Complying with the "CREP" Regulations in Making Eco Friendly Papers

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The pulp and paper industry has been categorized under Highly polluting industry. The Charter on Corporate Responsibility on Environmental Protection (CREP), framed by the Central Pollution Control Board (CPCB), under the guidelines of the Ministry of Environment and Forest (MoEF)) has made the Indian paper industry committed by way of reducing the impact of its processes on the environment, through the Indian Paper Manufacturers Association (IPMA). Meeting global challenges and environmental commitments need planned goal oriented objectives to be met on consistent basis. Though the ISO Quality management systems and Environment management systems provide us the guidelines to have systematic approach for consistent quality and environmental performance, the need for common targets as formulated by CREP gives the Pulp and Paper industry an improved environmental image. The paper discusses the steps taken to maintain the CREP regulations, better than the laid down limits, while making Eco-friendly Bagasse based papers.

INTRODUCTION

The Charter on Corporate Responsibility for Environmental Protection (CREP) norms framed by the Central Pollution control board deals with harmonizing the paper industry pollution which are attributed to variable factors such as raw materials, technology, efficiency of operation, process control. Irrespective of the above said variables, the onus lies with the individual paper mill to maintain the norms laid down, as a Corporate Social Responsibility. Implementation of ISO 14001 Environment Management Systems have proved that waste can generate wealth, if properly managed. At the same time, meeting the pollution control board norms with regard to effluent quality and air quality has been the order of the day. But the issues not addressed in the pollution control board norms such as discharge quantity, continual improvements of the pollutant discharged, solid waste management, liquid effluent management etc have been duly taken care in the CREP guidelines. A comprehensive approach towards environmental protection by the pulp and paper industry has been formulated and implemented through IPMA.

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The CREP guidelines for Large Pulp and Paper Mills (June 2003) include

- Discharge of AOX kg/tonne of paper AOX -1.5 kg/tonne of paper within 2 years and 1.0 kg/tonne of paper in 5 years
- Installation of Lime Kiln within 4 years
- Waste water discharge cum/tonne of paper to be Less than140 cum/tonne of paper within 2 years. Less than 120 Cum/tonne in 4 years for units installed before 1992 and less than100 cum/tonne of paper for units installed after 1992.
- Odor control by burning the reduced sulfur emissions in the boiler/lime kiln, by installing odor control system within 4 years
- Utilization of treated effluent for irrigation wherever possible
- Color removal from the effluent

The units not complying with the above (Under Environment Protection Act 1986) will have to submit action plan with PERT chart to the state pollution control boards.

Meeting the environmental requirements and the global competition has been quite challenging for the pulp and paper industry. Papermaking involves complicated processes utilizing hazardous chemicals such as Chlorine and organic biomass resulting in formation of Organochlorine compounds, which need to be controlled at discharge. The industry being highly water intensive, a equivalent proportionate quantity of water needs to be discharged as wastewater. The third aspect being solid waste

management, proper control of raw materials and process is very much essential for control of solid waste generation. Kraft process being the most prevalent pulping technology, control of odorous emission of mercaptans has always been an issue of concern.

The fourth aspect of aesthetics is the color of the effluent generated from pulp and paper industry. These specific aspects of the pulp and paper industry with reference to the environment have been considered specially and a regulation has been set.

The regulation with time frame has been provided to improve our environmental performance and making it legal makes it mandatory for compliance. The regulations have been set considering the present technological and process control levels. Hence all that is required is a planned and scientific approach to comply with these norms as a responsible corporate body. The ongoing discussions are focussed on such planning and execution of scientific approach to meet the CREP norms at Tamil Nadu Newsprint and Papers Limited, the largest integrated bagasse based pulp and paper mill. The mill has specific problems associated with bagasse as a raw material, with regard to air and water pollution, which had to be duly considered on compliance of norms.

SPECIFIC ADVANTAGES AND DISADVANTAGES OF BAGASSE AS RAW MATERIAL, WITH REGARD TO ENVIRONMENT POLLUTION

Bagasse is a bulky raw material with an open structure. This warrants high storage space requirement. Bagasse is seasonal, available only during sugar mill operation, has to be collected and stored for round the year operation. The environmental problems associated with handling and storage of bagasse include dust problems due to pith and fire hazard problem. The two problems could be kept under control by adopting wet bulk storage of bagasse by wetting the bagasse and then storing in pile of 15-20 m height. The presence of sugars and other fermentation products upon storage pose a serious concern owing to their very high BOD and COD. High amount of water is necessary for storage and sprinklers to keep the bagasse wet throughout. Also during processing of bagasse, the material is conveyed and processed in pulp mill, which involves a huge amount of water, unlike wood. The high water requirement and high BOD, COD loads pose a serious threat to the CREP norms of 120 m^3/tonne of paper.

