)</td>
<td>180</td>
<td>28 – 29</td>
<td>22 - 25</td>
</tr>
<tr>
<td>COD (mg/lit)</td>
<td>500 - 600</td>
<td>230 – 240</td>
<td>175 – 200</td>
</tr>
</tbody>
</table>

Benefits

Improvement in quality of effluent discharge and saving in power consumption of 60 kW.

Financials

Total investment for diffused aeration system as installed in APPM is about Rs. 230 Lakhs. The annual energy saving that is achieved is about Rs. 9.6 Lakhs. The larger advantage has been better quality of effluent discharge from the mill.

Issues faced during implementation

No major problems were faced in the plant by APPM. The system is operated manually and stipulated norms are easily met with.

Comments from the plant

The system is simple and easy to operate. Maintenance and cleaning is also easy.
Reduction of Water Consumption by Better Water Management

UNIT: NAINI TISSUES LIMITED

Background

Water is a precious and precarious natural resource on earth. Water is the life for humans, animals, birds, plants etc. and is being used everywhere like for drinking, bathing & washing, industrial & agricultural application etc. water scarcity is prominent in the country in states like Rajasthan & Gujarat where the people are not getting sufficient water for drinking and other usages.

As water is becoming an increasingly scarce resource, it needs careful planning & management. The quality of drinking water is deteriorating due to pollution from sewage and industrial waste. Therefore, water should be meticulously harnessed and carefully conserved. It should be economically used and safely disposed off after usage. In view of the resource requirements for next generation, it has become very essential to conserve and to properly utilize the present available resources.

A lot of efforts were made in Naini Tissues Limited since inception stage of the plant like maximizing the back water circulation, using of wastewater after treatment, monitoring & rationing on daily basis etc. The result is that the water consumption in Naini Tissues Limited could be reduced to 64 m³/MT of paper production.

Details of identified best practices

1) Installation of Mark- Save all for paper machine backwater clarification

The excess back water generated from paper machine is clarified in the mark-save all for utilization in the MSBP washer’s washing showers which otherwise requires fresh water for pulp washing. About 65 m³/hr of fresh water is saved by this step alone.

Advantages

a) Saving of huge quantity of fresh water
b) Reuse of fiber and fillers
c) Savings in power, chemicals & man-power as compared to other systems like Krofta, CAF or DAF system
d) Reduction on effluent load at ETP

2) Utilization of chlorinated backwater

The filtrate from chlorine washer is used for dilution of unbleached pulp before feeding to chlorination stage. This has resulted in reduction of fresh water consumption as well as slight reduction in chlorine demand at chlorination stage.

Advantages:

a) Drastic reduction in effluent load at ETP
b) Saving of fresh water consumption by 58 m³/Ton of pulp production
c) Reduction in chlorine demand by 0.5%

3) Utilization of paper machine warm water

The warm water from pope reel, steam & condensate system and hydraulic power pack is utilized in high pressure showers of paper machine.

Advantages:

a) Reduction in fresh water by 15 m³/hr
b) Reduction in hydraulic load at ETP

4) Caustic dilution with black liquor

Caustic is diluted from 700 gpl to 90 gpl with black liquor whereas in the beginning fresh water was used for dilution purpose.

Advantages:

a) Savings of fresh water by 11 m³/hr
b) Slight reduction in caustic consumption as compared to fresh water dilution
5) Utilization of treated wastewater from ETP final outlet

- **For raw material washing**

The raw material was earlier washed with fresh water at an average consumption of 50 m$^3$/hr. This has replaced with treated wastewater to reduce fresh water consumption without any adverse effect.

- **For bagasse wet bulk storage**

The ETP treated wastewater is used on wet bulk storage of bagasse to prevent the acidic hydrolysis. Total 600 m$^3$/day of treated waste water is sprinkled on the wet bulk storage.

- **Floor Cleaning**

The treated effluent from ETP is utilized in all sections for floor cleaning and in some sections for equipment cleaning too. This has resulted in a saving of 20 m$^3$/day of fresh water.

6) Utilization of foul condensate

Foul condensate from evaporator section of chemical recovery plant is utilized in washing showers of final Brown stock washer. Total 22 m$^3$/hr of foul condensate is used in washing showers.

