WASTE MINIMISATION IN SMALL SCALE INDUSTRY

WASTE MINIMISATION CIRCLE AS A TOOL TO ACHIEVE IT

(PARTNERSHIP FOR GROWTH)

WASTE MINIMISATION CIRCLE

Prepared by

Mr. M. J. Pervez, NPC
Mr. Harsh Thukral, NPC
Dr. M. Salahuddin, MoEF

Sponsored by

Government of India

Ministry of Environment, Forests and Climate Change

Nodal agency

National Productivity Council

Environment Management Division
National Productivity Council, India

(June 2014)

PREFACE

There are projects that set new trends and paradigms, those that serve most humbly as harbingers of a movement. They make a difference, they sow new seeds and demonstrate new possibilities, they give a new direction!

One such project is the Waste Minimisation Circle (WMC) project executed by the National Productivity Council (under Ministry of Commerce and Industry, Government of India) and sponsored by the Ministry of Environment and Forests, Government of India with partial support from the World Bank in phase II.

At its core the WMC project has set about the task of ushering in an 'Economy of Efficiency' in the Indian industrial sector and enterprise.

This booklet is prepared as an outcome of the experiences gained under the above project and seeks to serve as a guideline document to enthuse industry, professional and academic community to adopt and apply the WMC concept - a uniquely designed partnership approach - for realisation of economic and environmental benefits for industry and society at large.

The publication of the booklet has been made possible through the support provided by the Ministry of Environment and Forests, Government of India.

June 2014

FOREWORD

The achievement of high levels of productivity has many routes and the goal is a desirable outcome of every enterprise. The equations have indeed changed and profitability - the driving force for entrepreneurial ventures - is increasingly dictated by the market and extraneous factors. The enterprise is therefore required to deploy best skills and techniques for efficient and effective management of its constituents.

The Waste Minimization Circle project has been a novel participatory mechanism to manage men, material and resources at the inter and intra enterprise level in SME. It is especially relevant as green growth and development are possible through cooperative efforts and WMC is founded on this spirit.

The initiative of the Ministry of Environment and Forests in designing, promoting and sponsoring the WMC program is welcomed by all participants and felicitations are due to the WMC Facilitators and WMC Member Units who have taken the lead and demonstrated the programs appropriateness and effectiveness on the ground. The efforts of the Environment Management Division of NPC, National Cleaner Production Centre and core project team in executing the program deserves commendation.

I believe the success of this project will encourage government and private partnership to achieve sustainable development and growth through resource and environmental productivity improvement.

I further congratulate the authors for producing the WMC booklet which should serve as a valuable resource and reference guide to promoters and practitioners of WM and WMC concept.

Shri Harbhajan Singh, IAS
Director General
National Productivity Council

Message from Ministry of Environment and Forests

Industrial revolution brought in its fore rapid economic development. A development that has been driven by consumerism through production and acquisition of material goods. The scenario however has been application of any type of technology, lowest capital investment and achieve maximum profits particularly in SME. The fallout has been large scale propagation of obsolete technologies which have impacted our environment and we see today excessive wastage of natural resources and contamination of air, water and land.

The need to overcome outmoded systems has led to the promotion of cleaner production (CP) / waste minimization (WM) / clean technologies (CT). The 'Policy Statement on Pollution Abatement' since 1992 is providing impetus to this change from pollution control to pollution prevention through attitudinal shifts, policy reorientation, modified international terms of trade and green credit facilities etc.

The process of motivating enterprises to adopt CP / WM and demonstrating the potential as means of improving economic returns which also results in better environmental performance has found expression in the Waste Minimisation Circle (WMC) concept. From the pilot phase in 1995-96 when the program was conceived till date the achievements made by the project at ground level have been commendable and encouraging. In this regard appreciation is due to team of MoEF, National Productivity Council and its team of dedicated professionals who have marched ahead in taking awareness on WM / WMC to the industry's doorstep. The wholehearted involvement and participation of WMC Facilitators and SMEs has enabled the program to move forward.

These are clear signs of the WM / CP policy working and there is hope that more and more Enterprises will adopt the WM / WMC framework for reducing waste and enhancing productivity. This concise and picturesque manual containing case studies and examples of successes with it's step by step approach to the working of a WMC will undoubtedly serve as a guide to future efforts in propagating WM / CP in the industrial sector.

Ministry of Environment and Forests

ACKNOWLEDGEMENTS

'Waste Minimisation Circle (WMC) - Partnership for Growth' is prepared in the year 2014. It has been a long journey started in 1995-96 to reach this stage of WMC Manual, 2014. During this journey, valuable contributions have been made by number of organizations, institutions and individuals. It would not be possible to acknowledge everybody, however, the key contributors needs to be mentioned here.

First and foremost, we would like to place on record our sincere thanks and gratitude for Ministry of Environment & Forests (MoEF) for sponsoring this Project from Phase-I to Phase-II. Acknowledgements are due to World Bank for partially sponsoring Phase-II. We cannot forget Mr. T. George Joseph, the then Joint Secretary of MoEF who had conceptualized and initiated this Project. Subsequently the valuable contribution and dedicated efforts put in by Dr. G.V. Subramaniam, Dr. R.R. Khan, Dr. Nalini Bhatt, Dr. Raghupathy, Dr. Rajneesh Dubey and Dr. M. Salahuddin, senior officers under the guidance of Secretary and Additional Secretary of MoEF needs to be acknowledged.

We would like to acknowledge the contribution of all WMC Facilitators and Circle Members and their Waste Minimisation teams without whom it would not have been possible to move even an inch forward.

It would be appropriate to acknowledge the team of dedicated professionals of NPC under the guidance of Director General, who have made it a very successful Project, particularly Shri S.P. Chandak, who led the team from the front initially.

Acknowledgements are also due to all those who have directly or indirectly contributed in this journey.

CONTENTS

CHAPTER 1

WASTE MINIMISATION – CONCEPT, NEED, BENEFITS & METHODOLOGY

1.0 Waste Minimisation Concept

Prevention – the best policy

Since the beginning of environmental movement in the country, both government regulatory agencies and the industry focussed their environment protection efforts on controlling the effluent at the point where they enter the environment. This concept is appropriately known as "End Of Pipe (EOP)" treatment. While this EOP approach has to some extent been effective for protecting the environment, it has also presented following disadvantages:

I. It can result in the transfer of pollutant from one medium to another thereby effecting no net environmental benefits. In some instances, this transfer can even increase the risk to human health and the environment.

II. It requires huge dead investments and recurring expenses which makes this concept highly unsustainable and at times for most of the SMEs this is just not feasible on account of lower levels of profitability and space constraints etc. Further the sheer number of SMEs makes it almost impossible to regulate them effectively.

Realising these drawbacks and looking into other pressing problems (i.e. the pollutant assimilation capacity of the receiving bodies nearing exhaustion), the concerned agencies were forced to look back into the industrial production processes and search for alternative approaches for environmental protection - thus emerged the concept of proactive approach of waste reduction at source as a means for achieving environmental protection. In other words, waste minimisation concept was realised as the need of the day. Waste Minimisation can be defined as **"A new and creative way of thinking about products and the processes which make them. It is achieved by the continuous application of strategies to minimise the generation of wastes and emissions".**

For processes, waste minimisation involves conserving raw materials and energy, eliminating the use of toxic substances as much as possible, reducing quantity and toxicity of emissions and wastes before they leave the process etc.

For products, it means reducing their environmental impact during its entire life cycle from raw material extraction till ultimate disposal.

Waste Minimisation accordingly means economic savings from reduced consumption of raw materials and energy, it means lower pollutant treatment costs, it means better working conditions, it also reflects other benefits such as a better company image. Implementing Waste

Minimisation may not (in fact, will not) solve all environmental problems at a facility, but it does decrease the need for installing and operating end-of-pipe treatment equipment and reduces the quantity of hazardous wastes that needs to be treated and disposed off.

Waste Minimisation efforts often reduce workers' exposure to hazardous chemicals, as well as the frequency and severity of accidents and chemical releases. Products that are designed and produced with Waste Minimisation concepts in mind are often less harmful for consumers to use. In brief, the benefits of the WM could be summarized as:

- Reduces costs and increases profits through high levels of efficiency
- Enhances productivity and growth
- Improves quality (of products) - builds brands
- Conserves resources (e.g. material / energy) promotes wealth of the company
- Improves environmental performance - enables better regulatory compliance
- Enhances public image improves market opportunities
- Establishes appropriate systems and procedures
- Improves work environment and safety - develops loyalty
- Ensures access to greater finances – betters credibility
- It leads to the emergence of a sustainable enterprise and makes good business sense !

1.1 Prerequisites to succeeding in WM

It is important to put in place right conditions for any venture to bear fruit. The keys to a good start include the following :-

- Willingness
- Commitment at all levels, particularly of the top management
- Open mind
- Team work / Team spirit
- Structured methodology

1.2 Waste Minimisation Techniques

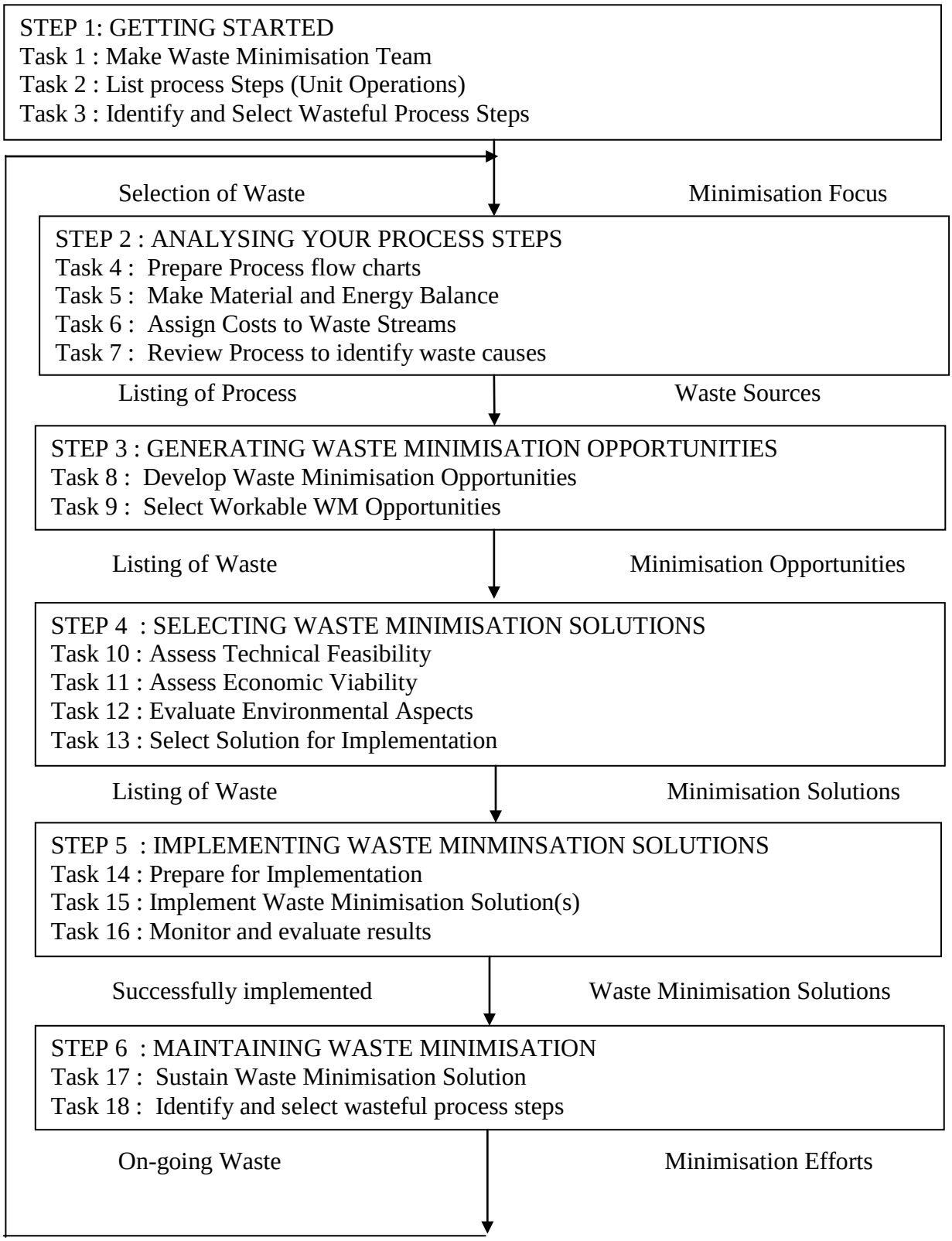
It is also said a worker is as good as his tools. Knowing your tools is the key to doing it right in the first place. It is indeed a suite of tools and techniques that help you do the job – be it crunching numbers, be it measuring light and sound, be it testing the concrete block, be it

bridging the river in spate! There are 10 generic techniques that can be associated with application of WM assessments. They are :-

Table 1.1: Generic Techniques

Sl. No.	WM Techniques	The Question(s)
1	Good Housekeeping	Can I reduce any obvious waste streams ?
2	Better Process Control	Can I further optimize process sequence and conditions ?
3	Recycle / Reuse	Can I use any waste back into the process ?
4	Recovery	Can I recover some raw material worth using again in the process ?
5	Energy Conservation	Can I reduce consumption of electricity / fuel and other energy resources ?
6	Input Material Change	Can I find safer alternatives for Toxic / Polluting raw materials ?
7	Equipment Modification	Can I modify equipment(s) to reduce waste generation ?
8	By-Product Manufacture	Can some other product be made from the process/waste ?
9	Product Modification	Can the product be improved that generates less wastes while maintaining the functional value ?
10	Technology Change	Is there any other technology to suit my needs and to reduce waste generation & resource consumption ?

Table 1.2: Six Step Methodology for Waste Minimisation Assessment



CHAPTER 2

CONCEPT OF WASTE MINIMISATION CIRCLES

2.0 Introduction

As mentioned earlier that in India there are very large number of SMEs and are the backbone of Indian economy. The growing global competition and the environmental challenges leave no option than SMEs to become more competitive. It is possible only to adapt Waste Minimisation as a strategy to remain sustainable and competitive. The SMEs can ill-afford the conventional methods to meet the environmental challenges. Waste Minimisation is very attractive proposition particularly for SMEs, however, it has not permeated adequately to reach the grass-root level of SMEs due to lack of awareness and proper guidance, absence of appropriate mechanism to overcome various bottlenecks which hinder adoption of Waste Minimisation. Further, the untrained manpower and the requisite resources which could address the gaps are also not available in SMEs. It is important to mention that SMEs are in clusters and use similar techniques/technology which results in similar problems as well as solutions. In view of this, Waste Minimisation Circle concept was evolved to reach a large number of units and obtain multiplier effect.

2.1 The Concept

A Waste Minimisation Circle consists of a small group of entrepreneurs in the small scale industry following similar production process and manufacturing similar products. The group holds regular meetings within the premises of each of the member units under the supervision of WMC Facilitator and analyses the production process being adopted in the different units. This analysis leads to identification of causes of waste generation and development of WM options through discussions. The group collectively implements the WM options in their respective units, which amounts to increase in individual profitability and overall reduction in pollution load.

WMC is a concept tantalizingly similar to the QC ideology and the next step forward. A concept that is designed to take on a bigger challenge, to overcome larger barriers, to usher in the economy of efficiency with a cluster approach. And this is where it differentiates from QC :-

Table 2.1: QC & WMC – The Different Strokes

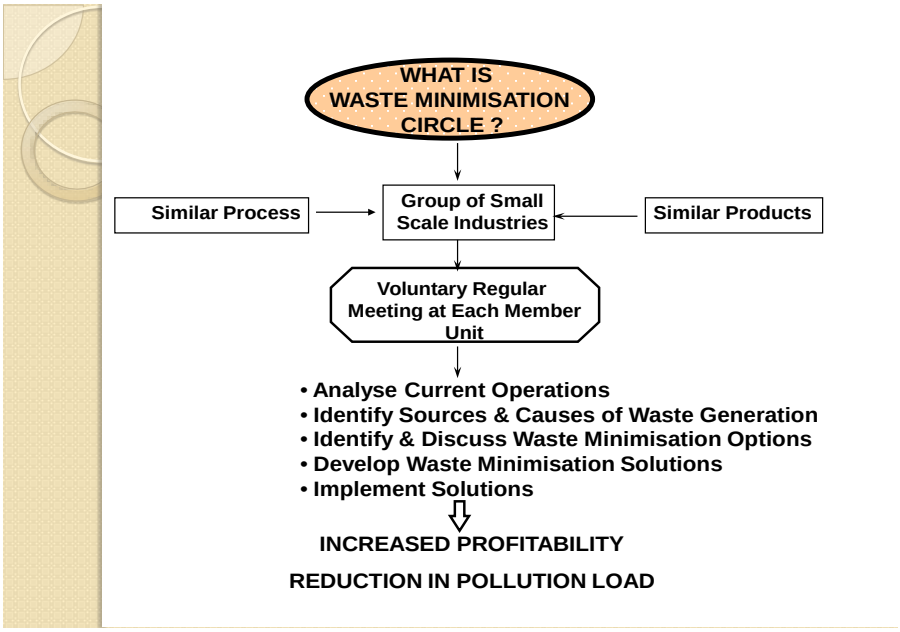
QUALITY CIRCLES	WASTE MINIMISATION CIRCLES
Developing innovative IDEAS and applying to the industrial processes for improving quality and ensuring better ergonomics in the work environment :-	Developing innovative IDEAS towards identifying Waste Minimisation Options and implementing WM Solutions for achieving economic and environmental benefits through collective efforts :-
•Within a given industry and applied on Shop floor level	•Among group of Small and Medium Scale units (5-6 Nos) at Cluster of industries level involving units with similar processes and products
•Employees who carry out tasks / operations in a section of the industry in same familiar surroundings	•Entrepreneurs / WM Teams focusing on varying versions of similar enterprises (i.e. member units)
•Ideas are generated by brainstorming, each employee contributing his knowledge, experience and creativity to evolve solutions	•Ideas are generated by participants observing unique features in member units and developing innovative ideas by brainstorming / cross fertilisation of experiences gained
•Commitment of the employees	•Commitment of the Member Units

As regards the WMC concept the involvement of a facilitating agency is essential to convince the potential industries / member units of a cluster to form a WMC. This agency also provides basic information on WM, guides the members in problem solving, provides technical assistance and ensures regulation of meaningful discussions / exploration of ideas and sharing of knowledge in the WMC meetings. This agency is National Productivity Council.

'I'he theme behind the working of Quality Circles is generation of innovative ideas and in this context WMC concept is a step ahead of QC. In a WMC, an entrepreneur interacts with fellow industrialists / entrepreneurs and is exposed to varied versions of similar units and the observations from this exposure leads to comparative analysis enabling him to generate fresh / innovative ideas for improving the current practices and attempt improvement of the existing processes.

In nutshell, the concept of WMC could be depicted as follows:

Figure 2.1: Concept of Waste Minimisation Circle



The WMC members meet regularly at pre-defined frequency under the supervision of WMC Facilitator to discuss their problems and evolve the solutions which are easy to implement and seek technical guidance from Nodal Agency that means National Productivity Council and report the progress periodically. The duration of a Circle is one year for which technical guidance could be provided by NPC.

CHAPTER 3

OBJECTIVES FOR ESTABLISHING WMCS

3.0 Objective(s) for Establishing WMCs

The WMCs are intended to be established with the following key objectives

(a) Awareness and information dissemination

- ✓ To provide a forum for discussions, sharing views and knowledge about waste minimisation at local level.
- ✓ To enable systematic compilation and dissemination of information on waste minimisation.

