Environmental Management - Its Impact on Paper Mills Performance

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Abstract

Environmental practices derived out of implementation of EMS towards ISO 14001 certification resulted in significant leap in TNPL's Environmental Performance. 9 well-defined Management Objectives are being achieved mill wide by specific targets through Environmental Management Programe. The unified Environmental Management System helped to fulfill the requirements of ISO certification and overall improvement in productivity. By measuring environmental and quality performance, it was possible to build a platform for future decisions. This paper discusses the implementation of ISO 14001 environmental management system in TNPL resulting in significant waste reduction and increased recycling and impressive benefits to the bottom line. The company pioneered the development of Writing and Printing paper grades and Newsprint chiefly from Bagasse, a non-wood fibrous raw material.

INTRODUCTION

In the present global industrial scenario, preservation of the environment has been one of the chief strategies followed. In a world heavily focused on technology, organisations are considering new approaches for implementing environmental management systems to become more Eco friendly and environmentally productive. As a result, ISO 14001 based Environmental Management is being implemented in various fronts from "National Parks to Industries" (1). At the end of year 2001, more than 37000 sites around the globe have been reported to have certified to ISO 14001 (2). It is reported that even though Cluster Rule from U.S. Environmental Protection Agency has been complied in many major pulp and paper companies, still the processes are not exempt from environmental scrutiny (3).

ISO 14001 has been the largest environmental activity at TNPL during the year 2001-2001. A sub-system towards cradle - grave approach with the certification Life Cycle Assessment (ISO 14040) has been initiated. The company is also implementing ISO 14021 for Eco labeling of its products.

Brief description of Business in TNPL and its Eco friendliness

Ecological conservation

TNPL paper grades contain 75% of Bagasse pulp and 25% Wood pulp. Bagasse is an industrial waste obtained from Sugar Mills after crushing. This material, used as the fuel in Sugar Mills, is procured by TNPL for papermaking. Every year, TNPL is using over 8 lakh tonnes of bagasse obtained from different Sugar mills. This has helped in saving forest cover to the tune of 30,000 acres per year.

Eco-Friendliness of bagasse as raw material for papermaking

The morphology of bagasse offers distinct advantage over wood. Bagasse has extremely open structure, which helps in pulping it in less

harsh conditions than that of wood pulping. Bagasse contains very low amount of lignin (18-20%) compared to plantation hardwoods, which have 26-29%, and softwoods, which have 30-35%, lignin content. The open structure and low lignin content present two advantages:

Very less pulping chemical requirement results in low pollution levels during pulping. Maximum lignin is dissolved and removed in the pulping stage itself thereby the amount of lignin that has to be removed in bleaching is very less compared to hardwood.

Unlike the hardwood lignin, the lignin in the bagasse unbleached pulp is in a more depolymerized state since the growth period of sugarcane is 12 to 14 months against 7 to 8 years in the case of hardwood species. This makes bagasse bleaching simpler and less intensive and in turn results in very low consumption of bleaching chemicals such as chlorine, calcium hypo chlorite in the subsequent bleaching stages.

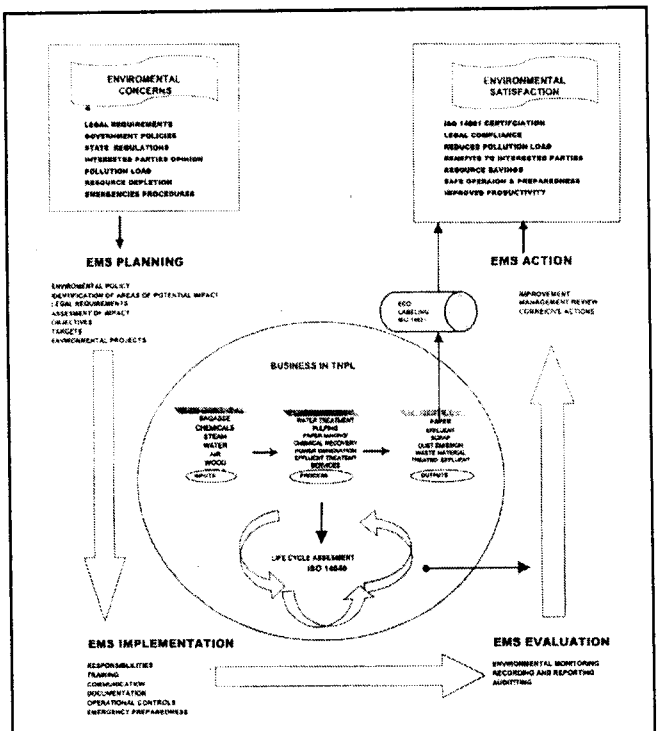

Fig. 1 Environmental management system in TNPL

Consequently, even with traditional chlorine containing bleaching sequences like CEH, the amount of chlorine required is very low (as low as 2-2.5% compared to 6 - 8% for wood pulps).