Bagasse has an open structure and low lignin content. It can easily be pulped to a low kappa number with a very short cooking time of 18-20 min. Even Soda cooking process will be sufficient and problem of malodorous mercaptans can totally be eliminated if bagasse alone is used as raw material. The cold blow technique reduces mercaptans and non-condensable gases generation during blowing, in case of Kraft pulping of bagasse. The pulp is easily bleachable and owing to low kappa number, the bleach chemical requirement is low. Hence even with conventional chlorine based bleaching, the AOX generation is well below the norms set provided the COD carryover to bleach plant is under control by having efficient washing system. Application of ECF technology for bleaching reduces the AOX level significantly.

The Eco-friendliness of bagasse lies in the fact that usage of renewable biomass such as bagasse in place of wood saves forest resources. Bagasse being an annual crop, it is easily renewable. The usage of pith generated during depithing and bagasse washing stages can be used as a fuel substitute for fossil fuels.

Presence of high amount of Silica in bagasse poses process related problems in recovery operations such as Evaporation, Causticizing, and Lime mud reburning,

These environment-related challenges due to bagasse had to be given specific consideration to meet the CREP norms.

MEETING THE CREP NORMS THE TNPL WAY

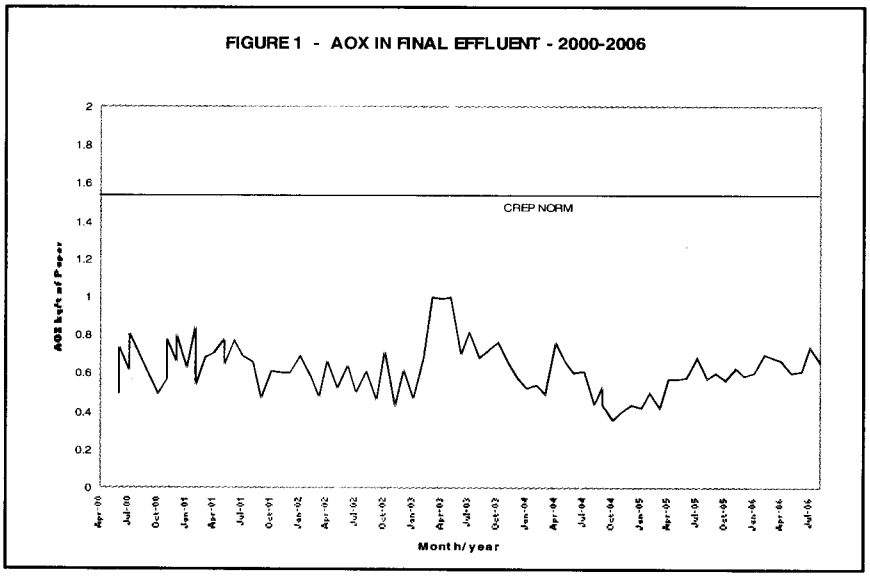
AOX levels :

As discussed earlier, bagasse being low in lignin content, generation of AOX, a factor dependent on the lignin content, is also low. TNPL utilizes 65-70% Bagasse pulp and remaining 30-35% is met with Wood pulp. About 5% of imported softwood pulp is being used for low grammage varieties as a long fibre support for paper at 900 m/min.

Since 70% of AOX contribution is from Bagasse pulp, which has a low kappa number of 10-11, the bleach chemical requirement is 50% as that of wood and so is the AOX generation. However, the washing stages need to be controlled to prevent COD carryover to bleach plant. In the wood street, Euca being the chief raw material, pulp of 18-20 kappa number is produced @ 110 tons per day and bleached with conventional CE (P) HH bleaching. Here again, a screw press has been introduced after the third stage brown stock washing to squeeze out the liquor carryover, thereby reducing the bleach chemical demand and hence the AOX.