(b) Demonstration

- ✓ To promote group efforts for demonstrating waste minimisation techniques.
- ✓ To facilitate adoption of Cleaner Production Technologies and enable a multiplier effect

(c) Environmental Compliance

- ✓ To facilitate compliance with environmental regulations.

CHAPTER 4

MAKING IT WORK

4.0 Strengths inherent to a WMC

Strategies and concepts remain so unless put to work. What makes WMC appropriate and sound as an approach for promoting Waste Minimisation in SMEs is the methodology that drives it.

4.1 Taking a closer look - the activities within 4 stages of a WMC and 6 phases of 18 WM Tasks

What keeps WMC activities on course is the interweaving of feedback – guidance mechanism. The cybernetics that works here is detailed in the activity – deliverables framework later. The main activities that go into successfully establishing and running of a WMC wherein NPC and WMC Facilitators coordinate and share responsibility are presented below : -

Stage 1. Planning and establishing of a WMC

1) Profiling a cluster and assessing WM / WMC potential
2) Organising workshop - starting the Circle
3) Setting agenda - initiating team work
4) Preparing process flow chart - developing baseline data
5) Establishing benchmarks - comparing member status

Stage 2. Analysing operations & generating WM options

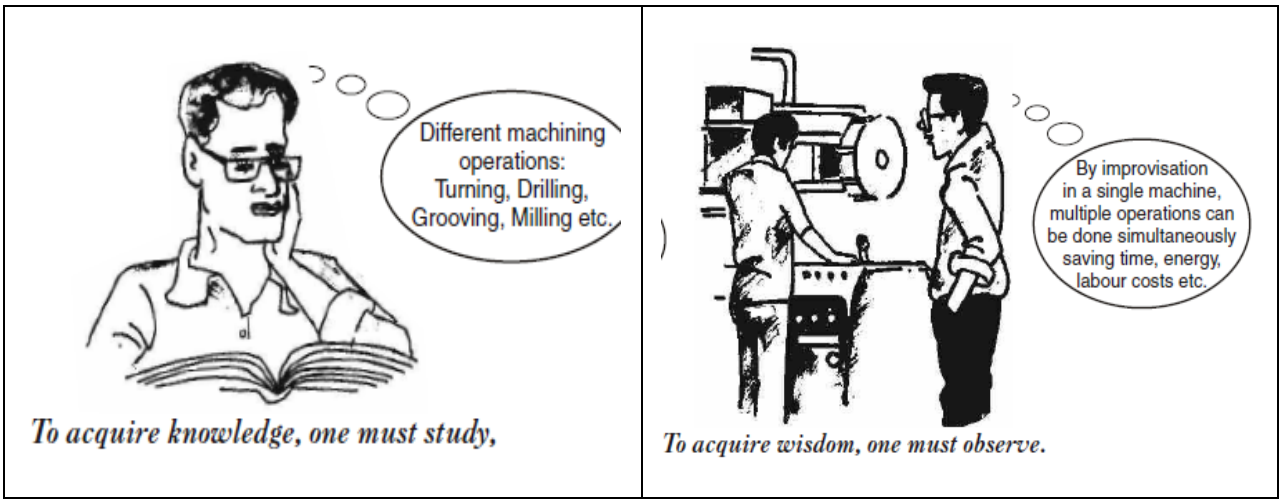
6) Studying unit operations - identifying waste streams
7) Making material & energy balances – quantifying wastes
8) Computing ‘savings potential’ establishing WMC focus
9) Generating WM opportunities - assessing feasibility
10) Prioritising options and planning implementation

Stage 3. Implementing solutions & reviewing progress

11) Implementing feasible solutions & recording results
12) Reviewing progress – correcting the course

Stage 4. Disseminating the results and spreading the concept

13) Evaluating performance & assessing outcome
14) Disseminating achievements
15) Building new cooperation / new roadmaps



4.2 Role of NPC, WMC Facilitators and Circle Members

4.2.1 National Productivity Council (NPC)

National Productivity Council the Nodal Agency responsible for execution of the project has the following terms of reference.

(i) To assist the WMC Facilitators in identifying the regions and industrial clusters amenable to form WMCs.

(ii) To help the WMC Facilitators in conducting the initial one or two awareness workshops, training programmes, brainstorming sessions etc., so that the 'WMC Facilitators' get a practical experience in conduction of similar workshops in future

(iii) To compile and record progress made by the circles as per documents submitted by WMC Facilitators. To conduct periodic reviews to assess the performance of each WMC.

(iv) To provide necessary technical assistance required by WMCs to ensure smooth and fruitful running of the circles. If necessary NPC may draw upon external technical expertise for providing such support.

v) To facilitate interaction within circles of the same industrial sector (inter circle networking)

vi) To interact with MoEF and other relevant agencies and keep the principal agency informed of the developments / progress achieved under the project.

vii) To publish a quarterly newsletter which will highlight the major activities and achievements made in the different WMCs etc., and publish articles, case studies / success stories regarding application of Waste Minimisation approach in industry etc.

xiii) To address the sustenance and sustainability aspects of WMCs by undertaking sustenance review / analysis and developing suitable recommendations and mechanisms for the same (WMCs established under Phase II).

ix) To organize 5 regional workshops and 1 national workshop for awareness generation and dissemination of project / programme results etc.

Accordingly 15 key Tasks have been identified as follows (Tasks 1-15).

Task 1. Undertaking sustainability review and identifying WMC sustainability factors and suitable strategy for WMC sustenance.
Task 2. Identification of potential industrial sectors and clusters for the WMC program
Task 2. Identification of institutions / consultants to be trained as WMC Facilitators
Task 3. Updation of the training package
Task 4. Conduction of training programs
Task 6. Selection of trained institutions / consultants as WMC Facilitators by NPC and MoEF
Task 7. Development of WMC progress assessment indicators, and MOU / Contract with WMC Facilitators
Task 8. Development of payment schedule for WMC Facilitators and sectoral institutions involved
Task 9. Providing assistance to WMC Facilitators
Task 10. Reviewing the WMC progress
Task 11. Final workshop for individual WMCs
Task 12. Bringing out quarterly WMC Newsletter
Task 13. Conduction of Regional level awareness workshops
Task 14. Develop Awareness material on Waste Minimisation and facilitator networking
Task 15. Energising synergies with financial institutions, and other agencies for promoting investment in waste minimization implementation and technology upgradation

4.2.2 Role oF WMC Facilitators

The various tasks / activities to be undertaken by the WMC Facilitators are briefly outlined below. The Progress linked Payment Schedule and Memorandum of Understanding between NPC and WMC Facilitator specifies in detail the activities / tasks to be carried out and the deliverables.

i) To establish and coordinate the activities of Waste Minimisation Circle
ii) To identify the industrial clusters amenable to form WMCs and make preliminary visits to the industrial clusters in order to assess the possibility of establishing a circle
iii) To prepare profile of industrial cluster in which WMC is to be established
iv) To identify one local resource person in each of the sectors selected above who would be able to assist in organising and running of WMC. This would involve interaction of the consultants, with a large number of entrepreneurs of that region. They would assess their capability and, willingness to function as a group leader.
v) To conduct one or two Awareness Workshops with NPC's assistance then conduct the subsequent workshops independently for more WMCs.
vi) To form the WMC after the workshop with the assistance of the group leader.
vii) To conduct a training programme for the circle members in which the concept and methodology of WM and modus operandi of WMC will be discussed.

viii) To formulate the action plan for the WMC.

ix) To assist the WMC members in generation of baseline data / monitoring of Circle

x) To help the WMC members in establishing Waste Minimisation as a part of their business programme

xi). To provide technical assistance required by the WMC in implementing identified WM measures

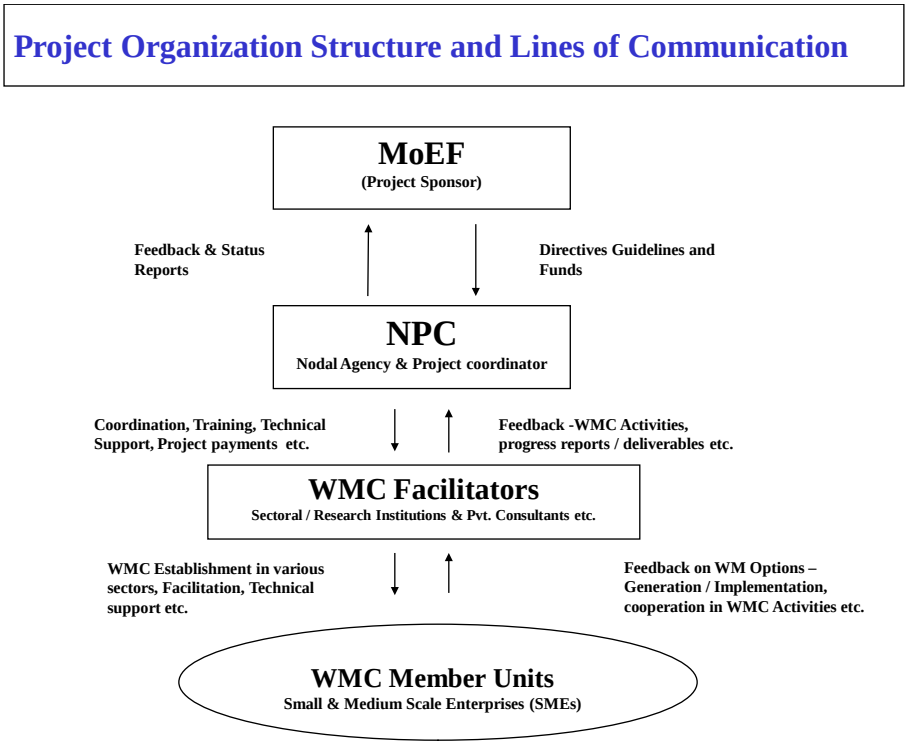
xii) To monitor the running of circle and to prepare necessary documents and provide regular feed back to NPC

4.2.3 Role of Circle Members

The WMC members will extend the cooperation to facilitators in organizing regular meetings and involve with open mind in discussing their problems, finding solutions and implement in their respective units. The WMC members are the ultimate beneficiaries. Their voluntarily participation as a WMC member has provided them an opportunity to receive professional services of WMC Facilitator and NPC which have been funded by the Ministry of Environment & Forests, Government of India.

In brief, the Project organization structure could be depicted as follows:

Figure 4.1: Project organization structure and Lines of Communication:



Visual thinking : The WMC provides an opportunity to apply a varity of tools and techniques and enables visualization of process details and identification of solutions.

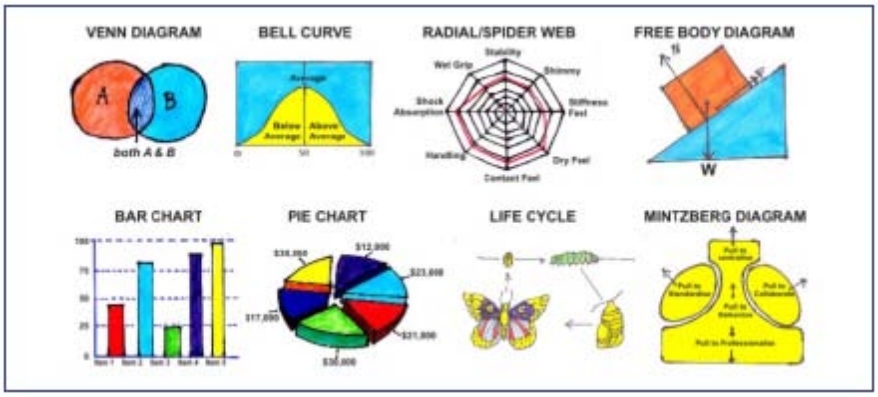


Figure 4.2: Visual Thinking !

4.3 Meeting WMC objectives – the indicators

Table 4.1: Output/Outcome Based Indicators

OUT PUT BASED INDICATORS	OUT COME BASED INDICATORS
• Sectors/Cluster Profile • Details of Awareness Workshop/Training Program/Review Workshop/Final Workshop (venue, schedule, participant list, press releases, photographs, highlights) • Commitment letters from WMC Member Units • Details of unit level WM Teams • Process Flow Diagrams • Comparison chart of processes / activities of Member units • Material & Energy Balance Diagrams/Worksheets • List of quantities of wastes generated along with the areas of generation and their cause	➢ Waste Minimisation Options • Number of WM options identified • Number of WM options implemented ➢ Investments and Savings (per WM Option) & Gross Economic Benefits • Total investments made for implementing WMOs • Net savings accrued per annum (Rs.) • Payback period ➢ Development of Unit Specific / WMC Data (Before and After Implementation of

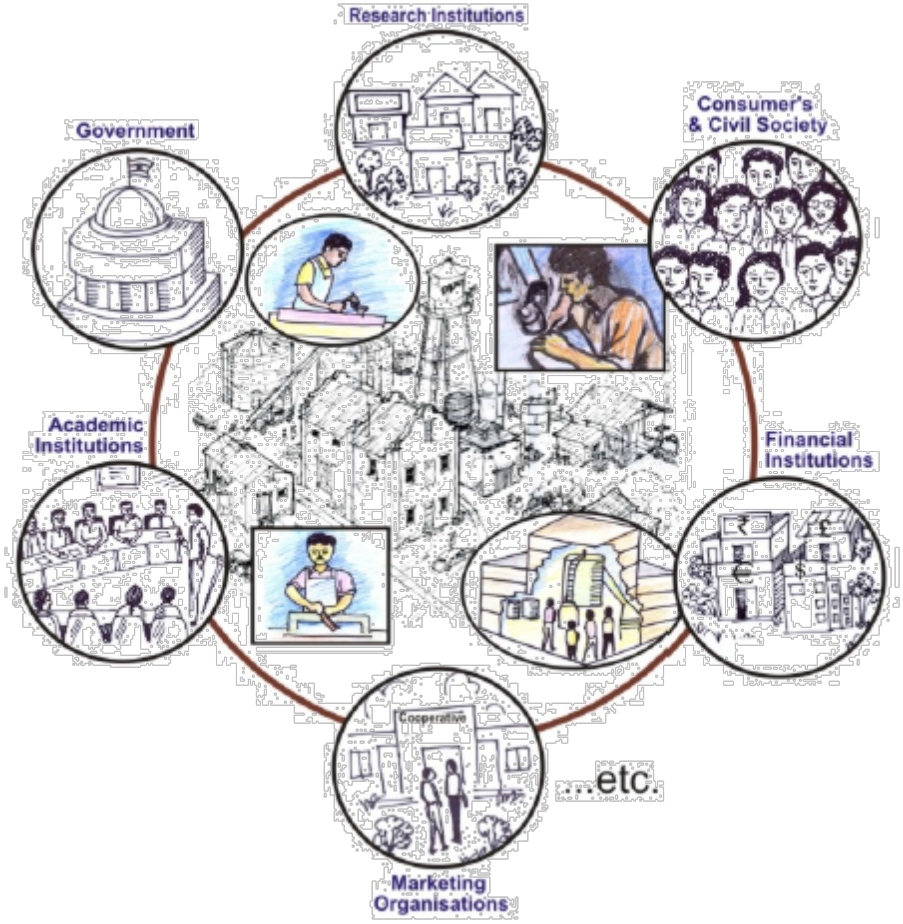
OUT PUT BASED INDICATORS	OUT COME BASED INDICATORS
analysis. • Details of WMC meetings and Agenda/Deliberations • Analysis reports of waste streams (before and after WM Option(s) implementation) • List of WM Options generated • Techno-Economic Feasibility Analysis of WM Options • Details of implemented WM options and the "Cost Benefit Analysis"(CBA) • Final report (Project achievements/ highlights etc)	WM Options) and assessing performance [Quantitative / Percent improvement per WMO and Gross achievements.] • Specific Raw Materials and Utilities Consumption • Specific Water Consumption and Waste Water Discharged / Treated • Specific BOD / COD / TDS / Heavy Metal Load etc. • Specific Fuel (LDO / Diesel / Furnace Oil) Consumption • Specific Electrical Energy Consumption • Specific Solid Wastes Generated • Specific Air Emissions generated (SPM / SOx / NOx etc.) Yield improvements / Losses reduction and Other achievements

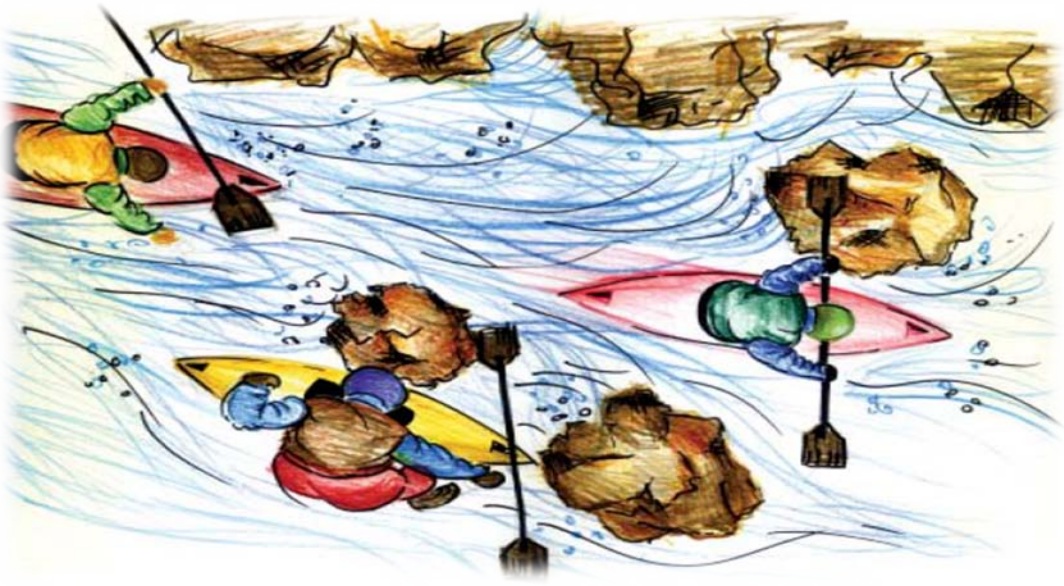
4.4 Summing up

WMC is a platform for sharing experiences, views, knowledge and innovations by a group of Small and Medium Enterprises (SME's) in a structured format, that lays emphasis on a self-help ideology and has a focused approach – to apply a systematic WM methodology, use WM Techniques, develop WM options and implement WM solutions for improving economic and environmental performance of the participating enterprises. It further leads to reforms in the institutions, stakeholders and systems that together in an interactive way lead to green economy and green growth.

CHAPTER 5

SCALING THE BLOCKS





Persistence leads to success … there is no limit on efforts !

5.0 The Taste of Success

It is challenges that make undertaking a task worthwhile. If it were not for difficulties that one faces en-route, the success achieved at the end of the road would be devoid of sweetness. Having said that, all parties need to however prepare for the unexpected, and take the steps that would enable overcoming of hurdles that are likely to come to the fore.

The discussion presented in this chapter cannot be exhaustive and nor is it prescriptive. However, the ideas that are collated are issues that have emerged and still emerging through varied experiences from the WMC project and previous WM assignments and several issues also border on plain logic.

5.1 The fundamental problem

The process of a WMC right from start to finish presents a fair number of issues and concerns that need to be addressed during its run. The sponsors have their concerns, the nodal agency needs to address several issues, the facilitator has problems to solve and the member units have their own difficulties to overcome.