**Advantages:**

- Saving of 22 m$^3$/hr of fresh water
- Scaling problem in pipelines and pumps reduced considerably
- Reduction in hydraulic load at ETP

**Salient Features and Benefits**

- Simple system for water conservation with minimum investment
- Reduction in wastewater generation and wastewater discharge
- Payback period within few months
- Easy to maintain & operate
- Improvement in corporate image & social liability
• Lesser water treatment cost

Issues

• Strict monitoring on water quality at each stage is required
• ETP final discharge has slight brown colour due to which the entire wastewater quantity from this point cannot be reused.

Financials

• Total investment on all these projects = Rs. 31.20 Lakhs
• Total quantity of fresh water saved per day = 3220 m³/day
• Payback period = 3 to 11 months for different modifications

Replication Potential

Replication potential of this scheme in other mills is high.

Further possibility

The colour removal project is under progress & after its success 100% utilization of ETP treated water is possible in the process, which can bring down the water consumption further to 40 m³/MT.
Rain Water Harvesting

UNIT: J.K. Paper Mills, Jaykaypur (JKPM)

Background

Rain Water Harvesting (RWH) is a technique of collection and storage of rainwater for direct consumption or artificial recharging of groundwater. Some industries and organizations have implemented RWH to achieve Zero Water Balance and as a part of Corporate Social Responsibility initiative. Some of the other benefits of RWH are:

- Increased water availability
- Safeguard declining water table
- Environment friendly method
- Improved public image
- Improves the groundwater quality through dilution of fluoride, nitrate, and salinity; prevents soil erosion and flooding.

In areas where there is inadequate groundwater supply or surface resources are either lacking or insufficient, rainwater harvesting offers an ideal solution.

Some of the techniques of rain water harvesting which industry can readily adopt are storage of rain water for direct use and artificial recharge of ground water.

Details of the Identified Best Practices

The plant has a coating plant from for manufacturing coated paper; rain water from top of the coating plant building is being collected through down-take pipe in a separate drain. This water is then used for recharging the ground through 2 nos. of recharge wells.

The down take pipes and recharge wells are shown above.
Rain water from the road and store roof tops which are going to the drain are presently charged to ground through the recharge pit made across the drain which is shown in the picture below.

**Salient Features**

- Improves the ground water quality in JK Paper Mills premise and also the surrounding area.
- The water table in and around J.K. Paper Mill shall improve.
- Rain Water Harvesting reduces flow to storm – water drains and also reduces non-point source pollution.

**Benefits**


1. From Roof Top
   
   \[ \text{Area of Catchment} \times \text{Rain fall (m)} \times \text{run off co-efficient} \]
   
   \[ = 4231 \text{ m}^2 \times 1.564 \text{ m} \times 0.9 \]
   
   \[ = 5955 \text{ m}^3 \]

2. From Storm Water drain
   
   \[ \text{Area of Catchment} \times \text{Rain fall (m)} \times \text{run off co-efficient} \]
   
   \[ = 3600 \text{ m}^2 \times 1.564 \text{ m} \times 0.7 \]
   
   \[ = 3941 \text{ m}^3 \]
The total Rain Water Harvesting potential is 9896 m³ / annum.

**Financials**

The investment for the above mentioned activates is 1.8 Lakhs which has improved the ground water level and its quality.

**Replication Potential**

Presently JKPM has covered the above two areas and within the next 2 years, JK Paper Mills is planning to implement rain water harvesting in all areas including colony.
BEST PRACTICE NO. 36

Provision made for Secure Land Fills

UNIT : Hindustan Newsprint Limited (HNL)

Background

Hazardous wastes when dumped could leach into the underground water system thereby rendering it useless and harmful for human consumption.

Details of the Identified Best Practice

In order to circumvent the above problem, a secure landfill was created where the dumped wastes would not leach into the underground water sources.

Salient Features

- Capacity : 17600 m³
- Area : 70 m x 50 m

It is basically a pond with various layers of – Compacted Clay, HDPE Geo-Membrane, Primary and Secondary Leachate collection layers.

Benefits

Safe disposal of chemical wastes like DM Plant Resin etc

Issues

This was required because of the serious environment issues involved.

Financials

The cost of the materials used for the construction and the civil work involved was about Rs.100 Lakhs.