The overall AOX in outgoing effluent, per ton of paper is 0.6 to 0.8 kg/tonne of paper produced. The AOX levels at different stage of the effluent treatment process have been evaluated and findings have been published (1). The AOX trend in kg/ Tonne of paper is presented in fig1. (Measured every month using Euroglas AOX analyzer, Column method)

FIGURE 1 - AOX IN FINAL EFFLUENT - 2000-2006



The mill is embarking on expansion and ECF conversion of the bleach plant with an overall outlay of Rs 565 Crores. This is likely to reduce the AOX to even less than 0.3 kg/T of paper. The hardwood new fiber line incorporates state of the art Presses for pulp washing. Two stage Oxygen delignification reduces 40% of kappa and D_{HT} -EOP-D bleaching to 88% ISO with interstage washing with Presses assures AOX of <0.5 kg/T of pulp. Likewise in Chemical bagasse pulp introduction of D-EOP-D bleaching with press before bleaching and interstage presses assures AOX of <0.3 kg/t of pulp.

Lime Kiln:

As a part of solid waste management, LimeKiln is already in operation producing burnt lime from the lime sludge. As discussed earlier, the problem of silica needs due consideration in bagasse based mills, which of course interferes with the Lime mud reburning process as well. To take care of the silica problem, Two-stage causticizing was introduced. In this 25% of the total lime required is first added and burged out along with the maximum amount of Silica, The remaining 75% of total lime is added, which after causticizing and washing goes to LimeKiln for reburning along with make up lime stone. Lime Kiln efficiency is being improved by reducing lime mud moisture content. Various approaches were made which include improving the lime mud washer design, improving vat temperature, use of additives etc. One of the major attractive improvements made in limekiln efficiency is usage of biogas from anaerobic treatment of bagasse washing effluent. The biogas generated could replace the furnace oil used for conversion.

Waste water discharge and utilization of effluent for irrigation

Bagasse storage and processing requires high amount of water. Controlling the wastewater discharge per ton of paper can be controlled only by controlling the fresh water consumption and by effluent reuse.

Water conservation in pulp and paper industry has been debated at several forums since water is the primary raw material for papermaking. Dwindling water resources has made the industry look for technological improvements and alternatives to minimize the dependence on water. Dilution should not be the way of maintaining pollution norms within the limits. Hence the norm for effluent discharge has also been introduced warranting control of pollution at source rather than end of pipe treatment. So water conservation efforts have been paid attention during recent years to effectively utilize the resource and to control wastage.

Scientific approach to water conservation and effluent reuse was made in TNPL to conserve the fresh water usage. (2). The water conservation team formed specifically for the purpose had the firm belief that " What is not measured cannot be monitored and what is not monitored cannot be controlled". Flow meters were fixed to get the actual consumption pattern of water area wise and total water consumption was balanced. Areas of fresh water wastage were identified and fresh water was rerouted back to water treatment plant. Non core areas not requiring fresh water was identified and fresh water was replaced with process backwater or treated effluent water. A specific water consumption as low as 65 m3/ ton could be achieved during water crisis and could keep the mill running, with of course some process problems due to excessive recycling. However our experience showed that with specific water consumption of 80-85 m3/ton we could run the mill without any process problems. Approaches made to achieve the same have been explained in detail in Ref (2).

The water conservation could be made successful only by augmentation of the demand with treated effluent. A separate treated effluent water scheme was made and all non-core areas were provided with sufficient quantity of effluent water for use. About 30000 m^3/d of effluent is