Indeed analysis has shown that most barriers (upto 65%) encountered in the effective implementation of Waste Minimisation programmes & Waste Minimisation Circle activities stem from **peoples' attitudes**. And the WMC project presents an opportunity for all its participants to take that bold step to tackle this fundamental problem.

5.2 A Window to the Barriers and Enabling Measures

The barriers that arise for a WMC go beyond what would arise during the process of a direct one-one: consultant-client waste minimisation assessment programme. WMC in effect reflects application of WM concept in a one-many and many-many inter-relationships scenario. And when you are dealing with attitudinal and systemic issues besides technical matters there surely is a task on hand.

The broad range of barriers that need to be encountered fall under following categories :-

Table 5.1: Barriers to WM assessment and implementation and the enabling measures :

Barriers		Catalysts	Enabling Measures
Attitudinal	• Lack Of Good Housekeeping Culture • Resistance To Change • Lack Of Leadership • Lack Of Effective	• First Time Team Members • Early Success	• Involvement Of Employees • Manage The Changes • Provide Effective Supervision

Barriers		Catalysts	Enabling Measures
	Supervision • Job Insecurity • Fear Of Failure		• Training Of Owners In Effective Leadership
Systemic	• Lack Of Professional Management Skills • Poor Production Records • Inadequate & Ineffective Management Systems	• Proper Documentation And Planned Layout • Proper House Keeping And Maintenance Provisions	• Training Of Plant Level Waste Minimisation Team • Development Of Simple Management Indicators • Top Down Housekeeping Drive • Dissemination Of Success Stories
Organisational	• Non-Involvement Of Employees • Decision Making Powers • Emphasis On Production Maximisation • High Turnover Of Technical Staff • Lack Of Recognition	• Family Supervision • Direct Involvement Of Owners • Information Sharing	• Involving Employees In Waste Minimisation Program • Delegate Decision Making Powers • Reward The Achievers • Increased Emphasis On Non-Production Issues
Technical	• Lack Of Infrastructural Facilities • Limited Or Non-Availability Of Trained Manpower • Limited Access To Technical Information • Technology Limitations • Technology Gap • Limited In-House Maintenance Facilities	• In-House Maintenance Workshops • Planned Lay Out • Rained And Qualified Personnel	• Develop Infrastructure Facilities • Information Dissemination
Economic	• Resource Pricing And Availability • Availability And Cost Of Funds • Exclusion Analysis Of WM Measures • Inadequate Investment Planning • Prevalence Of	• Economically Attractive Waste Minimisation Measures • Financially Sound Units	• Include Environmental Costs In Economic Analysis • Plan The Investment

Barriers		Catalysts	Enabling Measures
	Production Related Fiscal Incentives		
Governmental	• Pricing Policy Of Water • Emphasis On Eop Approach • Lack Of Enforcement Of Environmental Regulations • Lack Of Incentives For Waste Minimisation Efforts	• Scarcity / Non Availability Of Water • Regulatory Pressure	• Natural Resource Accounting • Focus On Wm / Cp / Pp / Gp Etc. Providing Incentives • Improvement In Enforcement Of Regulations Etc.
Others	• Lack Of Institutional Support • Lack Of Public Pressure For Controlling Pollution • Seasonal Variations • Space Limitations	• Demand For Consultant Engagement • Emergence Of Eco-Labeling And Its Applications • Vertical Space In Industrial Zones	• Adaptation Of International Programs • Design Of New Creative Intitutionalised Initiatives • Promotion Of Eco-Innovation and Eco-Products • Newer Measures And Indicators including financial Productivity, industrial land productivity etc.

Table 5.2: Towards getting a hold : The need to overcome idea killers, mental blocks and myths

Idea killers	Mental blocks
• Let's Think About It Later • We Have Already Tried It • It Is Not The Right Time • You Don't Understand The Problem • Talk To John, This Is Not My Field • It Sounds Nice In Theory, But It Will Not Work In Practice • We Are Too Small / Big For It • Has It Been Tried Elsewhere • It Doesn't Fit In Our Planning	**Fear of :-** • Making Mistakes • Being Seen As A Simpleton • Being Criticised • Disturbing Tradition • Being Alone • Data Being Misused • Losing The Security Of Habit

Idea killers	Mental blocks
	• Losing The Group's Respect • Change / Resistance To Change • Being Experimented With

5.3 Waste Minimisation Myths

- Good Only For Large Companies / Mncs
- Requires - Large Funds
- Requires Modern Technology
- Requires Qualified Professionals
- Automation Must
- One Time Activity
- Limited Potential

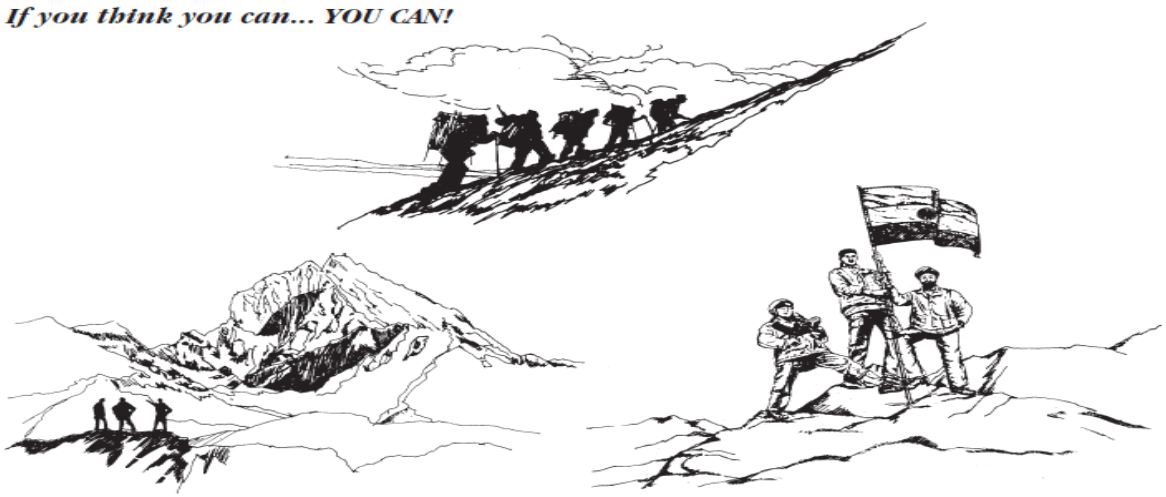
CHAPTER 6

CASES FROM THE FIELD

The driving force : Citius – Altius - Fortius = Faster – Higher - Stronger

How to keep going and the Lessons for keeps

Big achievements happen – when we build on each other's ideas



6.0 From the field

Before presenting the results, let us have a look of some success stories.

6.1 WMC in Engineering Sector - Dewas

Santosh Sharma, Plant Coordinator – HSE, Cummins Turbo Technologies Ltd., Dewas (Madhya Pradesh)

6.1.1 Introduction

The project on Waste Minimisation Circle facilitated by M/s EHS Consultants, found resonance with the firm and gelled with the Vision and Mission of the unit. It brought greater focus on initiatives that were being implemented and further being developed to address issues pertaining to improvements desired in plant operations for reducing wastes and increasing productivity. The interactions with participating WMC member units from the Engineering sector at Dewas added immense value to the experience as knowledge sharing and collective, participatory and group efforts further enhanced momentum amongst the units to explore and implement waste minimisation measures.

Further it is indicative that the unit focused on continually advancing quality of products being manufactured through application of evolving technologies and management techniques. It has been an endeavour to achieve global standards in manufacturing and systems and that the firm had obtained various certifications over the years such as (i) TS 16949 (Aug 2003); (ii) ISO 14001 (March 2004) and (iii) OHSAS 18001 (June 2008) etc. The firm has sought to serve a widening client base which includes companies based in India and in various countries abroad such as :- Daewoo, Eicher, KoMat'su, Mahindra, DaimlerChrysler, Scania, DCEC, HINO, IVECO, Hyundai, Tata, Yanmar, Weichai, Cummins, Vuchai, Renault etc. Further , as part of the focus in manufacturing TurboChargers the firm has been building global capacity and has plants in various countries including (a) India, Dewas : 300K units; (b) USA, Charleston : 450K units; (c) U.K., Huddersfield : 400K units; (d) China Wuxi : 300K units and (e) Brazil, Sao Paulo : 30K units.

6.1.2 An outline of a Turbocharger !

A **Turbocharger**, or **Turbo**, is a gas compressor that is used for forced-induction of an internal combustion engine. A form of supercharger, the turbocharger increases the density of air entering the engine to create more power. A turbocharger has the compressor powered by a turbine, driven by the engine's own exhaust gases, rather than direct mechanical drive as with many other superchargers. A picture of Holset turbocharger is presented in Figure 6.1.

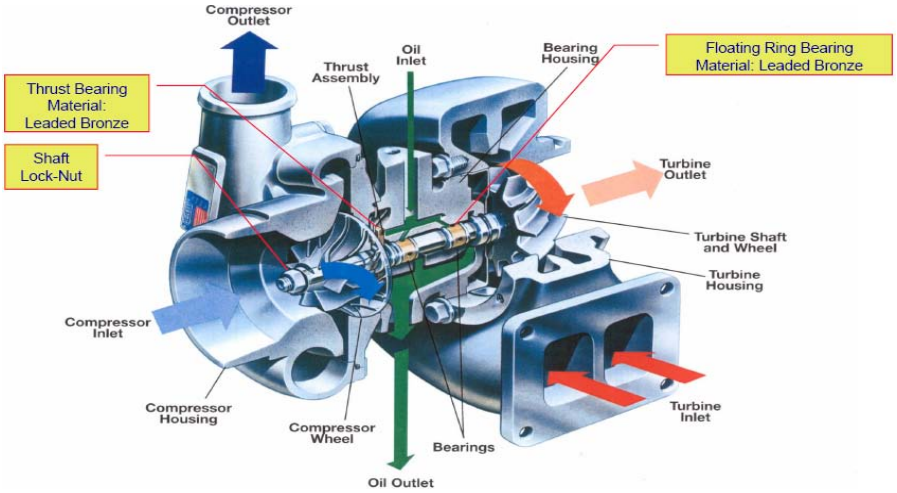


Figure 6.1: Sectional View of Holset Turbocharger

6.1.3 Activities undertaken as part of WMC

The firm actively participated in the WMC project meetings as part of the structured program that was facilitated by M/s EHS Consultants and undertook various initiatives as enumerated below :-

- Process Mapping and Studies
- Root - Cause analysis to identify the Wastes
- Waste Minimization strategy/ WM Options generation
- Implementation of WM options
- Awareness Training on relevant issues
- On-job training
- Inter Industry Waste Minimization Audit team formed and conducting WM audits etc.

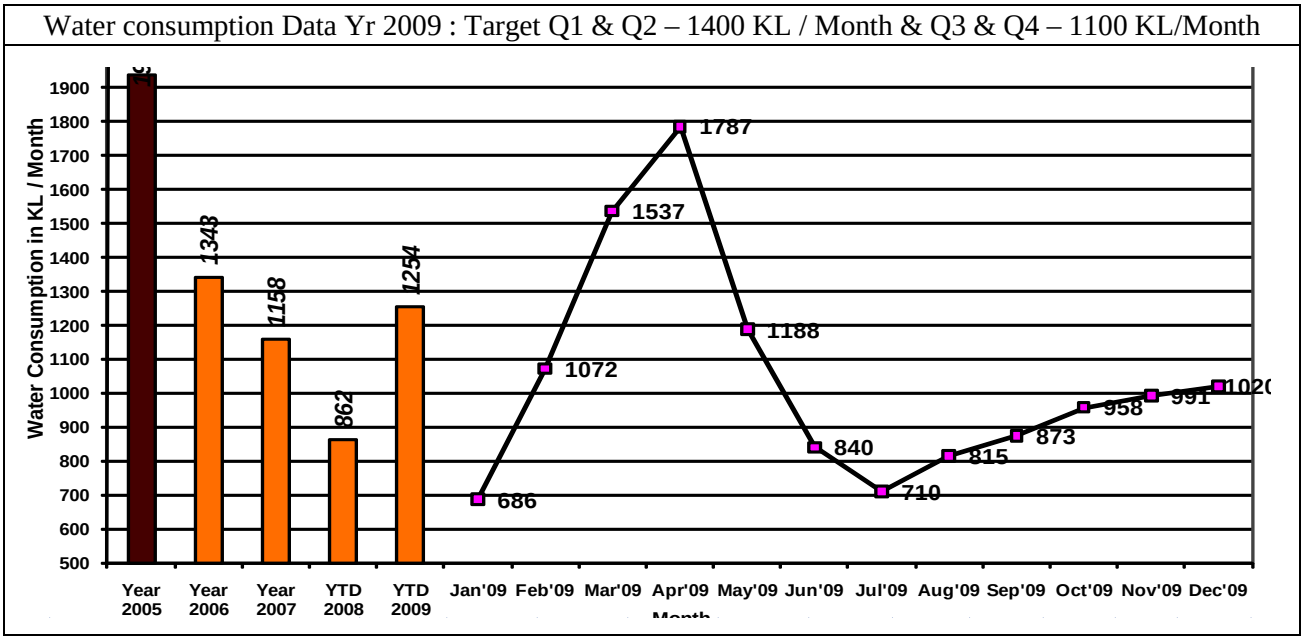
6.1.4 An outline of the plant based Waste Minimisation initiatives, trends and results collated

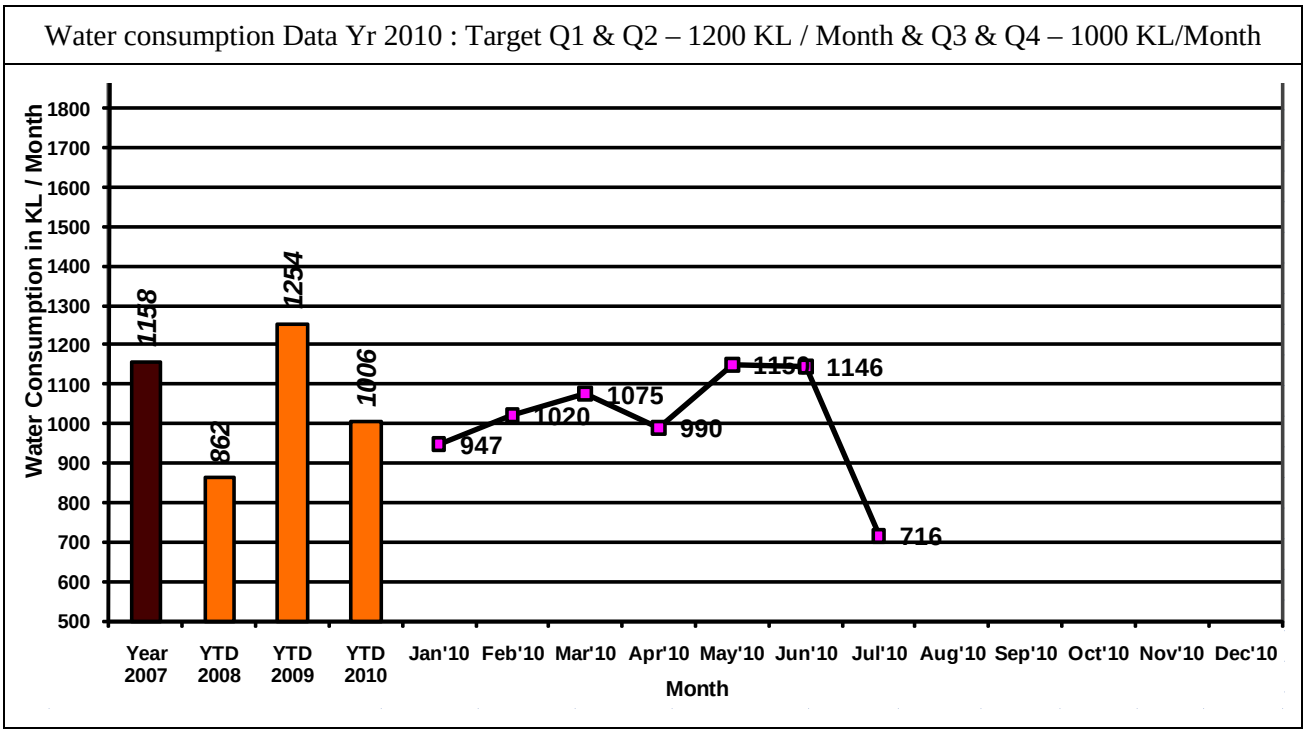
It is indicative that the WMC project efforts were especially dovetailed at the unit with the Health, Safety & Environmental Objectives

Table 6.1 : An overview of key Health, Safety and Environmental Objectives at CTT – year 2010

S.No.	Initiative	Target	Responsibility	Status R/Y/G				Remarks
S.NO.	Initiatives	Target		Q1	Q2	Q3	Q4	
1	Power consumption reduction	8.5 KWH /equivalent unit	AS	7.19	7.79			Q2-Avg 7.79 KWH / Equivalent unit
2	Oil consumption reduction	40 ml / equivalent unit	NS	39.60	40.00			Q2-Avg 40 ml / Equivalent unit
3	Water Consumption (KL / Month)	Q1 & Q2 1200 KL / Month & Q3 & Q4 - 1000 KL/Month	AS	1482	1377			Q2-Avg 1377 KL / Month
4	Paper Consumption	90 Pkts / Month	SS	88	89			Q2- Avg 89 Pkts / Month
5	Improve HSEMS internal audit effectiveness	Audit plan Vs Actual	NM					Third integrated internal audit done in May'10
6	Reduction in Hazardous waste generation	1.7 ton/Quarter	SS	1.31	1.27			Q2-Avg 1.27 Ton/quarter
7	Safety Incident Rate	Max 0.5	AC	0.00	0.00			Q2-Avg 0.00 / Month
8	Ergo Job Analysis	3 per quarter	AD	4	3			Q2-Avg 3 EJA / quarter
9	Hand Related enjuries	Max 1 injuries / Month	NM	1	1			Q2-Avg 1 injuries / Month
10	Improve road safety performance	Green on Scorecard	AK					driving safety policy released , contract agreement done , maint records

Figure 6.2: Charts depicting trends in the case of water consumption reduction targets and achievements for Years 2009 and 2010





The results in respect of quantum of resources conserved and wastage reduction are outlined in tabular format along with estimates on savings as an indicator of the cost / benefits obtained.