Replication Potential

This can be replicated in any industry which has waste disposal problems.
Background

Wood is the major raw material for the pulp and paper industry. Earlier, natural forests provided a ready available source, but with increasing anthropogenic pressures resulting in shrinkage and deforestation, this resource has drastically dwindled over the years.

Acting proactively, ITC launched a major Plantation Programme in 1982. Its objective was two-fold - to achieve self-sufficiency and improve productivity, on the one hand, and to provide agricultural farmers a viable alternative land use option, on the other.

Moving forward in this endeavour, ITC initiated a Biotechnology based Tree Improvement Programme (TIP), by promoting clonal plantations. The focus was on the genetic enrichment of pulpwood tree species and improvement of plantation package of practices.

Details of the Identified Best Practice

Plantation Coverage-Till March 2006, approximately 42,000 ha of land has been planted with 161 million saplings. ‘ITC Bhadrachalam’ clones were adopted for planting by Forest Departments, Forest Development Corporations, other paper companies and farmers, right across the country.

Encouraged by the positive results, ITC has continued to confidently pursue this strategy.
To build further on the strong foundation laid with dedication and perseverance, ITC’s plantation efforts are poised to get a boost through initiatives that will see the breaching of new frontiers.

**The plans envisage**

- Production of “designer fibre” through “designer tree” by genetics & breeding biotechnological methods for indigenous as well as exotic tree species, including bamboo.
- Development of agro forestry models with pulpwood trees best suited to various types of sites and needs of farmers.
- Implementation of sustainable farm practices and Forest Stewardship Certification.
- Enhancement of state-of-the- art R&D and Extension Centre.
- Further development of technically sound and scientific site management practices to enhance productivity to international standards.

**Social Forestry - Greening wastelands**

ITCs afforestation mission goes beyond regenerating wastelands and forests - helping enhance farm incomes by providing attractive land-use alternatives and generating employment opportunities.

In the pursuit of accessing wood-based raw material on a sustainable basis for the pulp mill, ITC launched the Social Forestry Programme in 2001. It has effectively leveraged its need for wood fibre to provide significant opportunities to economically backward wasteland owners, while transforming their land into lush green clonal plantations.

Under this initiative, superior planting stock that is fast growing and disease tolerant is supplied to farmers. A comprehensive package of free technical extension services is provided, which covers preparation of site, planting of saplings, maintenance of plantation till the harvest. ITC offers attractive buy-back arrangement for the mature plantations.
ITC works with select NGOs and the Government of Andhra Pradesh to identify poor tribals with wastelands and organise them into self-help user groups. They are then trained in the best silvicultural practices for growing plantations. So far, almost 6,000 ha of wastelands in 224 villages of Khammam district have been rejuvenated, benefiting 6,500 households. A part of the earnings is ploughed back into raising new plantations thereby making this a sustainable programme.

The Social Forestry Programme is integrated with the Watershed Development Programme, which seeks to achieve two crucial objectives: water conservation and soil enrichment. The farmers are organised into water user groups to build water-harvesting structures like check dams, percolation tanks and farm ponds, financed by ITC. These structures provide critical irrigation to over 8000 ha of drought-prone tracts, a figure that ITC aims to raise to 80,000 ha by the next decade.

**Partnering farmers for prosperity**

For the rural community, the plantation programme has provided an attractive alternative means of livelihood. The average net income from clonal plantations is around Rs 25,000/ha/yr under rain-fed conditions and Rs 40,000/ha/yr with irrigation, on a four-year rotation cycle, as compared to Rs. 12,500/ha/yr and Rs. 20,000/ha/yr respectively, realised from traditional crops. Significantly, the higher yield from clonal plantations comes at much lower risks. Not surprisingly, farmers from all over have been making a beeline for the ITC Bhadrachalam clones. Hence, ITC has added new production facilities to meet this tremendous demand.

**Employment generation**

The commercial plantations are contributing significantly to promotion of rural employment, thereby effectively addressing the problem of poverty in these areas. The 42,000 ha of plantations provide 4.2 lakh jobs in activities such as nursery, planting, maintenance, logging etc. The target for the decade is to plant 100,000 ha with 600 million saplings, creating employment opportunities for over 10 lakh people.
Advantage to the environment

The value of ITC’s forestry programme assumes even greater importance in the light of its ability to mitigate environmental degradation. Apart from other well-known advantages of such a large scale greening effort, the plantations have the potential to sequester millions of tonnes of Carbon dioxide, a potential Green House Gas (GHG).