Figure 2 - Specific water consumption trend - 1998-2006

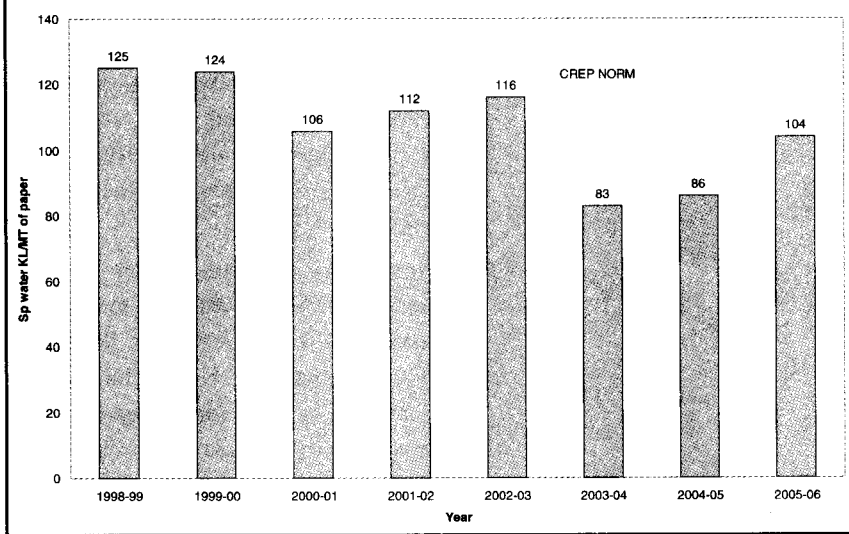


Figure 3 - Specific effluent discharged per ton of Paper - 2002-2006

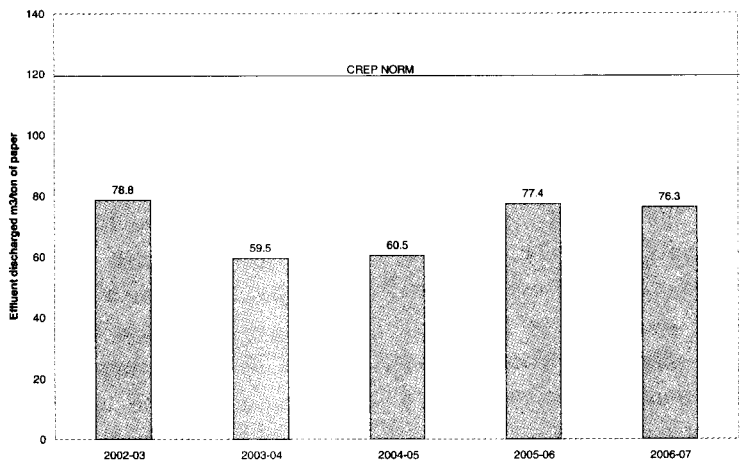


Table 1 - TNPL Effluent Water Lift Irrigation Scheme (TEWLIS) and CROPS CULTIVATED

TEWLIS	ACRES	CROPS	TONS/ACRE
• TOTAL AREA	1592.08	• SUGAR CANE	60
• AREA UNDER CULTIVATION	1487.18	• TAPIOCA	15.0
		• GROUNDNUT	0.5-0.60
• AREA NOT FIT FOR CULTIVATION	105.00	• GINGELLY	0.25-0.3
		• PADDY	2.00-3.0
• TOTAL COST OF TEWLIS SCHEME(Rs)	2.5 CRORES	• COCONUT	200 nuts/Tree
		• KORAI	60 - 75 bundles
		• PULSES	0.2-0.3
		• ONION	1.5-2.0

being put back to use within the mill.

The water consumption trend is presented in Fig 2. The specific effluent discharged per ton of paper is presented in Fig 3.

Utilization of treated effluent for irrigation:

Separate TNPL effluent water Lift Irrigation Scheme (TEWLIS) was developed and 1600 acres of barren land around TNPL have been converted into lush green fields. Different crops cultivated with TNPL effluent water is presented in Table 1.

About 54000 m^3 of effluent is being discharged per day for TEWLIS irrigation lands. The soil quality and effect of effluent irrigation on soil quality is being studied in collaboration with the Tamil Nadu Agricultural University, Coimbatore.

The effective utilization of effluent could be possible by the effluent treatment plant control. The effluent streams are segregated into two streams - High BOD stream and Low BOD stream. The High BOD stream from Bagasse washing area, which is rich in sugars, is taken for anaerobic treatment and biogas is generated in Biomethanation reactors. Subsequently the treated effluent after coagulation with Ferric Chloride mixes with the Low BOD stream and undergoes aerobic activated sludge treatment. The overall BOD removal is about 95% and COD removal is 75%. The suspended solids after secondary clarifier are as low as 45-50 PPM. Color of effluent is about 180-200 Pt.Co.units while BOD is as low as 5-8 PPM.

Odor control

TNPL is embarking on a major expansion program of ECF conversion of hardwood and bagasse bleaching lines and increasing the wood pulp production capacity from 120 tpd to 300 tpd with a new fiber line. The total outlay also incorporates a system for collection and combustion of NCG gases in lime kiln, so that compliance with the

CREP regulation will be met by June 2007. Inventory of the NCG was made.

Effluent color reduction

Color removal of pulp and paper mill effluents has been a challenge. An economically feasible method for large-scale treatment of effluent color from pulp and paper mills is warranted. TNPL has been making several approaches to reduce effluent color on a regular basis. Following are the efforts made with regard to color reduction of the final treated effluent

Color reduction at source

Sump pits and collection pits were made in pulping area and brown stock area. Similar collection pits were made in recovery area and not a drop of black liquor was allowed to enter the effluent stream. The sumps were made with level controls to ensure that no overflow occurs. Stand by sumps was also made for maintenance purposes.

The bagasse washing effluent undergoes anaerobic treatment and biogas generated is tapped and used as fuel in limekiln. The effluent form the anaerobic stream is black and has colloidal suspended solids. Alum coagulation followed by settling in clarifier was resorted to remove color. This was then replaced by ferric chloride treatment. Presently trials are on to remove color and suspended matter by coagulation with Ferrous chloride. This could result in a clear effluent. No increase in color could be seen after activated sludge process.