Table 6.2: Environmental and Economic Performance Indicators in respect of selected utilities / fuel etc and key savings from WMC activities

S. No.	Environmental Indicators	Performance (Quantity/Month)		Economical Indicators	Performance (Value in Rs.)		Saving /Month (Value in Rs.)
		Pre	Post		Pre	Post	
1	**CONSUMPTION OF FRESH WATER**						
a	Industrial (KL)	1400	1100	**Cost of the Fresh Water**	14000.00	11000.00	3000.00
b	Domestic (KL)						
c	Cooling water (KL)						
2	**GENERATION OF THE WASTE WATER**						
a	Industrial Waste Water + Domestic Waste Water (KL)	850	740	**Waste Water Treatment Coast**	61812.00	55268.00	6544.00

S. No.	Environmental Indicators	Performance (Quantity/Month)		Economical Indicators	Performance (Value in Rs.)		Saving /Month (Value in Rs.)
		Pre	Post		Pre	Post	
3	**GENERATION OF ETP SLUDGE**						
a	ETP Sludge (MT)	500 kg	200 kg	**Sludge Disposal Cost**	11000.00	4400.00	6600.00
4	**OIL CONSUMPTION**						
a	Hydraulic Oil (ltrs)	660	580	**Cost of Oil**	Fluctuate	Fluctuate	App. 10200.00
b	Cutting Oil (ltrs)	410	375				
Total							**26344.00**

6.1.5 Conclusion

The project on Waste Minimisation Circle enabled systematic sequencing of key activities for the purpose of waste reduction, cost control and productivity enhancement. It helped in structuring of procedures and application of techniques that could be applied for achieving various waste minimisation related targets across utilities and unit operations. The interactions with WMC member units and visits to each other's plants enabled insightful deliberations pertaining to plant operations and processes amongst the units and the brainstorming efforts facilitated at inter-firm and intra-firm levels added to the enriching experience for all participants in the process. The initiative towards teaming management representatives and other staff members undertaking **ISO 14001 and ISO 9001** related initiatives in respective firms and from other industrial sectors such as pharma unit, electroplating firms etc towards undertaking combined auditing efforts in a newer design and format was a special development in our WMC project which contributed to the approach / mechanism being further broadened at Dewas as evolved by WMC facilitator M/s EHS consultants.

6.2 WMC in Pulp and Paper Industry- Muzaffarnagar

6.2.1 Results of Waste Minimisation Circle activities at Bindlas Duplux

The unit a agro-residue based paper manufacturing industry with a capacity to manufacture 30 Tonnes /day of paper, was an active WMC member unit under Phase I of the WMC project. The unit undertook following innovative measures during the course of the project.

Table 6.3 : Environmental Improvements and Innovations

Section	Environmental improvements	Environmental innovations
Pulp mill	♦ Optimisation of pulp cooking process (with / without additional measurement and control devices) ♦ Improvement of the raw material preparation example with modification of dry dedusting systems ♦ Segregation and direct reuse of initial black liquor with existing pulp washing system	♦ Installation of depither for bagasse ♦ Vacuum drum washers for brown stock ♦ Double screw press for black liquor segregation ♦ Double wire press for black liquor segregation ♦ Elimination of use of hypochlorite for bleaching
Paper mill	♦ Installation of separate broke pulper ♦ Consistency control in pulp feed to head box	♦ High velocity hood on dryers ♦ Fibre recovery for white water

The unit generated in total 51 Waste Minimisation options of which 23 were implemented. The results achieved in aggregate is given in Table 4 below.

Table 6.4: Achievements Under the WMC Project

Sl.No.	Indicator	Baseline level before start of project	Post implementation achievements	Difference
1	Fresh water consumption (m^3/Tonne of finished paper)	158.0	115.0	-27%
2	Steam consumption (Tonne / Tonne of finished paper)	7.2	4.0	-44%
3	Electricity consumption (kwh/Tonne of finished paper)	880.0	600.0	-32%
4	COD load generated (kg/Tonne of finished paper)	1094.0	663.0	-39%
5	TSS load generated (kg /Tonne of finished paper)	365.0	220.0	-39%

Table 6.5: Financial Benefits Accrued From The WMC Project

Sl. No.	Indicator	Details
1	Implemented options	23 Nos
2	Total investments	Rs. 60 Lakhs
3	Total annual savings	Rs. 84 Lakhs
4	Pay back period	9 months

6.3 The Case of a WMC in Printed Circuit Board Sector, Bangalore

H.N. Chandrasekhar, Energy Economy and Environmental Consultants (WMC - Facilitator)

6.3.1 Introduction

The market for electronic goods has witnessed a tremendous growth in the last 3-4 decades. The global IT and electronics hardware industry is has been surpassing automobile sector as a driving force for economies.

The Printed Circuit Board (PCB) – which is an outcome of the miniaturization efforts in the electronic industry - acts as the integrated circuit which also serves as the physical support for mounting appropriately specified electronic components such as chips, transistors, diodes, resistors etc, positioned to a suitable design to make the goods work such as personal computers, television sets, radio and music systems, mobile phones, printers etc. Plate 6.1 depicts a typical PCB.

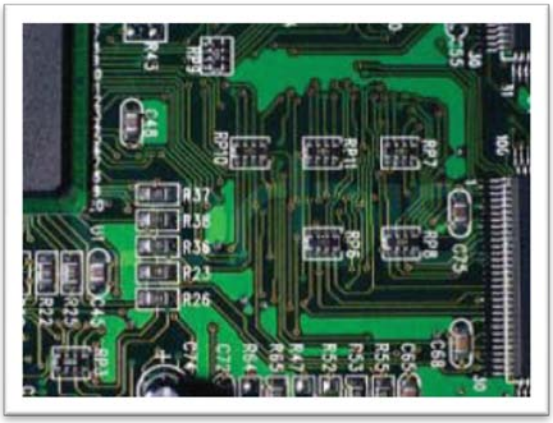


Plate 6.1 : A typical Printed Circuit Board

The conventional manufacturing of PCB's particularly involves a wide range of physico-chemical processing stages which leads to generation of substantial quantities of solid and liquid wastes. The WMC project provided and led to the establishment of 2 Nos WMCs in the PCB sector at Bangalore with spontaneous cooperation of the participating units.

6.3.2 PCB manufacturing process

The development of a printing circuit pattern in copper on the board (called Base), is normally undertaken through potentially two approaches, namely the additive and the subtractive approach. In additive approach the copper metal is deposited through appropriate metal deposition techniques to a required pattern on the bare board. Where as in the subtractive process, copper cladded laminate (i.e. the base on which a uniform layer of copper is already laminated) is subjected to various chemical and photochemical treatments so that only required pattern remains on the board. The subtractive approach is most widely used as it is relatively simpler in the process technology aspects besides being advantageous as it gives patterns with more consistent thickness in terms of copper wire circuits and with better electrical properties.

An overview of the generic steps in manufacturing PCBs is presented as a flow chart at Figure 6.3.

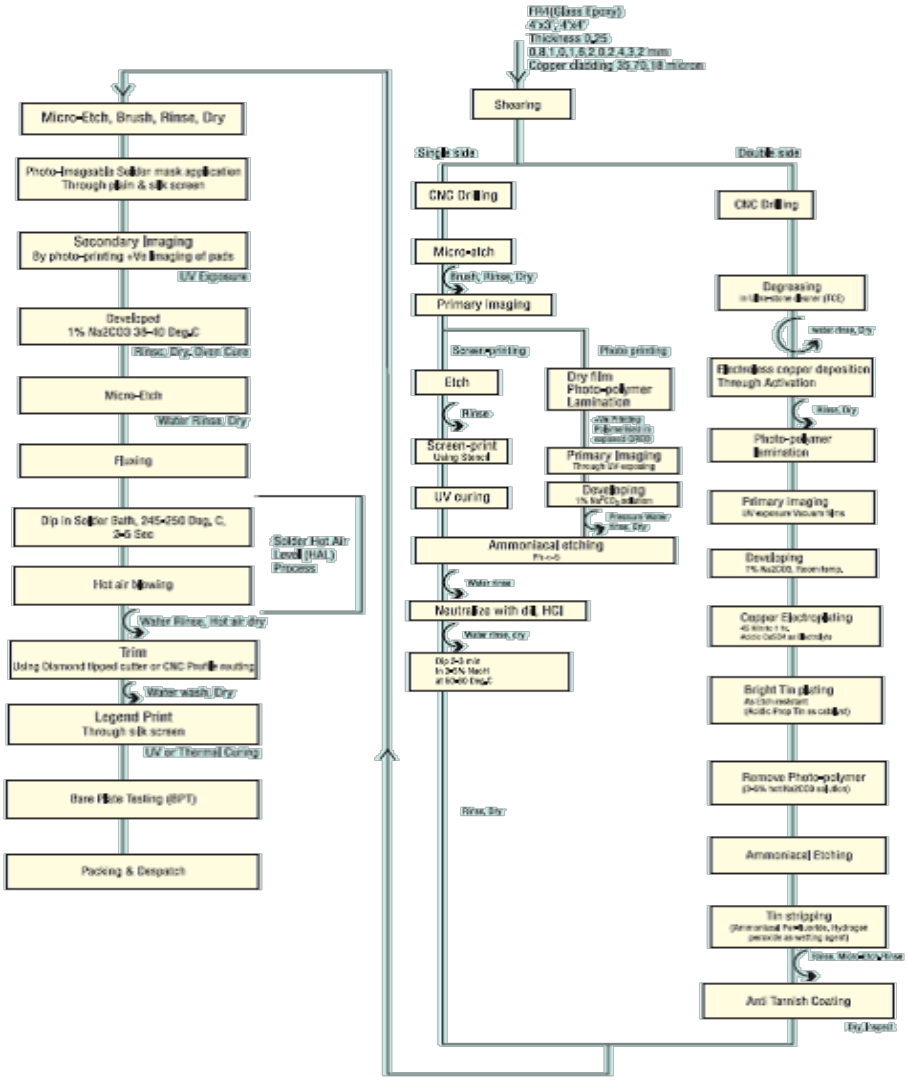


Figure 6.3: Flow Chart on PCB Manufacturing Process

The PCBs are generally categorized as single sided, double sided, multilayered etc., and manufactured as per the design, functional and technological requirements of the electronic goods. The statistics available from worldwide productions indicate 63% of PCBs to be multilayered, 18% as double sided, 10% as single sided and 9% as flexible. In our country the single sided and double sided PCBs are high volume products with a growing trend towards the manufacture of multilayered PCBs,

6.3.3 Waste Minimisation options

1. V-grooving of PCBs

V-grooving on a panel is analogous to the track of holes on the stamp sheet or in writing pads. A groove line will assist in easy separation of PCBs in the end and saves lot of panel space. The spacing between the individual PCBs can be thereby reduced to 0.3 to 0.4 mm instead of the 3 to

5 mm being provided in the conventional method. M/s UV circuits has been able to switch completely to V-grooved product through sustained efforts and are able to save about Rs. 20 lakhs per annum through this option alone.

2. Segregation of the chelating agent containing streams

Chelators are employed to allow metals to remain in solution beyond their normal solubility limit. Ferrocyanide, Ethylene Diamine Tetra Acetic Acid (EDTA), phosphates and ammonia are the common chelators used in PCB process baths. They enhance the cleaning, metal etching and selective electroless plating processes. Once the chelating chemical enters the waste stream, they inhibit the precipitation of metals and additional treatment chemicals must be used. These chemicals further end up in the ETP sludge and contribute to the volume of hazardous waste to be disposed. The process of segregation of these chelate containing streams is being successfully attempted in the units for appropriate treatment resulting in cost savings in the treatment process. An initiative for the use of non-chelate process chemicals instead of chelated chemicals would further reduce the generation of hazardous waste and related problems associated with them.

3. Drag out minimization

It has been estimated that approx. 15-20 ml of dragout occurs for processing about 1 square foot of PCB panel. This means for a PCB unit manufacturing 400 sq. m per month mainly using manual labour in the process, about 64.46 litres of total drag out per month is generated.

Increasing the withdrawal time for critical baths can control dragout of expensive chemicals and reduce wastage. The thickness of the film on the board depends inversely on the withdrawal time and more the withdrawal time, less copper ions are made to pass through a selectively permeable membrane and deposited and recovered on the cathode. The focus was to achieve about 11 feet /min of withdrawal rate could be maintained. A sufficient drain time can further reduce the drag-out. Through efforts in this regard about 40% of the dragout reduction was attempted.

4. Etchant & Copper recovery from spent etchant-

Electrodialysis process can be employed for the separation and recovery of etchant and copper present in the spent etchant. This is achieved by circulation of required volume of etchant in the appropriate compartments of the multi-chambered electrolytic cell designed for the purpose, whereby copper ions are made to pass through a selectively permeable membrane and deposited and recovered on the cathode. The purified and regenerated etchant in the other alternating cells is recovered when it achieves appropriate strength and desired chemical characteristics and sent back into the PCB process. M/s NSP Electronics have implemented the option with assistance from Central Electrochemical Research Institute (CECRI) and the salient parameters and cost savings are indicated in table 6.5.

Table 6.5: Salient Feature of Etchant Recovery System Installed at WMC unit

Salient features of Etchant recovery system installed at a WMC unit (Estimated Results)			
Sl	Details	Unit	Qty
1.	Copper recovered per annum	Kg	1400
2.	Etchant saved per annum	Tonnes	420
3.	Operating cost of etchant regeneration per annum	Rs. in Lakhs	12.6
4.	Savings from etchant regeneration	Rs. in Crores	3.6
5.	Revenue from selling copper	Rs. in Lakhs	2.2
6.	**Net savings being achieved per annum**	**Rs. in Crores**	3.5

Additional WM options included :-

5. Minimizing the bath chemical concentrations; 6. Using UV filters instead of transparent yellow covers in dark rooms; 7. Reuse of spent ink-stripper ; 8. Evaporation loss prevention; 9. Reuse of rinsing waters and recycling other treated water streams ; 10. Fog-nozzles for rinsing etc.

6.3.4 Conclusion

The Waste Minimisation Circle initiative in the PCB sector has yielded significant results. It has led to building a better awareness of the existing waste generation scenario and on the possibilities of improving the production processes to minimize waste, in improving working conditions and in deriving economic benefits.

6.4 WMCs in Steel Re-Rolling Units at Indore and Nagpur

Navin Goyal, Arvind Tiwari, Arun Radke, Essen Energy Technologies Pvt. Ltd., Indore

6.4.1 Introduction

In India, the production of 1.0 Ton of crude steel from iron ore generates about 1.2 Ton of solid waste, 2.5 Ton of carbon-dioxide and other pollutants. The small scale steel re-rolling mill sector constitutes a link in the overall supply chain. There are over 1500 such units which employ high energy and waste intensive processes. The direct energy use in this sector includes heating fuels principally coal, and electrical energy and is estimated at 25-30% of overall production cost. There are further indirect energy losses in view of scale loss and low yields. The essential aspects of production process is depicted in Figure 6.4.

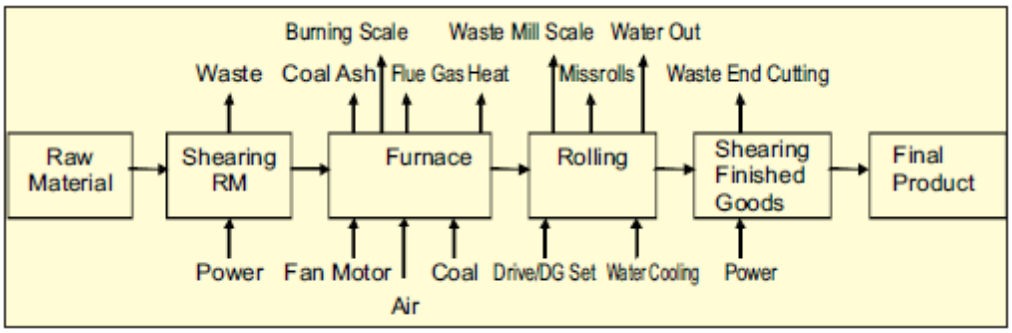


Figure 6.4 : Process chart of steel – re-rolling units

The key areas of focus included :-

- End cuttings, raw materials, finished products
- Burning loss in furnace and mill scale during rolling
- Electrical energy consumption
- Coal consumption, miss roll, roll consumption
- Overall maintenance including down time and equipment availability, manpower costs etc.

6.4.2 WM initiatives

In the course of the WMC activities various tests and assessments were carried out which included – motor efficiency, belt alignment, V-belt design, pump performance including testing of Normex foot valve, furnace insulation study, furnace flue gas analysis, roll surface temperature study and coupling assessments.

A few indicative examples include :-Assessment of motor efficiency in a unit as depicted below.

Table 6.6 : Motor efficiency test results in a WMC unit

Electrical Motor Name Plate Details

Sr. No.	Equipment & Location	Motor Sr. No	Make	Frame Size	Rated KW/HP	RPM	V	FLC	Phase	Insu. Class	Full Load Eff.	Remarks
1	Rough Mill Main Motor		Kirloskar		470/630	630	440	900	3	B	92%	

Motor Dimensions

Sr. No.	A-Cross Distance	B-Long Distance	L-Overall Length	D-Shaft Dia	H-Shaft Height	Frame Size
1	834mm-37 Inch	810mm-32Inch	2340mm- 92 Inch	110mm	546 mm-21Inch	

Motor no Load Reading

Sr. No.	Equipment & Location	Phase	V	Amp	PF	KW	Hz	KVARD	Start Time	KWH	Stop Time	KWH	KW (calc.)
1	Rough Mill Main Motor	R	425.4	75.6	0.738	0.170	49.5		10:47:30	23.9886	10:53:30	24.003042	0.14442

Motor Resistance

Sr. No.	Equipment & Location	Resistance R-1	Resistance R-2	Resistance R-3	Temperature ^{0}C	Remarks
1	Rough Mill Main Motor	16.1	16.3	16.5	35.2	

Calculated Motor Efficiency :79.03% Net Efficiency loss 12.97%
Average Annual Loss :Rs. 25,21,800 [6000 R Hrs; Rs. 5 / - Per Unit]

It is observed that in Re Rolling Sector , all the major motors are of high rating and are working at low voltage ; invariably , motors of rating 200 HP and above should be of high voltage viz 3.3 KV / 6.6 KV / 11 KV . High voltage motors should normally be installed to reduce the transients & harmonics in the electrical power system , besides , the copper loss is reduced to a large extent due to low current range .

(b) Belt Alignment was undertaken with the help of Laser beam instrument – the latest state of art technology which gives savings ranging from 5 to 15% ; the conventional belt alignment with tie cord , when is considered okay , has error between 5 mm to 50 mm depending on the center to center distance between the pulleys. Towards providing technical design data inputs to the circle members , technical expert of Vee Belt was invited from M/s Fenner India Ltd., Indore office to note major mistakes in the selection and installation of the vee belts at site . Vee Belt design was picked up after the technical session and two units modified their installation to generate electrical energy savings .

(c) Assessment of material composition of couplings and comparisons for couplings from different supplier regions

Table 6.7: Results of tests of couplings procured from different regions and desired values for Cast Iron and Mild Steel

SN.	C%	Mn%	Si%	P%	S%	Cr%	Ni%	Al%	B%	Cu%	Ti%	V%	W%	Fe%	Pb
A1	>4.500	0.436	0.824	0.153	0.403	0.019	0.111	0.005	0.005	0.04	0.016	0.005	0	93.417	
A2	>4.500	0.469	0.722	0.158	0.435	0.018	0.108	0.005	0.005	0.32	0.018	0.004	0.003	93.229	
A3	>4.500	0.523	0.663	0.141	0.472	0.018	0.107	0.005	0.006	0.028	0.017	0.004	0.007	93.048	
A4	>4.500	0.46	0.67	0.244	0.474	0.021	0.108	0.005	0.007	0.028	0.018	0.006	0	93.296	
B	3.864	0.442	1.032	0.341	0.204	0.722	0.107	0	0	0.07	0.028	0.012	0.054	93.102	0.024
C	3.655	0.254	0.582	0.251	0.151	0	0.1	0	0	0.088	0.016	0.002	0.046	94.892	0.027

A : Faster failing coupling; B : From local foundry; C : From Mandi Gobindgarh

Desired Values: Cast Iron

C%.	Mn%	Si%	P%	S%	Cr%	Ni%	Al%	B%	Cu%	Ti%	V%	W%	Fe%	Pb%
3.0-3.5	0.80-1.0	0.80-1.20	0.02-0.05 Max	0.02-0.05 Max	0.35-0.50	0.1-0.15	Nil	Nil	Nil	Nil	Nil	Nil 97.5		Nil

Desired Values: Mild Steel

C%.	Mn%	Si%	P%	S%	Cr%	Ni%	Al%	B%	Cu%	Ti%	V%	W%	Fe%	Pb%
0.15-0.20	0.55-0.065	0.30-0.35	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	98.8	Nil

It is to be noted that alloying elements provide following properties :- Mn – wear, hardness, toughness; Si – de-oxidiser and magnetic property; P – increases brittleness; S – damages machining property; Cr – resistance to corrosion + improvement in hardness; Ni – increases toughness and impact strength; Al – checks oxidization and promotes grain refinement; B – increases hardenability; Cu – improves pearlitic structure; Ti – increases austentic hardenability; V – increased strength by retaining ductility; W – impact hardness and wear resistance; Pb – machineability

It is to be also noted that coupling should have good toughness but less hardness. Notch should be provided at one of the joining point from where the coupling shall fail. Normally coupling would fail longitudinally. SG iron provides good toughness. Reasons for failure of couplings include aspects such as material, stress concentration due to sharp corners, grain structure issues, heat treatment inadequacies etc. It is however important that it is better for coupling to fail than rolls to break.