Moreover, the company has become Carbon Positive thanks to the plantation activity, which, together with an effective energy conservation programme, has placed it in a unique position of being eligible to create ‘Certifiable CQ Credits’.

Apart from the innumerable benefits of afforestation, clonal plantations directly contribute to in-situ moisture conservation, groundwater recharge and significant reduction in topsoil losses due to wind and water erosion.

In addition, the leaf litter from multi-species plantations and promotion of leguminous intercrops between rows of trees, constantly enriches the soil, leading to better productivity.

### Estimated CO$_2$ Reduction through Carbon Farms (Plantations)

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (ha)</th>
<th>Total Biomass (MT)</th>
<th>Carbon Sequestration (MT)</th>
<th>CO$_2$ Reduction (MT)</th>
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</table>

Fig in Crores | 2.7 | 1.3 | 4.9
Benefits at a Glance

- Each hectare of ‘ITC Bhadrachalam’ clonal plantations saves 20-40 hectares of natural forests
- Minimises pressures on natural forests and conservation of their rich bio-diversity
- Helps in environmental amelioration and maintaining ecological balance
- Conserves precious soil and water resources
- Minimises surface run-off of rainwater and regulates stream flow
- Prevents flash floods and desertification
- Restores marginal / wastelands to sustainable productivity, improving soil fertility through increased microbial activity addition of humus and recycling of plant nutrients
- Achieves significant sequestration of Carbon (CHG reduction) from the fast growing clonal plantations
- Generates large scale employment opportunities for the rural poor
- Meets future demand of fuel-wood / timber and wood-based products
- Creates potential for future export of value-added wood products
- Minimises imports of timber and wood products and conserves scarce foreign exchange
- Sustains the momentum of green revolution and life support systems

Financial

As the figure below illustrates, plantations are assuming a major role in the economic development of the farming community
BEST PRACTICE NO. 37 (B)

Afforestation as a strategy to increase the fibre security at J.K. Paper Mills, Jaykaypur (JKPM)

BACKGROUND

JK Paper Limited initiated its plantation programme in the year 1990 with two main objectives one being raising plantations for augmenting its raw material requirement and other generating rural employment and improving of socio-economic conditions in one of the most backward regions of the country.

Till date, we have covered more than 44,000 Ha areas under plantations in 11 districts of Orissa, 4 districts of Aandhra Pradesh, 2 districts in West Bengal & 1 district in Chhatisgarh. Every year more than 2 crores saplings are raised at around 100 locations for distribution and planting on 4,000 Ha. Plantation activities are ably supported by a R&D wing established in the year 1991 which has been successful in developing high yielding Eucalyptus clones which improve the productivity of marginal lands thus helping the grower get more out of his land.

The R&D wing today is proud to have some of the most sophisticated equipment in the country in the form of 13 fully automated mist chambers. Till date, more than 2.5 crores clonal plants have been distributed across the districts of Rayagada, Kalahandi, Bolangir, Ganjam, Khurda, Nayagarh in Orissa and Srikakulam, Vizianagaram, Vishakhapatnam in Andhra Pradesh. It has tie-ups with numerous prestigious research organizations in India as well as abroad such as KFRI (Peechi), IFGTB (Coimbatore), TERI (New Delhi), CSIRO (Australia) and DANIDA. Extensive extension activities through awareness generation programmes, seminars, exhibitions and much more have contributed greatly in a fare said objectives.

DETAILS OF THE IDENTIFIED BEST PRACTICE

The best practice identified for future green belt development & meet the raw material requirement is Research & Development activities on Eucalyptus Clone & other pulp wood species. The Research & Development wing of the Forest Organisation, Rayagada, is have thirteen mist chambers of which eleven are state of art with automatic humidity and
temperatures controls. The total production of clonal saplings expected during a year is 50 lakhs.

Two automised-hardening chamber also supports the Mist Chambers with a capacity of 300,000 and a open nursery of capacity 50 lakhs, fitted with a sprinkler system for watering. Clonal Testing Area and the Clonal multiplication Area assists in testing and further multiplication of selected clones. Today the Research and Development wing of the organisation has identified 17 nos. fast growing clones which would be able to produce 150 tonnes of pulpwood in a 7 year rotation period.