The generation of chlorinated organic compounds as AOX (Adsorbable Organic Halides) is far less compared to wood pulp. The total AOX generated is only 0.6-0.8 Kg/T as against the 2.5 Kg/T of statutory tolerance level in India. This compares with the standards laid down by advanced countries. Interestingly, studies on the bagasse lignin structure further reveals that possibilities of formation of hazardous chlorinated organic compounds like TCDD and TCDF are far less when compared to wood lignin due to the unique nature of structure of bagasse lignin which is based on p-coumaric acid moiety (4).

Right from the raw material to pulp manufacture, TNPL's technology closely adheres to environmental standards, which makes the TNPL's products unique in the country in terms of Eco-Friendliness. In this background, EMS certification has been one more step towards environment friendliness.

RESULTS AND DISCUSSION

Management commitment

The motives for implementing EMS certification were lofty and universal. But there were secondary reasons for the high interest (5). TNPL believed that it could be a sure way of ensuring strict compliance to all present and future regulations and therefore increase its market potential. Some believed that a certification would be demanded from customers in the future. Thus, they argued, it is better to start out early and be pro-active, instead of being forced into these systems. We firmly believed that a certified system and the process of using it would help us to improve our management practices and formal, strategic planning.

The initial impetus to EMS came from the very

foundation, namely Environmental Policy. The policy plays a key part of TNPL's EMS because it only gave required direction for EMS. TNPL's Environmental Policy included commitments, foremost among them is (1) Ecological preservation, (2) Dedicated R&D towards cleaner environment and conservation (3) To comply with the State Laws and (3) To increase environmental awareness both within TNPL and within the community. TNPL believes that by achieving those commitments it will be doing the right thing for business and environment and community. (Fig.1) To illustrate, the commitment to use non-wood raw materials for papermaking for preserving the ecosystems, inspired TNPL to develop a special sugar cane over the years, specifically for papermaking. This assures self-reliance in eco-friendly paper making from Sugar cane Bagasse.

Compliance with legislation and regulation

EMS driven mechanism persuaded TNPL to collect the entire Legislative requirements applicable to Paper Industry. A comprehensive accumulation of legal requirements was prepared. This paved way for increased compliance with the legal regulations with respect to environment in terms of Water, Air, Soil and Waste Management. The strong desire to comply with the legislation helped in continual improvements to meet the specifications as set forth in the statutory norms. The efforts made towards continual improvements are profoundly seen in the fulfillment of statutory parameters such as treated water BOD or COD etc. The impact of EMS is illustrated in Fig. 2. It can be observed that, the commitment in the Environmental Policy persuaded TNPL to go far beyond the basic requirements of Statutory requirements as prescribed by the Central and State Board Pollution controlling agencies.

Geared for future legislation

Compliance to Environmental Legislation and Regulation necessitates preparing for the future requirement (6). Since the Governments are more and more becoming concerned towards environment, laws governing the various manufacturing processes, emissions, handling of hazardous resources, liquid discharges, undergo frequent revisions and modifications and inclusions. Foreseeing these changes and maintaining an adequate system for upgrading the EMS was one of the key parameters for successful implementation of EMS. The EMS audit by certified auditors from an international accreditor confirmed this. The Register of Regulations (ROR) was developed as comprehensively as possible in order to have full proof EMS operating system.