Figure 6.5 A few pictures / plates from the WMC

			
Trolley for transporting billets over rails for better material handling	Normex foot valve installation for cooling water pump	New Laboratory equipment in a unit at Nagpur	A WMC meeting in progress at Pithampur

6.4.3 Conclusion

A total of 41 WM options were identified in the units of which 10 were implemented by different members. The collective investments made by the group members at Pithampur was Rs. 5 Lakhs and savings accrued in the range of Rs. 30 lakhs per annum (with a group pay back period of less than 2 months). At Nagpur the investments made wa about Rs. 10 lakhs and estimated savings being accrued to member units was in the range of Rs. 80 lakhs per annum. It is indicated that besides the identification of WM options and their implementation the engagement with the WMC project has been an enriching experience. The WMCs received considerable interest, support and patronage from eminent personnel in the respective industry associations and found references in the discourse related to SME developments.

6.5 Hosiery Sector at Ludhiana

6.5.1 Donning the vogue element

Garments made out of cotton and woollen hosiery are fashionable, colourful and stand for comfort. Hosiery is a key element in the vast variety that characterizes the textile sector. India being one of the largest exporters of textiles in the world, it is but natural that hosiery sector accounts for a sizeable chunk of export earnings. Moreover, hosiery sector is fairly widespread and typically represents the clustering phenomenon that is easily identifiable with the growth of Indian Small and Medium Enterprises. These clusters are located in Ludhiana (Punjab) and Kanpur (Uttar Pradesh) in the north, Kolkata (West Bengal) towards east, and Tiruppur (Tamil Nadu) in the south etc.

6.5.2 Focus on Ludhiana

Ludhiana in the state of Punjab is the city that launched the first woollen hosiery unit of India in 1902. Kolkata had already marched ahead as far as cotton hosiery was concerned having got its first cotton hosiery in kidderpore in 1893. The advent of the hosiery sector marked a phase of sustained growth of the textile sector itself, which promised a large variety of employment opportunities. However the industrial slowdown of the 1990's has plucked some of its steam.

6.5.3 Knitting the threads

Both the cotton and woollen hosiery units have common shortcomings. The units continue to be propped up on what is now considered obsolete and inefficient technology, continue to rely on largely untrained and unskilled manpower, continue to waste precious resources effusively. These units are highly water intensive, consuming water @150-250 m^3/ton of fabric processed. Further, almost 70% of the input resources like salts / chemicals & auxiliaries / dyestuffs etc., that go into hosiery processing find their way into the waste stream. It has indeed been a leaky case 'hosiery unable to grip the hose' and the numerous constituents that go with it– alkalies, detergents, dyestuffs, acids, solvents, starches, gums, oils etc.

6.5.4 Charting the WMC course

A close look at the industry and common operating practices showed potential for corrective action. To make an assessment and to demonstrate the possible benefits through a Waste Minimisation (WM) assessment process, NPC undertook the establishment of one of the first 15 Waste Minimisation Circles of India in the Ludhiana Hosiery sector in 1995-96. This was a WMC, which unequivocally contributed to the success of the pilot project on establishing and running Waste Minimisation Circles as a new partnership approach to growth. Partnership between entrepreneurs, between government and private sector, between professionals and businesses.

In those early days 5 hosiery units of Ludhiana responded to NPC's call to team up and Mr. Rajat Sood of 'Oriental Dyeing and Finishing' provided the momentum it deserved.

6.5.5 Tapping the WM potential

The WMC moved in top gear for 2 years (the bond that cemented 5 members together holds sway even today). The findings were a revelation. Each unit went for implementing solutions and benefited. The identified potential for WM is reflected in the table below.

Table 6.8 : Potential for Waste Minimisation in Hosiery Sector

ITEM	UNIT	POTENTIAL OF WASTE MINIMISATION Quantity	Value (Rupees/Ton of fabric processed)
Production / Yield	% increase	20-30%	350-500
Specific Chemical & Dye Stuffs consumption (kg/T)	% decrease	10-40%	1000-4000
Specific Water Consumption	m3/T decrease	50-100	25-50
Specific Fuel/coal consumption	Kg/T decrease	200-800	400-1600
Specific Energy consumption	KWH/T decrease	30-60	100-200
		Potential Savings Rs. 2000-5000 /Ton of fabric processed	

6.5.6 The Measures

A total of 176 WM opportunities were identified and 119 of them were categorised as directly implementable. 40 options needed further trials as undertaken voluntarily by the 5 member units in Ludhiana. Broadly the options are categorised as follows:

a) Conservation of water by using low water to cloth liquor ratio machines, optimising the washing rinsing operations, recycling of water from cleaner area to progressively dirtier area and reducing the processing steps.

b) Conservation of fuel by optimising boiler combustion low efficiency boiler with high efficiency FBC boiler, conversion of boilers to FBC, recovery of heat from flue gas, recovering condensate from indirect steam usage and improving the lagging of steam supply line.

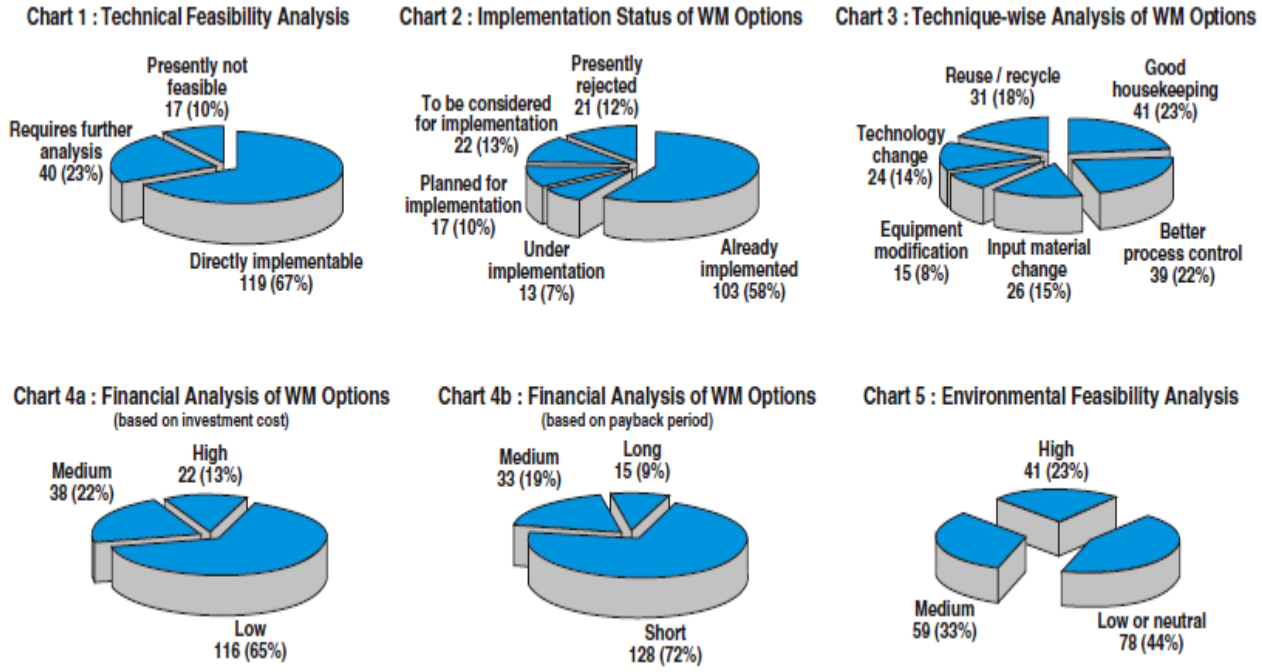
c) Optimising use of auxiliary chemicals & dye stuff. Streamlining the operating practices, dosing procedure, process control, avoiding unnecessary process steps etc.

d) Reduction in pollution volume & load by reducing water & chemical consumption, substitution of chemicals from toxic to less toxic chemicals, optimising dosages and recycling of condensate / cooling water streams.

e) Development of systems for production planning and scheduling, operating procedures for various equipment, introduction of log books for recording consumption and production parameters and the plant / equipment maintenance schedules. Undertaking preventive maintenance, plugging spills and leakages.

f) Reduction in re-dyeing/reprocessing percentage through better fabric pretreatment & process control to avoid dye stripping and reprocessing costs etc.

Figure 6.6: Charts Depicting Details of WM Options Implementation



6.5.6 Gross accomplishments

The WM options were analysed in terms of their environmental and economic impact achieved vis a vis what was anticipated (as a reflection of improvement in environmental and economic performance). Though scope for further rigorous analysis exists the results observed were topical and significant as shown below.

6.5.7 Environmental impact

The estimated environmental impact achieved through implementation of WM measures is enumerated below :

- % reduction in waste water generation : 40 - 50%-
- % reduction in pollution load to the ETP : 35 – 40% (in terms of COD)
- % reduction in gaseous emissions : 10 – 30% (in terms of GHG emissions)

6.5.8 Economic benefits accrued

The economic benefits through the implementation of WM measures in the WMC member units varied from Rs. 16 to 60 Lakhs per annum depending upon the investment made and the payback period achieved varied from 9 to 18 months. In gross terms the units made combined total investment of Rs. 256 Lakhs which resulted in Savings of Rs. 198 Lakhs / annum with a payback period of less than 16 months.

6.6 Rice Millers of Nizamabad

6.6.1 A grain of rice

Rice is one of our staple food items - it is the food of the masses. India is the World's 2nd largest producer of rice (approx. 90 Million tons / annum) . The farmlands of India provide suitable conditions for rice production i.e. fertile land and availability of substantial fresh water. India has the largest land area under paddy cultivation which is roughly 40 Million – Hectares.

The milling of paddy typically produces 65% rice, 22% husk, 6% bran, 3% broken rice and balance comprises worms and wastages. The large variety of dishes prepared from rice are both nourishing and a gourmets delight. Rice is also characteristically a resource intensive product - consuming large quantum of water and energy - right from its farming to milling stage.

6.6.2 The Nizamabad Millers

The 'Rice Millers of Nizamabad' (Nizamabad is a verdant township of Andhra Pradesh situated approx. 170 km from Hyderabad) have for several decades catered to the domestic demand and also contributed to the granaries and export earnings. The state of Andhra Pradesh alone houses over 25000 rice mills. A typical rice mill has a capacity of 20 tpd. Rice milling as part of the agricultural and rural sector for years has received substantial support from both Central and State Governments in the form of subsidies in power, water, taxes etc., and in effect the sector has stood for assured growth and returns. The rice milling community has therefore been an advantaged lot.

6.6.3 Changing times

The scenario over the past decade has changed and the economic viability of the sector is under strain. Besides factors pertaining to changing state policies the very process of milling i.e. existing technology and operational practices have come under the scanner.

Indeed the raw rice and parboiled rice mills are found to be grappling with problems. Problems such as increasing power bills, strictures for better management of large volumes of waste waters and for control of dust emissions, problems arising due to persistence with simpler and obsolete technologies and machinery, and due to continuance of now outdated management practices - a la breakdown management !

6.6.4 Advent of the Waste Minimisation Circle (WMC)

In the above backdrop, Mr. I.V. Ramesh Kumar, a specialist in Energy Management set out to establishing and facilitating two WMCs starting September 1998 - one each in raw rice and parboiled rice mills. He had earlier been equipped with the tools and techniques to be applied in a WMC through a 'WMC Facilitator Training Programme' conducted by NPC. He convinced Mr. B. Vittal Reddy the then President of Nizamabad Rice Millers Association to participate in the program, who in turn persuaded some of the youthful members of the association to join the action. In tandem they all pitched a milestone in the rice milling sector !

The WMC Members (4 member units in each circle) supported by the facilitator committed themselves to a spirit of cooperation in exploring wasteful areas / processes and other growth limiting factors of each of their respective units. Then they collectively set about identifying and implementing Waste Minimisation Options i.e. methods to check wastages and improve process operations. They had thus initiated a journey towards enhanced productivity and growth.

6.6.5 The measures

The units (mill owners and their employees) identified many waste generation areas such as (a) inefficient boiler operations and steam distribution system (b) poor equipment maintenance and usage (c) outdated electrical systems and poor power factor (d) inappropriate equipment power ratings vis a vis load applied and randomness of equipment design and installation (e) poor material handling and storage aspects causing losses of paddy, rice and byproducts (f) improper management of wastewater and boiler ash etc.

They then undertook implementation of a number of waste minimisation solutions. The key measures include (i) installation of modern high efficiency rice husk based boiler replacing old and outdated Lancashire boiler (ii) improved steam distribution system with suitable condensate recovery mechanism (iii) revamping of electrical power distribution system and adoption of failsafe electricals and high tension supply (iv) replacement of rewound motors and installing suitably power rated equipment (v) installation of screw conveyor for optimal feed of husk as fuel to boiler (vi) modification of heat exchanger system introducing copper finned tubes instead of MS tubes (vii) optimisation of consumption of water for parboiling per batch (viii) improvements in dust containment and ventilation system (ix) improvements in material handling and storage in all sections – paddy receipt and storage, milling, rice husk storage / handling, polished rice and byproducts section and despatch area (x) optimisation of parboiling process time through better heat transfer system whereby augmenting plant capacity and utilisation.

Table 6.9 : Specific Indicators for Raw Rice and Par boiled Rice mills

RAW RICE MILLS — SPECIFIC INDICATORS

S. No.	Parameter	Indicator
1.	Specific Electricity Consumption (kWh/Qtl)	3.0 to 3.5
2.	Standard Specific Electricity Consumption (kWh/Qtl)	1.6 to 1.7
3.	Waste Generation	Dust, waste husk 2MT/day, rice bran, brokens
4.	Possible power generation by using husk (kW/rice mill)	130
5.	Possible power generation (MW/75 rice mills)	10

Note: 1 Qtl = 100 kgs

PARBOILED RICE MILLS — SPECIFIC INDICATORS

S. No.	Parameter	Indicator
1.	Specific Electricity Consumption (kWh/Qtl)	3.5 to 4.5
2.	Standard Specific Electricity Consumption (kWh/Qtl)	2.6 to 2.8
3.	Specific Steam Consumption (kg/Qtl)	1.3 to 1.5
4.	Standard Specific Steam Consumption (kg/Qtl)	0.8 to 1.1
5.	Effluent Generation for 30 MT/day plant (m^3/day)	40
6.	Waste Generation	Rice husk ash 2 MT/day, dust waste husk 1 MT/day, rice bran, brokens
7.	Possible Power Generation through Cogen (kW/par boiled unit)	130
8.	Possible Power Generation through Cogen (MW/for 65 par boiled unit)	8.5

Figure 6.7 : WMC members from Raw Rice and Parboiled Rice mills at Nizamabad with WMC Facilitator Shri I.V. Ramesh Kumar having installed a new bio-mass fuelled boiler

6.6.6 Gross accomplishments

The two circles identified over 30 WM options and implemented 70% of them within a span of 1.5 years. The units made a combined investment of Rs. 25 Lakhs in implementation of the options and accrued nett savings worth Rs. 30 Lakhs per annum with a payback period of less than 10 months. The enhancement in production capacity of the WMC members is further estimated to be worth Rs. 1 Crore per annum.

Other achievements include (i) reduction in electricity consumption by over 2 Lakh units per annum (ii) improved management of over 2000 tonnes / annum of rice husk previously wasted and inefficiently burnt (iii) reduction in consumption of approximately 2.5 million litres / annum of water resulting in reduced wastewater management problems (iv) reduction in steam generation requirements by 25% and (v) reduced dust emissions to a factor of 50%.

The most significant achievement of the WMC has been the inculcation of a scientific temperament coupled with a spirit of cooperation. The willingness to address common problems

and undertake innovative efforts for mutual benefit and the desire to continue the same in future augurs well for the rice millers of Nizamabad.

6.7 Electroplaters of Pune

6.7.1 Imparting sheen - The art of metal finishing

Metals are today a pillar of our existence both literally and figuratively. Whether seen or unseen they simply surround us in many forms. Be it housing and construction, electronics and communication, transport, white goods and home furnishings, kitchenware, jewellery etc., they have decisively found their way into our lives.

It goes to the credit of the metal finishing industry that the metals we get to see are presentable, neat, beautiful and bright. Metal finishing per se amongst other things imparts beauty and corrosion protection. There are different ways and means to do it – viz. electroplating, painting, powder coating etc.

6.7.2 Electroplating in Pune

Electroplating as an industry is widespread and practiced in most industrial townships in India. Pune, a vibrant and youthful city in the state of Maharashtra however is an electroplating megapolis. The city and neighbouring townships are endowed with a large industrial base having well entrenched automobile and engineering conglomerates (e.g. TELCO, Bajaj, Mahindra's etc. and their ancillaries) which provides an ideal setting for electroplating industry to grow and sustain.

Over 250 electroplating units are established in the SSI sector in Pune alone with a gross annual turnover of over Rs. 25 Crores. They mostly undertake job work and fixed contracts. They span a great variety - undertaking a range of electroplating processes such as alkaline Zinc, acid Zinc, Ni-Cr plating, plating with Pb, Sn, Ag, Cd, Cu etc. Whether as organised or unorganised sector, proprietorship or partnership firms, with systems and operations either mechanised, partially mechanised or wholly manual, they are all diligently engaged in the art of electroplating.

6.7.3 Broaching a WMC

As elsewhere problems pertaining to the electroplating sector has chased the electroplaters of Pune as well. They are increasingly being pressed to address problems pertaining to treatment and discharge of large volumes of wastewaters bearing unrequited heavy metals and toxic chemicals. Furthermore, growing competition, declining profitability attributable mainly to production losses and process inefficiencies, product rejects and quality control factors etc., are driving them into undertaking urgent corrective action. However, there are hindrances and they are compounded by the fact that a major chunk of the units (almost 80%) lack strong and indepth knowledge of the process chemistry that is fundamental to their trade.