For testing and short-listing of more clones we have more than 50 Ha of land planted at various locations. In recognition of its R&D capabilities the organization is currently implemented the project awarded by the Govt. of India for identification of suitable high yielding clones of Casuarina and Eucalyptus with optimum chemical consumption for pulp production.

**SALIENT FEATURES**

**SOCIAL FORESTRY PROGRAMME**

Initiated in the year 1990 it has covered 51,922 Ha. Area across the State of Orissa, Andhra Pradesh, West Bengal, Chhatisgarh, Maharastra & Guajarat States. Saplings of Eucalyptus, Casuarina and Bamboo are distributed at subsidised cost to farmers/growers for plantation on their dry/degraded lands.

**FARM FORESTRY PROGRAMME**

This programme was initiated in the year 1993 and benefits poor farmers taking up plantation under a tripartite arrangement between the company, State Bank of India and the farmer. Under this programme the farmer can avail loans from commercial Banks for taking up plantation of clonal Eucalyptus on their lands. Around 4000 ha. area has been covered under this programme.

**ROLE OF THE COMPANY**

The Company played the role of facilitator, provided technical know how and a ready market for the produce through buy back agreements. It also provided the farmers with good quality hybrid saplings raised under expert hands in the company’s decentralized nurseries at the farmer’s doorstep.

**NURSERY FOR GREENING BHUBANESWAR**
The Company has been raising more than 2 lac saplings for environmental rehabilitation and beautification of Bhubaneswar, after the devastating cyclone of 1999. More than 100 species of plants are available for distribution at the nursery. Till date more than 30 lakhs saplings have been distributed to the public.

**BENEFITS**

**Social Benefits**

- Upliftment of rural living standards from sustained employment and higher income.
- Stabilization & improvement of upland communities through elimination of the need to shift sites of farm activities.
- Increased disposable income initiating change of attitude towards nutrition, health and literacy.
- Improved social status resulting in improved bargaining potential of the people.
- Utilization of unskilled labour: Plantations generate employment for unskilled labour.

**Value Enhancement of degraded lands:**

The economic value of such lands improved because of improved status of these degraded lands.

**Raw Material availability**

**Fire Wood:** Which is collected after traveling kilometers, will be available to the rural people at their doorsteps, i.e. at their field in the form of lops and tops @ 5 tons/ha. Approx after 7 years.

**Pulp wood:** Rural farmers will be immensely benefited from the returns after 7 years. Besides, the company also stands to gain due to the increased raw material availability for the Mill. Raw material availability at reasonable prices when compared to the present prices inclusive of the high transportation costs will make the industry more competitive internationally.
Ecological Benefits

- Eradication of surface run off, nutrient leaching and soil erosion, because, tree roots and stems impede these processes.
- Improvement of micro-climates such as lowering of soil surface temperature and reduction in evaporation of soil moisture through mulching and shading.
- Improvement in soil structure through the constant addition of organic matter from decomposed litter.
- Use & restoration of degraded land and marginal lands.
- Greening the wastelands and increasing the area coverage under trees.
- Reduction in pressure on natural forests.

ISSUES

Major issues before the Company is now how to eradicate the gull problems started shortly with Eucalyptus Clone in Andhra Pradesh. Presently we are working on the issues through our R&D and tie up with other research Organization in India & abroad.

FINANCIAL

As plantations are harvested in due course of time, income generated reaches the rural households resulting in more disposable income for the people to cater to other essential needs. The pulpwood harvested from the plantations is expected to be sold for at least Rs 1400 per MT at farm gate.

- Assets equivalent to Rs. 310 crores created.
- Employment equivalent to 4.50 crores of man-days generated for rural poor
- Income equivalent to Rs 180 cores generated for rural poor

REPLICATION POTENTIAL

It can be replicated in anywhere in India. In the millennium development goal, the Government of India has started the Green Belt Development Project to meet the GHG (Reduce Carbon Dioxide) mitigation.
Afforestation as a strategy to increase the fibre security at Tamil Nadu Newsprint & Papers Limited (TNPL)

Background

Currently, TNPL is consuming about 1,50,000 Mts of pulpwood per annum. This requirement is met through procurement from TAFCORN/Forest Dept and open market sources. On implementation of the Mill Development Plan, the pulp wood requirement would increase to 4,00,000 Mts per annum. After considering the pulpwod available with TAFCORN, the company is still left with a requirement of around 2.30 lakh MT of pulpwod to be met from other sources. Even though the present raw material requirement is being managed from existing Government and private sources, the pulpwod availability in future may be a critical factor due to the following reasons.