Pollution abatement and control of environmental impact through structured environmental programme

All departments started by doing an environmental review. When doing such a review the most important negative (and positive) environmental impacts were identified (impacts being the consequences). For many Managers this was perceived as a hard task. Especially the valuation and comparison of different environmental problems were difficult, and thus the trade-off between different impacts. The questions were What is the really most important to start working with in order to minimize the negative environmental impacts, while at the same time

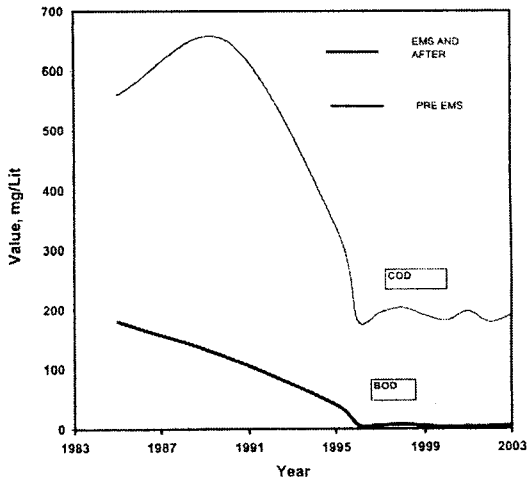

Fig. 2 Effect of EMS on effluent parameters

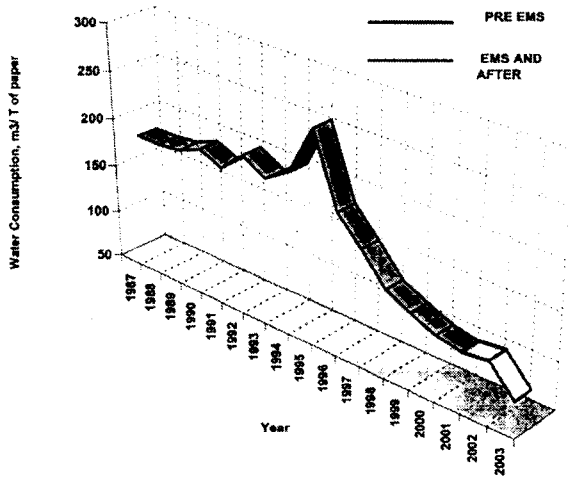

Fig. 3 Reduction in water consumption.

fulfil product quality demands, and being viable?

In the course of implementation, Environmental Management Programmes (EMP) played a key role in minimizing the environmental impact. The end of pipe system employed by TNPL exploits advanced wastewater treatment technologies. Prior to the implementation of EMS, the high COD water from Bagasse Effluent, rich in dissolved organic matter and residual sugar was put to anaerobic treatment in open ponds resulting in dramatic reduction in COD and BOD. However, one aspect was ignored. The emissions from the Anaerobic digestion, predominantly, Methane is one of the most potential threats to the Eco-sphere. Methane an established green house gas, 21 times more potent than Carbon-di oxide was let out into the atmosphere. In a year, around 2800 T of Methane equivalent to 70000 T of CO_2 was being generated during the anaerobic oxidation of the bagasse wash effluent. The Environmental Management Programme through the installation of a Bio-Methanation plant utilizing Upflow Anaerobic Sludge Blanket technology removed this large source of pollution by utilizing the bio-gas generated in the process as a fuel in place of Furnace Oil. Further utilization of biogas as the replacement fuel resulted in reduction of Furnace oil, another major source of Carbon di oxide. In a year, 11000 T of furnace oil as Carbon dioxide was reduced upon using Bio-gas from Biomethnation plant. TNPL's Biomethanation plant based on Bagasse wash effluent, first of its kind in the world, has become the model plant in the country (7).

An Environmental Management programme was developed to handle the biomass removed from Activated Aerobic Sludge process, for which the input mainly consisted of pulp waste from bleach plant. This sludge is being sent to land filling. However, EMP involving organic composting converts it into useful organic biofertilizer and during composting the hazardous organic compounds like Absorbable Organic Halide are mineralized in to harmless inorganic chlorides (8).

Environmental Management Programme to control fugitive Dust emission gave impressive performance during and after the implementation of EMS in TNPL. An array of high-speed continuous water jets sprinkled treated wastewater on the storage piles of Coal minimizes the dust formation remarkably to low levels.

Blow Heat Recovery system was installed as a part of EMS implementation in the Hardwood pulping digesters. This, besides results in savings in heat energy, also contained the emission of non-condensable malodorous gases like methyl mercaptons, methyl sulphides generated during the blowing operations after the pulping process in the Pulp Mill.

About 60 Environmental Management Programmes like the ones mentioned above were developed to handle about 500 aspects identified as high impact sources for getting the satisfactory environmental performance. Most of these EMPs have been completed and their impact on the system is being continuously monitored (Table 1). Fresh Environmental Management Programmes are being developed as part of the continual improvement.