Mr. R.C. Mahulkar, a consultant previously experienced in matters pertaining to public health engineering decided (with NPC's support) to introduce the concept of Waste Minimisation Circle to a group of willing and forward thinking electroplaters. He fuelled the sublime desires of each entrepreneur. He exhorted them (a) towards undertaking analytical self and externally aided introspection of their units to curtail expenses and enhance profitability (b) to participate in a small forum of fellow businessmen in openly and collectively exploring development and innovations in their trade (c) for sharing of experiences in identifying and overcoming process deficiencies (d) towards establishment of a network of receptive and reliable friends for support and mutual benefit, say for collectively bargaining for cheaper raw materials from suppliers and offering optimal / appropriate sales prices regarding standard electroplating services to buyers (e) to jointly analyse implications of changing government policies / notifications impacting the industry and to make suitable representations where required (f) to join a national network of industries which have initiated exploration of new developments under the MoEF sponsored / NPC executed 'WMC project'.

Eight entrepreneurs teamed up and galvanised into action. They achieved spectacular results and the WMC project won new spirited advocates.

6.7.4 The Measures

The members put their heads together, explored a number of problem areas and their potential causes in each member unit and identified and implemented solutions as enumerated below.

(i) Re-contracting and reducing the Maximum Demand Load for their units with the Electricity Board resulting in 15-20% reduction in energy bills (ii) Experimenting with and adopting low concentration Cyanide-Zinc baths for Zinc plating [i.e 30-35 gpl CN^- & 15-20 gpl Zn instead of 75-90 gpl CN^- & 45-50 gpl Zn] whereby reducing chemical losses and pollutant concentration in wastewater besides reducing the treatment costs (iii) Modifying chemical dosages / concentrations in passivation processes and achieving upto 50% savings in chemical cost while maintaining the quality of passivation through better process control (iv) adopting sandwich type clamping of bus bars to electroplating baths / lugs replacing the traditionally used "nut & bolt" joints to reduce electrical energy losses (v) implementation of cascading rinses and suitable water conservation measures where not already existing

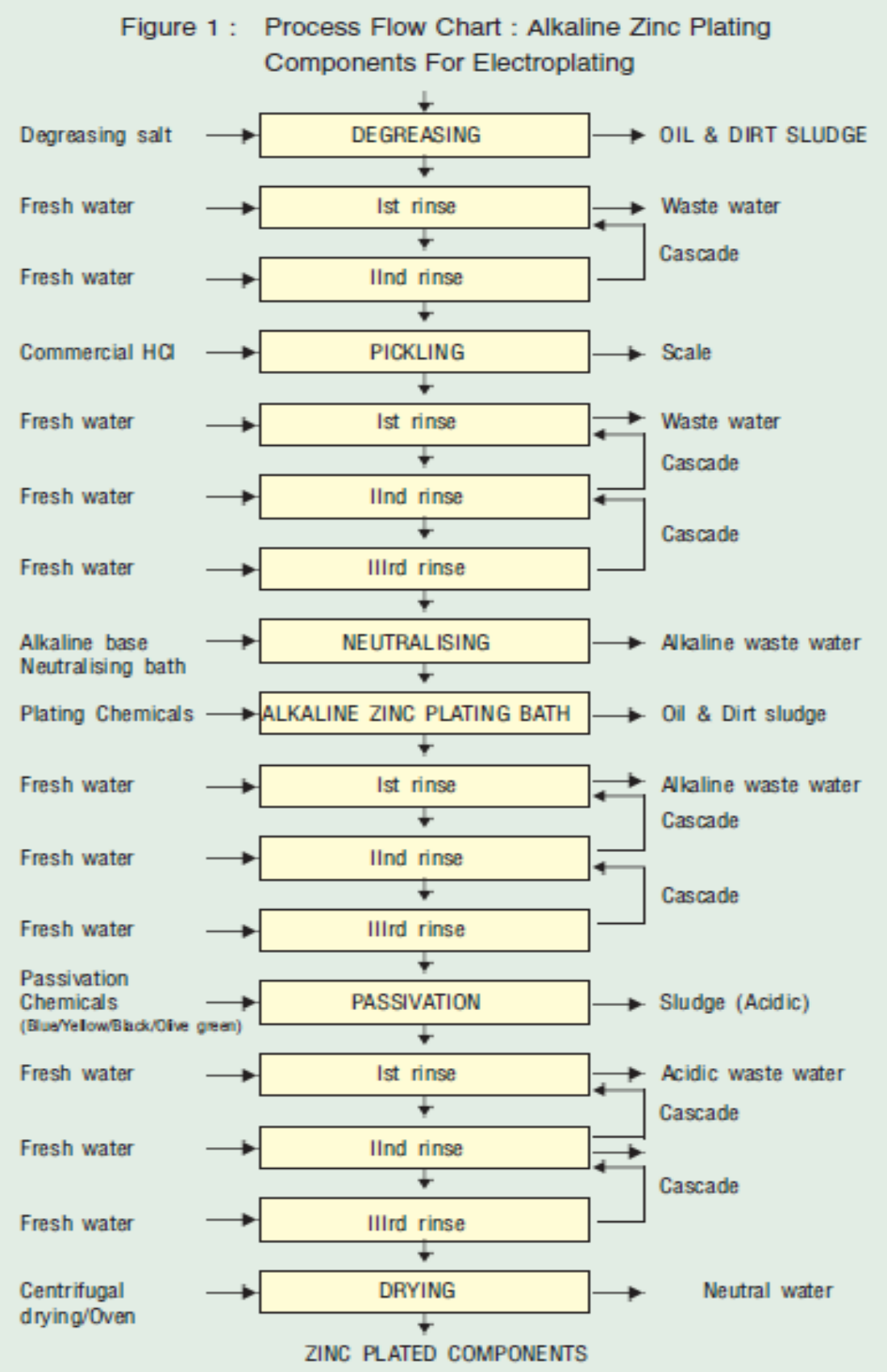


Figure 6.8 : Typical Process Flow Chart for Electroplating

Table 6.10 : Key indicators on resource consumption and profitability

Table 1 : Resource Cost and Profitability indicators		
Sl.	**Particulars**	**% of Sales**
1.	Power	10 to 15
2.	Water	1 to 2
3.	Wages (Labour)	8 to 10
4.	Salaries (Supervisory & Management)	1 to 2
5.	Metal, Chemicals & Fuel	
(a)	Metal	8 to 12
(b)	Kerosene / Diesel / Fuel	5 to 8
(c)	Salts (eg. NaCN, NaOH, ZnO etc. & for Degreasing	10 to 12
(d)	Brightener	1 to 2
(e)	Passivation	3 to 5
6.	Other Consumables	2 to 3
7.	Misc. incidental expenses	3 to 8
8.	Overheads & office expenses	33 to 13
9.	Net profits	15 to 8

(vi) Making arrangements for continuous removal of floating oils / greases from degreasing tanks to avoid contamination of downstream baths (vii) installing suitable dimmer / variat for maintaining voltage in baths at 6-6.5 V instead of at 7.5-8.0 V (viii) installing timers / alarms for maintaining plating consistency and quality whereby optimising process operations and reducing chemical losses (ix) Undertaking suitable modifications in plant layout to facilitate easy material handling and reducing cross contamination in baths (x) Repositioning rectifiers / electrical switches and installing new cables to ensure convenience to workers for controlling plating operations (xi) installing suitable fume extraction and ventilation systems complete with ducts, blowers and scrubber (xii) Installing bus-bars of appropriate size / KVA capacity to optimise energy consumption (xiii) making suitable changes in lighting / illumination for better visibility (glass fibre roofings for more daylight and suitably rated and positioned tubelights for 2^{nd} shifts) - resulting in reduction in rejects through improved visual inspection of components in process etc. (xiv) installation of suitable acid proof flooring and constructing appropriate drainage channels for segregation and treatment of wastewater streams that require treatment at ETP (xv) applying heat insulation system (using construction brick and mud lining) for degreasing tank and experimenting with gas / diesel as fuel for heating the furnace while replacing traditional wood fired system (xvi) experimenting and adopting the addition of suitable detergents for degreasing operation for better efficiency and cost economics (xvii) undertaking informal training of operators and workers along with supervisors during group visits to each member unit and also inviting and discussing forthcoming suggestions from workers for implementation etc.

6.7.5 Gross accomplishments

The circle members implemented 80% of the identified options within a span of 1.25 years. The units made a combined investment of Rs. 10 Lakhs in implementation of the options and accrued nett savings worth Rs. 25 Lakhs per annum (including enhancement in production capacity for certain product streams) with a combined payback period of less than 6 months.

Other achievements include (i) reduced electrical energy consumption upto 30% (ii) reduced wastewater generation by 20% (iii) reduced toxic Load (example CN^-) to ETP by 30-40% (iv) improved shop floor environment through ventilation systems for fugitive emissions and better plant layout for better operations on shop floor (v) reduced consumption of various chemicals from 20-40% for similar quantum of output and without affecting quality of plated / passivated components etc.

The most significant achievement of the WMC has been the accolades received from the Pune Metal Finishing Association and the demand for an encore by the electroplating community of the region.

6.8 Wall Tile makers of Morbi-Wankaner

6.8.1 Ceramics – The moulding of earth

The tale of ceramics is the tale of human history – as important remnants of our past they have served as clues to the ancient way of life. The terracotta artefacts and bricked townships of Harappa and Mohenjodaro, the pottery works that spread across continents of Africa, Asia and Europe and many tablets scripted with evolving languages for communication during those times etc. are all indicators of the role of ceramics and refractories in the civilization of mankind.

This sector represents both artwork and advanced engineering today. It is characterized by the ability to give varied shapes to appropriate mixes of earthen material and minerals through the use of heat energy for making products with applications in a multitude of industrial and commercial sectors. Be it architecture and décor, metallurgy and chemical technology, power generation and distribution, electronics and space exploration, ceramic materials have made many things possible as we know them today. The commonly known contemporary products include grinding wheels, refractory bricks, tableware and crockery, stoneware and sanitaryware, tiles and murals, electrical components, insulating media, tower packing materials etc. The state of Gujarat is home to the burgeoning ceramic sector of India. Over 900 Small and medium and over 10 large scale ceramic units are established in 3-4 townships here (Ahmedabad, Thangadh, Morbi-Wankaner, Himmatnagar etc.).

6.8.2 Glazed wall tiles of Morbi-Wankaner

Morbi-Wankaner region is one of the key areas of Gujarat where Ceramic sector has developed and progressed. There is a concentration of about 175 units consisting of 50 sanitaryware, 100 glazed wall and floor tile units, another 25 units making speciality ceramics and about another 200 roof tile manufacturers. The installed capacity for ceramic tiles at Morbi-Wankaner is approximately 4 Lakh tonnes per annum and the capacity utilization is ranging between 70-80%. The worldwide production of ceramic tiles is approximately 5071 million m^2 and India accounts for 1.9% of world production.

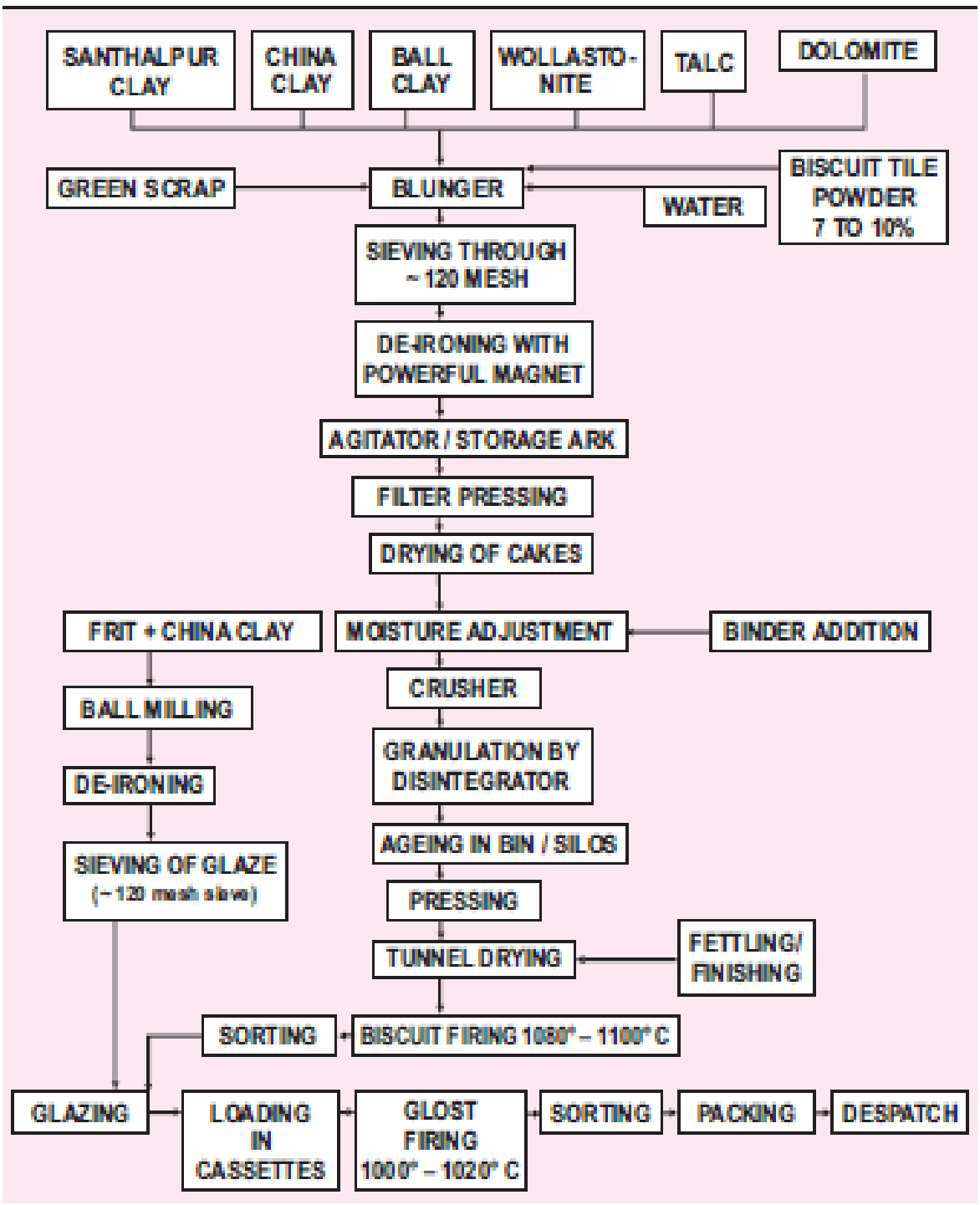


Figure 6.9 : Flow sheet for manufacture of ceramic glazed wall tiles

Figure 6.10 : Hydraulic press for pressing tiles

6.8.3 Sector bottlenecks

As in other sectors there are problems that plague ceramic industry in the country and at Morbi-Wankaner. The sector is energy intensive and is affected by fluctuations in supply and price and quality of fuels. Further the quality of produce is dependent on the quality of raw materials and technology deployed which is largely labour intensive, inefficient and outdated. The results are obvious – low capacity utilization, lesser percentage of 1st quality goods, higher levels of waste generation.

The other factors that contribute to the above scenario include use of non-standard and inconsistent raw materials, inefficient and improper processing methods and poor process control, obsolescence of technologies, lack of awareness of energy efficient technologies, improper and faulty firing schedules, total lack of awareness on good housekeeping, non-utilization of fired ceramic wastes, and inadequate training of personnel engaged in manufacturing.

6.8.4 Establishing WMC – filling the gaps

At this juncture, in year 2001, the Central Glass and Ceramic Research Institute (a premier Sectoral / Research institute with headquarters at Kolkata) was invited to establish WMC's in

ceramic Sector in India by NPC. Seeing merit in the concept it responded to the call. Further, as CGCRI , Naroda Centre, Ahmedabad had already embarked upon the cluster development programme for the ceramic industry in the Gujarat region, it was easy to recognize the potential in the WMC concept to make their ongoing efforts meaningful and comprehensive. The institute viewed the Waste Minimisation Circle approach as promising as the process would lead to improving productivity, quality enhancement, and contribute to technology upgradation while addressing environmental protection issues in the sector and particularly in the participating units. CGCRI therefore launched into the WMC project in the region and established WMCs for crockery ware (Ahmedabad), sanitary ware (Thangadh) and wall tile making units (Morbi-Wankaner) in Gujarat state.

In respect of glazed wall tile manufacturing, 10 units from Morbi-Wankaner had come on board the WMC project facilitated by CGCRI under the able guidance of Dr. K.N. Maiti, Scientist in-charge at Naroda centre, Ahmedabad.

6.8.5 The efforts undertaken

Through the period 2002-2003 the WMC activities at Morbi-Wankaner moved from strength to strength. Initiating with discussions and comparisons of existing production levels and turnovers, range and quality of products, and specific consumption of raw materials, fuel and utilities etc, the circle members purposefully engaged in detailed assessment of process parameters, quality of raw materials used, defects in products encountered and analysis of causes, operational and design aspects of machinery and equipment, process control aspects and efficiencies of labour and machinery, comparison with benchmarks and best practices etc.

The exploration of causes regarding generation of wastes and losses on account of quality problems led to development of waste minimisation options with identification of appropriate solutions through conduction of experiments and trials at the production scale. The demonstration of good practices and techniques for the sector by CGCRI's scientists in the premises of member units and sharing of knowledge and innovations made by the entrepreneurs, successfully led to implementation of a large number of waste minimisation measures in the units bringing about substantive economic and environmental benefits to the participants.

The measures included taking action in the four major areas – materials, machinery, manufacturing methods and manpower. These included addressing quality aspects of incoming raw material - testing, storage and handling; removing impurities by using appropriate strength magnets and mesh sizes of sieves; control of spillages and ensuring good housekeeping; appropriate sequence of charging of material for blunging and ensuring correct rpm of agitator; assessing quality of water used for mixing the materials and recycling for conservation; checking size and quality of grinding media and ratios (on weight basis) of the mixes for body and glazes and reducing batch timings and conserving electricity; providing appropriate ageing time to the cake; using good quality of fuel for firing and ensuring improvements in firing schedule during biscuit firing and glost firing to reduce firing rejects (consistent with pyro-chemical properties of the materials) besides reworking kiln size / length; using appropriate pressure for pressing tiles; recycling of biscuit pitcher; training the operators and supervisors on good practices etc.

6.8.6 Accomplishments

The units participating in the WMC have reported that - Rejection of green ceramic tiles at the press shop reduced from 6% to less than 2%; rejection of biscuit tiles from the point of biscuiting prior to glazing reduced from 6% to less than 1%; enforcement of process control measures increased the percentage of 1^{st} and 2^{nd} quality production from 70% to over 95% whereby reducing cost of production and raising profitability; recycling of wastewater from filter press effected water conservation upto 30%; solid waste disposal reduced through recycling of biscuit waste and sale of glost ceramic tile rejects for domestic use for roof covering purposes; the efforts have led to savings in fuel consumption upto 15% and 20% in electrical energy also export performance of the units has improved substantially.

The WMC has led to inculcation of better management systems and 6 of the units obtained ISO 9000 Quality certification and all the 10 units have achieved quality standards according to requirements of BIS 13753:1993 and EN 159 specifications.

6.9 Aluminium Utensils at Jagadhari

6.9.1 Aluminium Utensils : A preferred kitchenware

There are over 21 clusters in India where utensils are manufactured and at Jagadhari in Haryana (near Yamuna Nagar) small & tiny industrial units produce utensils made from aluminium, brass and stainless steel using metal scrap, sheets, billets or ingots as raw material. The units use traditional technology and work on small margins and units compete on the basis of cost and credit. In aluminium utensils sector here there are 60 units. It is noted that the units face following problems **:-** Scarcity of unadulterated fuel oil; Scarcity of skilled labour; Non-availability of quality raw material at a reasonable price; Use of inefficient and old technology for production and Low efficiency of production processes. The Energy Management Group NPC took up the WMC action to address prospects of improvements in the willing group of units with scope for multiplier effect in the cluster.