Regular continuous monitoring of color of effluent, stage wise and take remedial/corrective action immediately by concerned department.

Color reduction of final effluent Lab and plant scale trials

As an effort to reduce the effluent color, several studies have been made with final treated effluent. Some were done on lab scale and some were performed on pilot plant scale.

The Ozone decolorisation of effluent was done in lab and same study was done on pilot plant scale. Reverse Osmosis method for color removal was studied on pilot plant scale for different effluents. Chemoautotropic activated Carbon oxidation (CAACO) process developed by CLRI, Chennai was studied on pilot plant scale. Chemical methods of color removal using Alum, Hypochlorite, Oxidative extraction, Hydrogen Peroxide. Adsorption methods for color removal using Activated carbon like fly ash, boiler bottom ash, activated carbon were studied on lab scale.

Electrochemical decolorisation method using Iron and Aluminium electrodes, in laboratory scale.

Biological methods like fungal decolorisation of effluent using White rot fungus were also studied.

All the methods could reduce the effluent color. But translation of the laboratory experiments to plant scale continuous decolorisation, on large scale proved not viable.

DISCUSSIONS:

Environmental protection is the prime duty of everybody concerned. A long term approach and plan need to be in place to conserve the Mother Nature. All over the world, environment takes the prime position. The customer awareness has increased and need for quality products are always on the rise. Customer is ready to pay for quality. But customer is also concerned about the manufacturing practices and environmental implications of products. Hence Eco labeling concept for products is on the rise. To meet the global competition, the need for World class manufacturing concept is required which takes into consideration the quality, environmental and human aspects as well.

The CREP norms laid down by the CPCB is definitely a guideline for responsible corporate organizations manufacturing paper. The norms have been quite practical and technological advances can make them more easy to accomplish. The norms have been fixed as a beginning. There is a long way to go in making these norms more stringent, on par with international norms. With more and more developments in the paper making technology, conservation of raw materials, power, water and energy are being given priority. Lot of process chemicals has been developed to take care of functional requirements of paper. Hence the developments in plant and machinery are oriented towards conservation of resources. Pollution control is now part of manufacturing and the process loop considers the pollutant generation as one of the major criteria. Developments on one side, the existing mills are now required to gear up to comply with the norms of CREP.

Effluent generation per tonne of paper and effluent irrigation go hand in hand with water consumption and all necessary steps have to be taken to measure and utilize water judicially for the process. Improvements have to be made in the washing area for lower water consumption. This will also help in the recovery front. Irrigation of effluent is possible only if the treated effluent is devoid of suspended matter and dissolved solids are within limits. This is accomplished by proper effluent treatment method and extent of recycling of process backwaters. The treated effluent used for irrigation has turned barren land into greenery. All types of crops could be grown making it a promising way of useful effluent utilization. Full utilization of paper machine effluent after suspended solids removal can substantially reduce water requirement.

Rerouting of process back waters in pulp mill, use of foul condensate from evaporators in brown stock washing, closing the brown loop in pulp mill, use of respective filtrates for cover showers and wire cleaning are some of the approaches to reduce water requirement in pulp mill, which is the major water demanding area. Paper machine white water utilization is also

of paramount importance not only in the water quantity but also for utilization of process chemicals available in them. No effluent generation from soda recovery except for vacuum pump sealing water, which can be accomplished with effluent water itself.

Color reduction at source is the best approach rather than removal at the end. No black liquor should be allowed to enter the effluent stream. Only bleach plant effluent should go to effluent and color less paper machine effluent. A viable plant scale color removal technique needs to be devised for continuous large-scale decolorisation.

CONCLUSION

CREP norms for paper industry have paved way for meeting environmental requirements towards continual improvements. The global competition has been demanding world class manufacturing, as a necessary method to stay in business. CREP norms are one such method for environment.

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REFERENCES

Letter from IPMA on CREP regulation

The fate of adsorbable organic halogens (AOX) in activated sludge process of agro based pulp and paper industry, Chinnaraj S., Malathi R., Reddy, K.P., Venkoba Rao,.G., IPPTA Vol 12, No 4, Dec 2000.

Scientific approach to water management and conservation, Rajesh,K.S., Faizur Rahman, M.C., Md Naseeruddin, Ranjit, N., Marappan, S., Elangovan,S., Mani R, Krishnan, R.V., IPPTA convention Issue 2004.