1. Increasing raw material requirement due to future mill expansion
2. Declining yield pattern in forest plantation in subsequent rotation
3. Severe competition among wood based industries from within and neighboring states to procure raw material from available private source

In accordance with the National Forest Policy 1988, TNPL has accelerated the plantation activity in year 2004-05 to meet the requirement of pulpwod. For the sustained supply of 4 lakhs meters of pulpwod every year, around 15,000 acres of land has to be brought under pulpwod plantation. To achieve the target, TNPL has launched two schemes namely Farm Forestry Scheme and Captive Plantation with a support of Clonal propagation and research centre.

Details of the identified Best Practices

1. Farm forestry

Under this programme, the major activities carried out are motivating the farmers on tree farming and facilitating them to raise the pulpwod plantations by way of supplying quality planting
material to the farmers with a buy back assurance. Presently, development of pulpwood plantation in the land belonging to small and marginal farmers in cluster of villages is encouraged.

2. Captive plantation

Captive plantations are raised in the lands belonging to the company, Government department, Educational Institutions and in the large land holdings belonging to farmers. The land would be taken either on long term lease spanning over a period of 20 to 30 years or on revenue sharing basis. In the case of revenue sharing basis, the benefits would be shared between the company and the landowners after the harvest at an agreed ratio.

3. Clonal Propagation and research

Productivity of plantation is dependent on the quality planting material, which is supplied to the farmer’s field. The seed routed plantation has its inherent disadvantages of low survival and low productivity, whereas the clonal material produced from selected proven superior trees, show uniformity, good pulping content, high survival, growth rate and higher productivity. The farmers were facing the problem of availability of quality plants in time. The concept of clonal production centre was devised by TNPL to achieve self sufficiency in planting material and production of quality clonal plants.

**Salient features of Farm Forestry Scheme**

- Provide high quality seedlings/clones to the farmers at concessional rates.
- Support buy back of pulpwood with minimum support price
- Assist the eligible farmers in getting bank finance.
- Provide free technical assistance for establishment of pulpwood plantation.
- Make arrangement for harvesting and transport of pulpwood.

**Salient features of Captive Plantation scheme**

- TNPL will undertake the responsibility of land development, plantation and maintenance of trees. There will not be any expense to the landowners.
- At the end of 5th year, the produce harvested in the land will be shared between TNPL and the land owners as per the mutually agreed ratio
  (Or)
- TNPL will pay lease rental to the land owners every year depending upon the land category
• The entire produce raised from the land will be taken by TNPL.

**The salient features of Clonal Propagation and Research Centre**

• Propagation of quality clonal plants to the tune of 15 million clones per annum

• Established 8000 sq.m of Mist chambers, 4000 sq.m of hardening chamber and 12,000 sq.m open nursery with updated technological innovations equivalent to international standards.

• Provisions are made to establish various research programmes in micro and macro propagation of Eucalyptus, Casuarina and other alternative pulpwood species.

• Mini-gardens and breeding orchards are established to carry out breeding and tree improvement works.

**BENEFITS OF AFFORESTRATION PROJECT**

• The project provides gainful income to about 10,000 farmers from the underutilized lands by which the standard of living and social status of the rural farmers will be improved.

• It is estimated that one ha of tree cover can employ about 280 man-days and during harvesting the employment potential will go up to 1000 mandays per ha. In other words about 50 million mandays will get employment by developing 40000 ha of plantation by end of 2012. Thus, the programme will provide substantial employment in a sustained manner.

• It is estimated that about 20 lakhs MT of pulpwood and 2 lakhs MT of firewood will be produced from these underutilized vacant land with an average yield per ha is 50 MT/Ha of pulpwood and 5 MT/Ha of firewood.

• The plantation programme will have a desired impact on the Eco-system of the area where it is being implemented in terms of checking soil erosion of lands and thus, reducing further degradation of lands.

• Rational agroforestry systems under this programme will result in the green belt / green cover continuously and thus restoring the ecological balance of the operational area.