6.9.2 Key production process steps and related improvement perspectives

The figure below highlights the core steps in the production of Aluminium utensils. The raw materials are mainly scrap from different industries and the local market. These are sorted visually and also by using magnets, and some of it is baled for easy handling. The raw material is melted in crucibles of capacity 400 to 650 kg where the average cost of crucible is Rs. 15/kg of crucible weight. The melt temperature is between 730 to 760 ^{o}C, which is beyond recrystallisation temperature. It is advisable to maintain melt temperature in the range of 680 – 720 ^{o}C. The melt temperatures are only occasionally monitored and the expertise and judgment of the operator is relied upon. Degassing is done by immersion of degasser tablets which happens to get localized leading to faults in later stages. Nitrogen gas based degassing would further help the process. Impurities are removed by adding flux and from the dross aluminium recovery is between 50 – 70%. As regards fuel about 60% of the units use oil and balance hard coke. In terms of fuel preparation almost all the units at Jagadhari do not condition the oil to suit burner capability i.e. no preheating is affected. A few units however have provided electrical heater in their day tanks which again is used only during start up and winter season when oil flow becomes a hindrance. It has also been noticed that oil pressure at the burner tip is not sufficient enough to ensure good oil atomisation. The ideal oil pressure at the burner tip should be around 0.5 kg/cm2 i.e. around 15 ft. of height between the day tank outlet and the burner, whereas in most of the units the height is 6-8 ft and the combustion of the fuel is not proper resulting in increase of the fuel consumption. The specific oil consumption ranges between 90 to 120 litres/ton of molten metal.

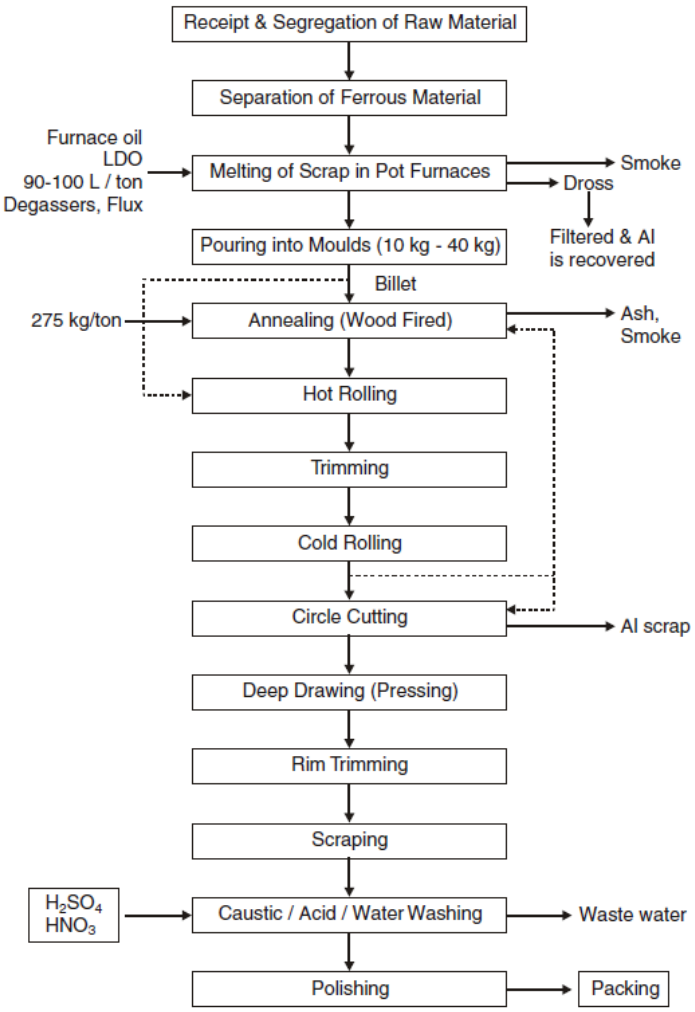


Figure 6.11 : Typical process chart for Aluminium Utensils

As regards pouring and billet making the moulds are made up of cast iron and it takes about 3 - 4 minutes for molten metal to solidify on the mould. The typical mould capacity ranges between 8-42 kgs. (in increments of 2 kgs.) In some units the billets are stacked and transferred directly into the hot rolling mill, whereas in several other unit, the billets are annealed for 2-4 hrs. before the billets are hot rolled. An improvement in mould design to ensure uniform and steady heat dissipation would be to fabricate a mould block containing 2-3 mould with water cooling in between. In respect of annealing it is carried out on rolled sheets that are stacked at the centre of the furnace and burning wood is placed all around. The annealing process usually takes around 6-7 hrs. The temperature maintained in the furnaces ranges between 500- 550 Deg C. The specified annealing temperature is 425-450 Deg C. Measuring temperature is not a standard practice and hence higher than desired temperature is a prevalent feature. Use of inexpensive thermocouples (costing about Rs.2000/-) could be adopted to keep track on annealing temperature. The capacity of the annealing furnace ranges from 1 ton to 2 tons. The draft is achieved through a chimney at the top centre of the furnace with a damper arrangement. In many of the units the chimney is blocked and not functional. The doors through which charge is fed into the furnace are very large in most of the cases, associated with unnecessary heat loss and

increased fuel consumption. The improvements in annealing processes are highlighted in figures below with a reflection on the same in following table.

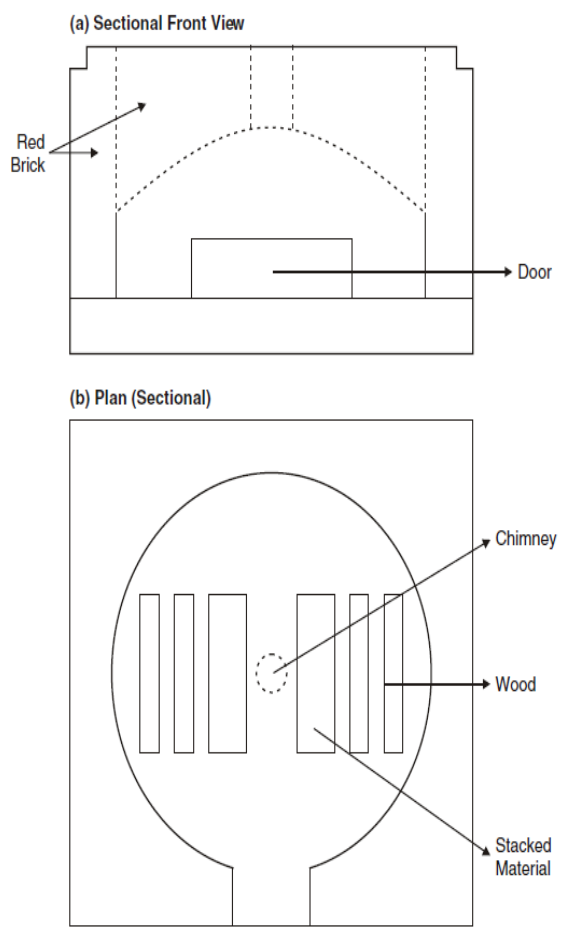
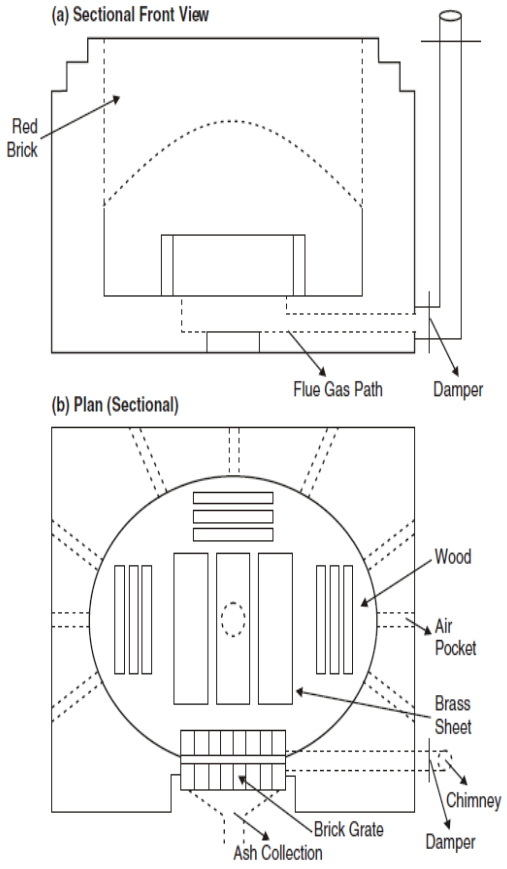
Existing wood fired annealing furnace	Modified wood fired annealing furnace
	

Figure 6.12 : Comparison of Existing and Wood Fires Annealing Furnace

Table 6.11 : Comparison of Existing and Modified Wood Fired Annealing Furnace

Existing Wood Fired Annealing Furnace	**Modified Wood Fired Annealing Furnace**
There is no proper provision for supplying combustion air and the combustion air intake and flue gas exit takes place from the front door through which material is being fed.	Proper flue gas passage provided through the floor of the furnace and provision of chimney with damper, which has created proper draft for the combustion. Separate passage for the combustion air through the side of furnace.
Inadequacies in maintaining & controlling uniform furnace temperature resulting in uneven surface hardness.	Thermocouple was provided so as to know the furnace temperature
Excess temperature resulting in oxide formation in the surface of products. The temperature in the furnace was found to be 500 Deg C & more in some cases, whereas the desired annealing temperature for the aluminium would be around 425-450 Deg C depending on the material composition	Uniform temperature inside the furnace

Advantages of the modified furnace

- Reduction in fuel consumption
- Improved quality of the product
- Improvement in working conditions

As regards hot rolling most of the units have one hot rolling unit with the connected motor drive ranging from 40-60 HP. Some of the units have induction motors and the others have slip ring motors. These are belt driven (mostly flat belt) and very few have V-belt driven pulleys. Invariably the billet is rolled in hot condition and reduction in size affected is usually from the thickness of around 1" to 5-8 gauge in about 6-8 passes. The nature of rolling operation causes intermittent loading on a motor and as a result the motor runs at no-load for at least 70% of the time resulting in drop in motor efficiency during no-load cycle

After hot rolling the sheet develops uneven edges at the ends and these are trimmed away on a shearing machine. Cold rolling machines are powered by induction/slip ring motors of 40-60 HP.

The cold rolled sheets are initially marked for different circle sizes and cut into smaller bits manually for smaller circles and for the bigger circles shearing machines are used. The units employ a small lathe where the cold rolled sheets are cut into circles. On an average, the units maintain at best 25% to 35% scrap from sheets, which would be recycled. Further for deep drawing the annealed circles are lubricated (generally low grade furnace oil is used whereas good quality lubrication oil is preferred) and deep drawn to requisite shaped vessels and plates are formed in presses. Small presses are mechanically operated whereas large presses (250 Tons and above) are hydraulically operated. Most (95%) of the units make medium and small vessels and the press involved are also not above 150 ton capacity. Very often defects initiated at the melting stage, manifest themselves during the pressing stage (as well as on the cold rolling stage) in the form of cracks, pealing off and scratches. In some of the units the percentage rejects that manifest themselves are as high as 10-15%. Further, scraping is carried out using spinners.

In addition is the process of anodising which is a mild electroplating operation where the vessel is the anode in the electrolyte cell and the bath is made off an electrolyte of crystals of H_2SO_4 and HNO_3. However, most of the units do not follow this process and instead dip the vessel in the bath with diluted H_2SO_4 and then diluted HNO_3. The vessels after washing are fine polished using spinners by the use of polishing wheels, which gives the vessels a shining finish before fixing handles etc for packing and despatch.

6.9.3 A summary of waste minimisation endeavours and main accomplishments

1. Units started screening of Aluminum scrap manually and with help of magnets to remove Iron particles and stones etc to improve quality of Aluminum melt there by reducing 20 Kg impurities per day in aluminum scrap yielding better quality products.
2. Furnace oil used for melting is being filtered to eliminate choking of burners. Filtering of Furnace oil reduced down time in repairing burners. The impurities in Furnace oil used to get deposited on crucible, whereby forming scale reducing heat transfer efficiency and also the life of crucible, which is avoided.
3. Slag from furnace is poured against a sloping wall instead of flat surfaces to enable less dense Aluminum in slag to flow down the slope first which is collected and reused.
4. Increasing the height of furnace oil storage tank to 15 ft from the existing 6-8 ft to improve fuel atomisation and thereby increasing combustion efficiency as the above measure has resulted in increase of the furnace oil pressure from 0.2 Kg/cm2 to 0.5 Kg/cm2 in a unit with very marginal investment.
5. The pressure of furnace oil is increased from 0.2 Kg/cm^2 to 0.5 Kg/cm^2 by pumping furnace oil with a gear pump and furnace oil was heated to 90 ^oC by heating coil before feeding to burners to reduce viscosity.
6. Procured a thermocouple to measure melting temperature and thereby adjust the temperature to be in between 680-720 ^oC instead of 730-750 ^oC observed in units which resulted in fuel saving. In addition to fuel saving the maintenance of temperature reduced Hydrogen absorption by Aluminum thereby reducing blister formation.
7. Modified existing annealing furnace to maintain optimum temperature range (i.e to 425-450 ^oC from 500-550 ^oC) to conserve fuel (wood). The new design has resulted in reduction of wood consumption to around 30 %. The reduction of wood consumption resulted in reduced

green house gas emission and less ash disposal hassles. Besides fuel conservation quality of the product was improved due to uniform temperature inside the furnace thereby resulting in defects reduction by 10%.

WMC Project Sample Fact sheets

7.1 WMC – Khandsari

CIRCLE NO : C/01/IPP/01/BIJ
SECTOR : Khandsari
LOCATION : Bijnore
FACILITATOR : IPPCON Consultants

WM options identified / implemented :

Number of WM options identified : 25
Number of WM options implemented : 12

Economic Indicators :

Total investment made (Rs.) : 31,90,000/-
Net savings accrued per annum (Rs.) : 38,90,000/-
Payback period : 10 months

Environmental Indicators :

DG set Fuel (Diesel) consumption : Reduced by 70,000 litres/ annum
Juice evaporation fuel (bagasse) consumption : Reduced by 1500 tons / annum
Lime Consumption : Reduced by 52,500 Kg per annum
Yield improvement : Increased by 172 tons per annum (between 1 to 3.5 % for different member units)

Major Options Implemented:

- Removing top eight inch portion of the cane having very high content of impurities and very less of sugar before crushing.
- Installed fiberliser/hammer mill for cane beating/cracking resulting in increased juice recovery.
- Increased roller diameter by one inch at the beginning of the season.
- Use of Needle bearings in place of Journals
- Increased number of rollers from six to nine (i.e added one more extraction stage)
- Use of DG set exhaust gases for drying of bagasse
- Avoiding overheating of juice and excess consumption of fuel by regular brix analysis at evaporation stage and removing syrup as soon as brix reaches 45

7.2 WMC –Pulp & Paper

Circle No	: C/03/GEC/02/MOD
Facilitator	: Green Enviro Consultants
Sector	: Pulp & Paper
Location	: Modinagar
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 21
No of WM options implemented	: 16

Economic indicators :

Investment made	: Rs 6,85,000/
Savings achieved	: Rs 11,90,000 / per annum
Payback period	: 6 months

Environmental indicators :

1. Reduced water consumption by 800 m^3/day.
2. Reduced fuel (bagasse) consumption by 1800 tons per annum.
3. Reduced caustic consumption by 120 tons /annum
4. Reduced electricity consumption by 6,00,000 units per annum.

Major Options Implemented:

1. Insulated steam lines and digesters.
2. Installed DG sets for continuous running of unit.
3. Reusing condensate water as boiler feed water.
4. Installed high pressure shower in wire & felts.
5. Refining pulp at high consistency.
6. Changed refiner disc design.
7. Reusing back water for pulp washing in potcher in-place of fresh water.
8. Maintaining water pressure in centricleaner at design values for achieving improved efficiency.

7.3 WMC –Refractories

Circle No	: C/04/GEC/03/MUZ
Facilitator	: Green Enviro Consultants
Sector	: Refractories
Location	: Muzaffarnagar
No. of Member units	: 3

WM options identified / implemented :

No. of WM options Identified	: 15
No of WM options implemented	: 14

Economic indicators :

Investment made	: Rs 6, 61,000/- (including cost of DG sets)
Savings achieved	: 14,38,000/ per annum
Payback period	: 5.5 months

Environmental indicators :

1. Reduced wood consumption by 113 tons/annum
2. Reduced electricity consumption by 1,26,150 units/annum.

Major Options Implemented:

1. Installed a magnet to separate Iron from Grog.
2. Wood is used instead of coal in slow firing as wood is cheaper and easily available in local market.
3. Installed temperature gauge in kilns to help workers to maintain requisite temperature thereby conserving fuel, reduced breakage of bricks due to control of temperature fluctuations and improving quality of bricks.
4. Bypassed one pug mill used for mixing of clay.
5. Using flue gas for pre-heating of bricks and removing initial moisture.
6. Mixers, Elevators and Jharna are connected to a single motor through belt conveyor instead of one motor to each of the equipment thereby conserving electrical power
7. Workers were trained on methods for control of dampers to maintain appropriate air to fuel ratio.
8. Installed CO_2 meter to monitor and correct air to fuel ratio.
9. Installed reduction gear box instead of Open and Huge gears to reduce electricity consumption and noise levels.
10. Using waste refractory as grog (broken bricks).
11. Installed DG sets to reduce power costs.

7.4 WMC – Dye and Dye Intermediate Manufacturing

CIRCLE NO : C/05/CIM/01/MUM
SECTOR : Dye manufacturing
LOCATION : Ambernath, Thane
FACILITATOR : Corporate Insight

WM options identified / implemented :

Number of WM options identified : 16
Number of WM options implemented : 12

Economic Indicators :

Total investment made (Rs.) : 62,45,000/-
Net savings accrued per annum (Rs.) : 47,66,000/-
Payback period : 16 months

Environmental Indicators :

Waste water generation : Reduced by 2150 m^3 per annum
Electrical energy consumption : Increased by 34750 units per annum (increased consumption is offset by increased dye yield)
Fuel (HSD) consumption : Increased by 128750 litres per annum (increased consumption is offset by increased dye yield)
COD load : Reduced by 17600 Kg per annum
TDS load : Reduced by 119500 Kg per annum
Caustic Consumption : Reduced by 41000 Kg per annum
H-Acid Consumption : Reduced by 800 Kg per annum
Yield improvement : Increased by 15400 kg per annum (5%)

Major Options Implemented:

- Modified process for Red M8B, Orange M2R Orange H2R to avoid isolation and filtration process steps
- Solar drying of black B liquor before isolation instead of salting and filteration
- Stopped handling of raw material bags with hooks
- Replaced wooden plate and frame filter press by polypropylene filter press
- Made provision for rain water harvesting
- Replaced wooden reactors by rubber lined MS reactors
- Finished product packaging changed from drums to empty raw material bags
- Installed spray drier for product recovery from dye mother liquor
- Installed reverse osmosis system to reduce evaporation cost in spray drier

7.5 WMC –Foundry

Circle No	: C/06/3EC/01/BEL
Facilitator	: Energy, Economy and Environmental Consultants
Sector	: Foundry
Location	: Belgaum
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 14
No of WM options implemented	: 10

Economic indicators :

Investment made	: Rs 1,05,000/
Savings achieved	: Rs 30,000 / per annum + (1,00,000/ assumed savings in paint due to new paint booth and laying tracks)
Payback period	: 11 months

Environmental indicators :

1. Reduced fuel (LDO) consumption by 2800 liters per annum.
2. Reduced electricity consumption by 8600 units per annum
3. Recovered 30% metal from risers and runners
4. Recycling of sand is done reducing fresh sand consumption by 90% and avoided waste sand disposal.