Documentation

A certified system puts high and new demands on documentation, for instance written working routines, checklists, and goal-specifications. Most of the personnel in TNPL perceived these demands as positive and had experienced benefits from working with them. When documenting, they gained more knowledge and control over what happened in the process. Moreover, it was easier for them to remember how they solved problems from one time to another. But there were some difficulties in formulating what they experienced in a written and formalized form, for instance to write down what routines they used, which goals they had committed to, and how a policy should be formulated. By creating and maintaining authentic, reliable and useable records and protecting the integrity of those records for as long as in required organizations can reap the benefits of conducting their business in an orderly efficient and accountable manner.

By measuring environmental and quality performance, it was possible to plan for future decisions. As such, documentation supported the decision making process and decreased uncertainty. Also, the collected data and information has especially helped for long term and strategic decisions.

Daily Meetings played a very important role in the TNPL EMS. These meetings invariably included the process activities that had direct impact on the environmental parameters. This helped to construct an impressive database with which it was possible to take appropriate decisions and corrective actions. For instance, every single spillage in every corner of the mill was recorded which led to fluctuations in the pollution parameters such as Colour, COD and Suspended Solids and Suspended particulate matter. The accumulated data of these physical environmental observations was again summed and an executive summary was sent to the Top management as Monthly report. This would be again taken up in the quarterly Management Review meetings.

Non-conformities

An important part of the documentation is to write down the non-conformances that have occurred during the year. A non-conformance is by definition the difference between what is planned and what is achieved. The process of reporting non conformances helps managers check and analyze problems that occur in the production system. As a consequence, preventive action can be taken. Information about those environmental and quality goals that are not reached has to be reported, as well as all necessary corrective actions are taken in order to prevent the same non conformances to occur again. Corrective and preventive actions, external

Table 1. Environmental management in TNPL at a Glance

Departments	14
Activities relating to environment	425
Potential impact sources identified	546
Critical impact sources on environment	183
Environmental objectives	9
Targets	70
Environmental projects completed	44
Total investment made on environmental programmes, Rs. in lakhs	1707
Operational control procedures	147
Emergency operational control procedures	30

reactions (complaints, but also praises) etc, have to be documented. At the start, some managers felt that it was difficult to know exactly how to address the non conformances. As the EMS became more established, finding potential non conformances became easier and meaningful.

Measuring the environmental performance

Employee awareness and participation on environmental management

The relation to the personnel also changed. According to some Managers the relationships became more professional. Well-defined and more accurate routines and job descriptions created better guidelines, but this did not result is a stronger hierarchy between the employer and the employees. On the contrary, this created more involvement and participation in the management process among all the employees. Two formal activities that support these statements, are (1) the demands for regular meetings with the personnel and (2) the documentation of all measures and activities taken in the production.

When working through all aspects of the business and its relations, most managers perceived that they got a better understanding of their department as a system. They also had been able to improve the structural conditions. This was evident in all the plants. Some employees felt more self-confident, something that also characterized the feelings of many employees. As a result, the Mill as a whole had higher status. The Indian Journal "Business World" described TNPL as a global scale company and summed up its culture as "Training, Tolerance, and Social Responsibility." The Journal described TNPL as "fun place to work" (9). Training plays a key role in developing competency and an environmentally friendly approach among employees. All were made aware of EMS and its requirements. One of the most important training given to was to update employees with the frequent changes in the Legal requirements.

Environmental monitoring impact assessment

a) Internal monitoring system

Any Environmental Management System should have reliable monitoring methods to evaluate the performance (10). Environmental Monitoring Plan is the artery of the TNPL's EMS. It was the most comprehensive of all the documents ever prepared during implementation. This plan consisted of about 180 key parameters with exhaustive written analytical procedures and

Table 2. Some significant resource savings in a typical year through environmental management programmes

Resource	Saving method	Typical quantity in a year	Typical savings in a year
Water, m^3/year	Recycling of treated effluent water	6600000	112.20
Water, m^3/year	Recycling of chlorine filtrate	3060000	52.02
Chlorine, MT/year	Recycling of chlorine filtrate	393	32.00
Furnace Oil, m^3/year	Bio-methanation of bagasse effluent	3672	352.00
Pulp washing losses, MT/year	Technology modification	96	11.50
Electricity, units/year	Wind mill production	26703264	720.00
	TOTAL		1279.72

permissible tolerances thus making it an ideal guide for monitoring. This plan also acts as a ready checklist and kept in all the departments.