• By implementing this programme and achieving the target of 40,000 ha of pulpwood plantation outside the forest area by the year 2012 will definitely convert 2% of the under utilized degraded wastelands into green cover.

• Further by establishing pulpwood raw material outside the forest area, the same amount of natural forest will be protected without disturbance by the people for pulpwood and firewood.
• This would facilitate production of preferred, site-specific clones suited to individual operational areas and reduce the cost of clones to the company and emerge as a profitable enterprise to the farmers.

ISSUES
• Availability of land for raising plantation in bulk
• Fragmented and scattered land available with Farmers
• Lack of support from Government policies and norms

FINANCIALS
• Promotional charges is being met @ Rs. 1000/- per acre for Farm Forestry plantation
• Establishment of Captive Plantation @ Rs 50,000/- per Hectare for 5 year rotation
• Invested Rs.5 crore for establishment of Clonal Propagation and Research Centre

REPLICATION POTENTIAL

The project is proven success model to ensure the fibrous raw material resource on a sustained basis for the paper industries which is being implemented by most of the major paper mills.
**ACTION PLAN & CONCLUSION**

**Action Plan**

- The individual paper plants have to assess the present performance and should develop its own individual target for improving all the parameters.
- Set and achieve voluntary target of at least 1 to 5% reduction in specific energy consumption every year.
- The best practices and the performance improvement projects compiled in this manual may be considered for implementation after suitably fine tuning to match the individual plant requirements.
- If required, CII-Godrej GBC will help the individual units to improve the performance by providing energy audit services and identifying performance improvement projects specific to individual units to achieve the targets.
- The present level of performance and the improvements made by the individual units have to be monitored.
- The performance improvement of these units will be reviewed in the “Papertech” every year and the information will be disseminated among the Indian Pulp and Paper plant.

**Conclusion**

The objective of the project will be fulfilled only if the performance of all the pulp and paper units improves and achieves world class standards.

We are sure that the Indian Pulp and Paper units will make use of this opportunity, improve their performance and move towards the world class Energy Efficiency.
ATTENDEES OF THE CEO MEET ON 10th MAY 2007
HELD AT CII - GODREJ GBC, HYDERABAD

1. Mr Utpal Sengupta Vice Chairman, CII - Andhra Pradesh
   & Managing Director AT Foods
2. Mr Pradeep Dhobale Chairman, Energy Efficiency Council,
   CII - Godrej GBC
   & Divisional Chief Executive, ITC - PSPD
   & Director (Operations),
   Seshasayee Paper and Boards Ltd
4. Mr R R Vederah Managing Director, Ballarpur Industries Ltd
5. Mr P S Patwari Executive Director, Emami Paper Mills Ltd
6. Mr Raji Philip Managing Director,
   Hindustan Paper Corporation Ltd
7. Mr. R. Narayan Moorthy Secretary General, IPMA
8. Mr B M Khanna Managing Director, Khanna Papers
9. Mr. Ved P. Leekha Director, Pudumjee Paper Mills Ltd
10. Mr N Gopalaratnam Managing Director,
    Seshasayee Paper and Boards Ltd
11. Mr Anil Kumar Executive Director, Shreyans Industries Ltd
12. Mr. Rajneesh Oswal Chairman-cum-Managing Director,
    Shreyans Industries Ltd.
13. Mr V Murthy, IAS Managing Director,
    Tamil Nadu Newsprint and Papers Ltd
14. Mr A Velliangiri Director (Finance),
    Tamil Nadu Newsprint and Papers Ltd
15. Mr R C Mall Executive Director,
    The Andhra Pradesh Paper Mills Ltd
16. Mr Ved Krishna Managing Director, Yash Papers Ltd.
## Annexure - B

### LIST OF WORKING GROUP MEMBERS

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<th>S.No.</th>
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<td>Mr K S Kasi Viswanathan</td>
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<td>7</td>
<td>Mr Siva Prasad</td>
<td>Andhra Pradesh Paper Mills Ltd.</td>
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<td>8</td>
<td>Mr Rajkumar</td>
<td>Baldor Electric India Pvt Ltd.</td>
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<td>Mr Amar Singh</td>
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<td>Mr D S Raju</td>
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<td>Mr Mihir Baruah</td>
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<td>Mr Sampath Shetty</td>
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<td>Mr A Padmanabhan</td>
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