Mill wide physical inspection helped to identify sources that would have direct impact on the environmental parameters and curtail any activity that would lead to non-conformances. Instead of waiting for the non-conforming act to occur, it was possible to stop even before it happened.

b) External monitoring system

The performance of the company towards environment should also be measured by other competent external agencies. Some times this activity is called Environmental Impact Assessment (EIA). This has been carried out in TNPL by National Environmental Engineering Research Institute (NEERI), Nagpur. The EIA is a comprehensive environmental study measuring various types of environmental parameters towards Air, Water, Solid waste, Biology, and others. This is being done at a regular interval. In addition, the quality and the effect of TNPL's treated Effluent water has been extensively studied by Tamil Nadu Agricultural University (TNAU) periodically.

Resource saving

Water is the most sought out commodity and its depletion has been found to be increasing in alarming rate in many parts of India. In the context of pulp and paper industry, it is one of the major inputs without which it is impossible to produce pulp and paper. During the implementation, one of the objectives was the reduction of resources with specific reference to liquid discharge. This could be done in two ways viz. 1) Cutting off water in useless areas 2) effective recycling. This would also reduce the quantity of treated water that would be sent to irrigating lands. In the course of implementation, a task force was set up to determine the most sensitive areas of the mill where reduction in water consumption and recycling could be achieved. Some of the significant Environmental Management Programmes concentrated on these aspects are:

- In the bleaching plant, the effluent obtained from the Chlorine washing was recycled resulting in significant reduction in the water consumption. This also helped to reduce the Chlorine consumption.

- Major areas were identified to use the treated water. This resulted in recycling of about 20000m^3 of treated water. This represented nearly 35% of the fresh water intake every day. The extent of water conservation during the EMS implementation is shown in Fig 3. The water consumption in TNPL is among the lowest among Indian paper mills and comparable to the best of Asia.

Table 2 illustrates some of the significant savings that were achieved with TNPL EMS.

Waste reduction

One of the main areas of thrust during EMS implementation was reduction in hazardous wastes. This necessitated a detailed mapping of hazardous waste materials. This mapping helped to classify the hazardous waste materials mainly in two-categories viz. 1) Unused excess materials generated in the various processes 2) Used materials and by-products in the process. This also involved intensive communication throughout the mill, which was done in the early beginning of the implementation itself. The guide prepared for 14001 training itself contained a list of showing of hazardous and non-hazardous waste materials. Remarkable improvement was made in the collection and delivery of the used waste Oil, and Batteries. In addition, the quantity of hazardous waste generated itself reduced over the years after the implementation.

Business relations

An EMS will move into the maturing stage only after successfully negotiating the transition phase. The key to maturing an EMS is that, it must continue to demonstrate value to the organization.

For most organizations this means cost savings. For others it could mean increased market share, reduced liability, an improved rating in the market, and decreased public criticism or any combination of reasons.

Being certified, the company has to be aware of and in control of all business relations. It is about putting together all customer contracts, as well as relevant information about your suppliers. The managers valued both these aspects, and some real benefits had already come out of it. Some stakeholders, for instance local authorities, have responded positively to company being certified. The Eco-friendly nature of TNPL's products has been discussed in depth with one of the Australia's leading environmental organization such as Planet Arc who have endorsed TNPL products as Eco-Friendly. Similarly, worldwide Fund for Nature-India (WWF) endorses its Panda logo in TNPL branded products such as TNPL copier and TNPL Eco-friendly note books.

TNPL has been rewarded with" MOTHER THERESA BEST CITIZEN AWARD" by Loyola Institute of Business Administration for outstanding social commitment, professional management, eco-friendly technology and compassionate concern for welfare of the weak and underprivileged. "DR. M.S.SWAMINATHAN AWARD FOR 2002 FOR ENVIRONMENTAL PROTECTION" was bestowed on TNPL by Rotary club of Madras East and Earth Care for displaying corporate commitment to Environment Care. Indian Paper Makers Association (IPMA) recognized TNPL and called the "Best Paper Mill of the Year".

CONCLUSION

Overall, the key benefits obtained from ISO 14001 certification are improved environmental performance and improved corporate image followed by improved procedures, relations with authorities and relations with communities. Our experience has demonstrated that well-established and documented system coupled with precisely defined aims and objectives concerning the intended environmental contributions are basic prerequisites. The pattern and impact of Environmental Management in TNPL almost parallels the global trend across the world.

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