Major Options Implemented:

1. Checking inventory of raw materials daily.
2. Tracks laid upto fettling section which reduced spillages in handling raw material.
3. Installed separate painting booth.
4. Shot blasting of runners and risers to recover 30% metal.
5. Installed hopper for transporting materials reducing labor cost.
6. Procuring Sodium silicate in bulk and reduced costs of procurement.
7. Furnace flue gases are used to heat laddle.
8. Recycling silicate bonded sand.
9. Installed capacitor bank to reduce power consumption.

7.6 WMC – Electroplating

CIRCLE NO	: C/07/CIM/02/MUM
SECTOR	: Electroplating
LOCATION	: Ambernath, Thane
FACILITATOR	: Corporate Insight

WM options identified / implemented :

Number of WM options identified	: 15
Number of WM options implemented	: 10

Economic Indicators :

Total investment made (Rs.)	: 1,25,000
Net savings accrued per annum (Rs.)	: 5,00,000
Payback period	: 3 months

Environmental Indicators :

Water consumption	: Reduced by 35 to 40% (3.5 to 2 and 13.5 to 8.3 m3/day)
Nickel (Ni) consumption reduction	: 85 Kg per month
Chromium (Cr) consumption reduction	: 42 Kg per month
Acid consumption reduction	: 1500 kg per month
Lime (treatment chemical) reduction	: 1500 Kg per month

Major Options Implemented:

- Using vibro machine to physically clean the components and reduce pickling acid consumption
- Provided drag out trays over plating tanks
- Provided hangers on plating tanks to suspend jobs and collect metallic bath drippages
- Adopted counter current static rinse system to reduce water consumption
- Using first stage counter current rinse water for plating bath makeup
- Maintaining plating bath concentrations at minimum

7.7 WMC –Hotels

Circle No	: C/08/ECE/01/BHP
Facilitator	: Enviro Consulting Engineers
Sector	: Hotel
Location	: Bhopal
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 15
No of WM options implemented	: 11

Economic indicators :

Investment made	: Rs 2,07,000/
Savings achieved	: Rs 5,43,000 / per annum
Payback period	: 5 months

Environmental indicators :

1. Eliminated ash generation by 10 tons per annum by using LPG inplace of coal.
2. Reduced electricity consumption by 1,33,000 units per annum.
3. Reduced water consumption by 1100 m^3/annum.

Major Options Implemented:

1. Installed air curtains to reduce heat load.
2. Installed double door system at kitchen to reduce heat load.
3. Changing coal fired tandoor to LPG fired tandoor.
4. Replacing conventional bulbs with CFC's (with diffusion) in lobbiers, rooms and kitchen areas.
5. Reusing vegetables washing water by using potassium permanganate.
6. Using bulky fishes and reduced wastage.
7. Using leftovers, bits of flesh, bones, heads etc for soup, cutlets etc.
8. Optimised timings (running hours) of ventilation fans.
9. Dishwasher is fully loaded before use.
10. Reduced water consumption (flushing) by keeping 1.5 liter bottle in cistern.
11. Reducing water consumption by using compressed air water showers.

7.8 WMC –Distillery

Circle No	: C/11/EPR/01/SNG
Facilitator	: Environmental Protection Research Foundation
Sector	: Distillery
Location	: Sangli
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 6
No of WM options implemented	: 5

Economic Benefits :

Investment made	: Rs 3,00,00,000/
Savings achieved	: Rs 1,30,00,000/ per annum
Payback period	: 2 years 4 months

Environmental indicators :

1. Increased yield of 4000 liters of alcohol per day
2. Reduced COD load in effluents by 6500 Kg per day.
3. Reduced water consumption by approximately 750 m^3/day.
4. Reduced BOD load by 3000 Kg/day.

Major Options Implemented:

1. Technology of distilling alcohol changed from Batch mode to CONTINUOUS "DUAL BIOFERMCEN" mode reducing the spent wash generation by 40% and increased the production capacity by 100% i.e 300 days a year from 200 days a year because of the following Process Benefits.

   i) High fermentation efficiencies in the range of 89-90%
   ii) High ethanol concentration of 8- 8.5% v/v in the fermented wash
   iii) 25% spentwash is used for fermentation process which results in less water consumption
   iv) The filler material is wetted with distillery spent wash water and then composted. In batch process the spent wash water generation is high and the requisite amount of filler material is not available. As a result the distillery is being run for 200 days only. With the new process the reduction in spent wash water helped the unit to run the distillery for 300 days i.e through out the year increasing overall profit.

2. Avoided pre-clarification of molasses.
3. Avoided addition of Bakers yeast.
4. Spent wash water used for composting.
5. Introduced re-boiler system to increase the concentration of spent wash.

7.9 WMC –Paints Manufacturing

Circle No	: C/16/KEC/01/VAD
Facilitator	: Kadam Enviro Consultants
Sector	: Paints
Location	: Vallabh Vidyanagar
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 23
No of WM options implemented	: 10

Economic indicators :

Investment made	: Rs 7,14,000/
Savings achieved	: Rs 14,35,000 / per annum
Payback period	: 6 months

Environmental indicators :

1. Reduced solid waste generated by 4 tons per annum.
2. Reduced emulsifier handling losses by 1,200 liter per annum by using hand pump.
3. Reduced electrical consumption by 19,000 units per annum.
4. Saved 450 liters of solvent by reusing in primer preparation.
5. Reduced COD load in effluent stream by 1000 Kg per annum.

Major Options Implemented:

1. Procured four trolleys for transportation of Raw Material to reduce handling losses.
2. Labelled and marked raw material storage areas for each chemical/pigment.
3. Storing raw materials on wooden pallets placed over tin sheets to recover and reuse spilled raw materials.
4. Procured hand pump to pump emulsifier from barrels rather than transferring the material by tilting the emulsifier container to reduce spillage losses.
5. Installed capacitor banks to improve Power Factor.
6. Changed contract maximum demand with Electricity board from 400 KVA to 300 KVA by one unit and 300 KVA to 230 KVA by other units.
7. Installed a bead mill for white paint to reduce time for mixing and grinding from 24-36 hours to 3-4 hours.
8. Recycling, solvent used to clean paint vessel in next batch.
9. Reusing solvent used for washing hands and testing for Primer making.
10. Sequenced start of operations to reduced peak electricity load.

7.10 WMC –Resin Manufacturing

Circle No	: C/17/KEC/02/VAD
Facilitator	: Kadam Enviro Consultants
Sector	: Resins
Location	: Vallabh Vidyanagar
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 14
No of WM options implemented	: 12

Economic indicators :

Investment made	: Rs 2,07,000
Savings achieved	: Rs 8,31,500 / per annum
Payback period	: 3 months

Environmental indicators :

1. Reduced LDO consumption by 62,320 liters per annum.
2. Reduced xylene leakages by 2050 Kgs per annum.
3. Reduced water consumption by 300 m^3/annum.
4. Reduced oil spillages by 3600 liters per annum.
5. Reduced COD load into effluent by 9360 Kg. per annum.

Major Options Implemented:

1. Reusing "Water of reaction" for cooling after neutralisation.
2. Air -fuel ratio adjusted to achieved CO_2 levels from 7.5% to 9.0% to improve combustion efficiency.
3. Adding fuel additives in LDO to improve combustion efficiency.
4. Plugged leakages in Xylene transfer line.
5. Breaking Gum Rosin blocks by placing them on plastic sheets instead of breaking on ground to reduce losses of rosin by contamination.
6. Charging small size rosin lumps into reactors reduced time of melting from existing 7-10 hrs (the variation of 7 to 10 hours is due to difference in type of resin)by 30 minutes and charging 400-500 Kg initially and then 100-150 Kg after observing that initial load is melted through watch glass.
7. Spillage of oil during transfer to reaction kettle eliminated by providing a baffle in transfer line.
8. Procuring oil (Coconut and Palmolive) in barrels instead of present practice of procuring in 15 Kg tins.
9. Insulated un-insulated flanges and valves in Hy-therm line reducing radiation losses and reduced fuel consumption.
10. Adopted Counter Current Washing for resin trays to reduce water consumption.

7.11 WMC – Pesticide Formulation

CIRCLE NO : C/26/CIM/01/AMD
SECTOR : Pesticide Formulation
LOCATION : Ahmedabad, Gujarat
FACILITATOR : Corporate Insight

WM options identified / implemented :

Number of WM options identified : 14
Number of WM options implemented : 10

Economic indicators :

Total investment made (Rs.) : 5,20,000
Net savings accrued per annum (Rs.) : 9,53,000/-
Payback period: : 6 months

Environmental indicators :

Water consumption : Reduced by 8-10 m^3 per day
Yield improvement : 1% to 2%
Solid waste : 200 drums disposal avoided as the same being sent to supplier for reuse.
Fugitive Emissions : Not quantified however significant improvement in work environment reported.

Major Options Implemented:

- Installed fluid coupling device in dust blenders to start blenders at full load without unloading after power breakdown.
- Installed load cell based packing machine to reduces fugitive technical emissions in work environment
- Replaced mechanical balance by electronic balances in raw material charging section to reduce off-specification products.
- Installed electronic control to stop water overflow from overhead storage tank.
- Purchased technical in 20 Kg drums instead of 200 Kg drums wherein technical can be handled easily and without breaking drums. The empty drums sent back to suppliers for reuse.
- Introduced solvent recovery system
- Technical recovery through spillage control, collection and drum washing solvent use in liquid formulations.

7.12 WMC – Printed Circuit Board Manufacturing

CIRCLE NO	: C/27/CI/02/AMD
SECTOR	: Printed Circuit Board
LOCATION	: Gandhinagar
FACILITATOR	: Corporate Insight

WM options identified / implemented :

Number of WM options identified	: 11
Number of WM options implemented	: 8

Economic Indicators :

Total investment made (Rs.)	: 40,000/-
Net savings accrued per annum (Rs.)	: 9,00,000/-
Payback period	: Immediate

Environmental Indicators :

Solid hazardous waste generation	: Reduced by 900 Kg / annum
Dry film consumption	: Reduced by 240 m^2 / annum
Rejection rate	: Reduced by 4 to 6%
Water consumption	: Reduced by 360 m^3 / annum

Major Options Implemented:

- Procuring even edged laminate sheets to avoid edge cutting waste (approx 5% of total sheets area)
- Implemented counter current rinsing system for PC board rinsing leading to reduced water consumption by 50 %
- Board cutting optimisation using operational research techniques leading to reduced board wastage by 5 to 10 %
- Improved CNC machine loading and operating practices leading to reduction in support spindle wear and tear and rejection rate by nearly 2%
- Implemented a system of quality check at every processing stage so that defective pieces can be separated at that stage and does not go for further processing thereby saving further processing cost on defective pieces
- Implemented 5S concept in the units thus avoiding rejections (2 to 3%) earlier caused by improper placement of tool bits from their respective slots.
- Reduced gap between PCBs during masking by dry film leading to reduced dry film consumption by 5 %.

7.13 WMC – Edible Oil

CIRCLE NO	: C/30/MPC/01/MDU
SECTOR	: Edible Oil
LOCATION	: Madurai
FACILITATOR	: Madurai Productivity Council

WM options identified / implemented :

Number of WM options identified	: 12
Number of WM options implemented	: 8

Economic Indicators :

Total investment made (Rs.)	: 2,15,000/
Net savings accrued per annum (Rs.)	: 5,00,000/-
Payback period	: 6 months

Environmental Indicators :

Fuel (Fire wood) consumption	: Reduced by 20 Tons / annum
Oil loss in filter press mud and floor washings	: Reduced by 52,500 Kg per annum
Yield improvement	: Increased by 10,000 liters / annum

Major Options Implemented:

- Controlled raw material quality by using Moisture content measuring meter
- Seed cleaning to remove husk/dirt/trash which leads to reduced outgo of oil along with this dirt.
- Seed storage system modification to avoid seed degradation.
- Spillage recovery
- Using flue gas to preheat water
- Improved insulation of steam distribution lines

7.14 WMC –Ply Board Sector

Circle No	: C/32/GEC/04/DEH
Facilitator	: Green Enviro Consultants
Sector	: Ply Board
Location	: Dehradun
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 12
No of WM options implemented	: 10

Economic indicators :

Investment made	: Rs 78,00,000/
Savings achieved	: Rs 2,21,00,000 / per annum
Payback period	: 4 months

Environmental indicators :

1. Reduced coal consumption by 440 tons per annum.
2. Reduced consumption of wood by 2,100 Tons per annum.
3. Reduced consumption of electricity by 1,50,000 KWH per annum.

Major Options Implemented:

1. Installed steam traps in all the drying chambers and proper tapering of steam condensate line and proper regulation of damper opening etc., has led to improved drying efficiency and reduced steam & electrical energy consumption

2. Substitution of conventional phenol formaldehyde bonding resin by phenol-rosal resin, to enable the use of oil based preservatives has improved the quality of the ply board, in terms of water resistance property and increase in ply board strength by 33% (>120 hrs. of boiling water resistance as compared to general standard of 100 hrs. as guaranteed earlier). This quality improvement has not only increased the product demand but also net profit margin has increased by 5%, equivalent to about Rs. 6 Million per annum.

3. Management systems were introduced for strict quality control check at various stages of conversion which resulted into reduced rejection rate from 2.5% to 1.0% and second grade (25% depreciated value) from 13.5% to 7%.

4. The second grade product with little modification is converted into an economical product and marketed with a brand name “SANTRO”. This no cost option has resulted into direct savings of about Rs.3.0 million per annum.

5. Wood log procurement was standardised to improve peelable percentage from the existing 60% to 90%, with 10% higher purchase price resulting in increased yield of veneer by 4.5%, of planks by 6%, with reduced wood purchase cost by Rs. 2.04 Million and reduced consumption of wood for the same finished product manufacture by 13% and electrical energy savings of 1,50,000 KWH/annum

6. Production scheduling and segregation of planks reduced side cutting losses

7. Optimised usage of wood baton in door panel frame by matching larger size & smaller size as per production order has resulted into substantial saving in cutting losses.

8. Implemented preventive maintenance schedule and routine sharpening of cutting knives, the trimming losses of veneer and electrical energy consumption could be reduced.

9. Removing of head knots having excess moisture before drying could lead to reduced fuel consumption, reduced electrical energy consumption and increased drying capacity.

10. Maintaining moisture in veneer according to IS standard i.e 8.5% instead of 5% thereby reducing fuel needed to remove extra moisture 3.5%.

7.15 WMC –Edible Oil - Solvent Extraction

Circle No	: C/34/3EC/04/CHT
Facilitator	: Energy, Economy and Environmental Consultants
Sector	: Edible Oil
Location	: Chitradurga
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 6
No of WM options implemented	: 6

Economic indicators :

Investment made	: Rs 8,00,000/
Savings achieved	: Rs 19,00,000 / per annum
Payback period	: 5 months

Environmental indicators :

1. Reduced boiler fuel (rice husk) consumption by 600 tons per annum.
2. Reduced caustic consumption by 6000 Kg per annum.
3. Avoided sulfuric acid (98%)required for treatment by 7400 Kg per annum.
4. Reduced TDS in effluent by 10650 Kg per annum.
5. Reduced water consumption by 6000 m^3/annum.

Major Options Implemented:

1. Recycling Caustic soda lye in refining plant
2. Recycling Waste water from solvent extraction plant.
3. Recycling exhaust steam in solvent extraction plant.
4. Recovering Flash steam and hexane.
5. Introduced physical refining.
6. Recycling treated waste water.

7.16 WMC –Textile Processing

Circle No	: C/35/POU/01/FBD
Facilitator	: Poush Consultants
Sector	: Textile Processing
Location	: Faridabad
No. of Member units	: 3

WM options identified / implemented :

No. of WM options Identified	: 24
No of WM options implemented	: 12

Economic indicators :

Investment made	: Rs 50,000/
Savings achieved	: Rs 4,25,000 / per annum
Payback period	: 2 months

Environmental indicators :

1. Reduced 30% water consumption in print screen washing section by installing pressure nozzles.
2. Reduced fuel consumption by 23.6 Klit per million meter cloth processed
3. Reduced print paste (Black) requirement by 210 Kg per annum
4. Reduced COD load by 300 Kg per annum

Major Options Implemented:

1. Optimised caustic concentration in scouring
2. Installed doctor blades to recover and reuse print paste in dark shades
3. Provided nozzles at the screen washing section to reduce water consumption
4. Provided infrared heater in flat bed printing to reduce electricity consumption
5. Converted four stage static post print washing to four stage counter current washing.
6. Reusing spent mercerizing liquor for scouring and bleaching.
7. Optimised sodium hypochlorite concentration in bleaching operation to reduce hypo consumption.
8. Temperature gauges installed in Jigger and Winch.
9. Hydrogen peroxide stabilizer is added during peroxide bleaching.
10. Avoided bleaching for darker shades.
11. Plugged leakages in steam lines and Jiggers etc reduced steam and chemical losses.

7.17 WMC –Khandsari

Circle No	: C/40/IPP/02/CHD
Facilitator	: IPPCON Consultants
Sector	: Khandsari
Location	: Chandpur
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 60
No of WM options implemented	: 24

Economic indicators :

Investment made	: Rs 12,00,000/
Savings achieved	: Rs 15,35,000 / per annum
Payback period	: 8 months

Environmental indicators :

1. Reduced down time by 20%.
2. Reduced (Fuel) diesel consumption by 9.7 Liters per ton of produce.
3. Reduced (Fuel) Bagasse consumption by 0.9 tons per ton of produce.
4. Reduced Green house emissions by 0.94 tons of Carbondioxide per ton of produce.
5. Improved yield by 0.74-1.2% in different member units.

Major Options Implemented:

1. Selective raw material preparation before crushing.
2. Increased roller diameter with increase in milling rollers from six to nine (increase in extraction stage).
3. Product modification for higher product price realization to suit existing market conditions.
4. Installed Calendriea to increase heat transfer area from 32% to 35% of furnace area.
5. Using black mud for lining to insulate furnace wall and floor.
6. Using recovered heat from flue gases for Bagasse drying, and raising the temperature of bagasse and fresh air with optimised firing practices within permissible limits of existing Rohilkhanda Bhatty design.
7. Scheduled and implemented regular preventive maintenance of Bhatty and plant.
8. Monitoring all process parameters regularly to derive optimum yield.

7.18 WMC – Brass Utensils

Circle No	: C/42/EMD/02/JAG
Facilitator	: NPC – Energy Management Division
Sector	: Brass Utensil Manufacturing
Location	: Jagadhri
No. of Member units	: 4

WM options identified / implemented :

No. of WM options Identified	: 11
No of WM options implemented	: 10

Economic indicators :

Investment made	:1,90,000/
Savings achieved	: 5,54,000/ per annum
Payback period	:4 months

Environmental indicators :

1. Reduced water consumption by 3000 m^3/annum
2. Reduced Furnace oil (F O) consumption by 31,000 liter per annum.
3. Reduced wood (Fuel) consumption by 100 tons per annum
4. Reduced off-specification products by 10%.
5. Increased furnace gate life by 3years i.e; from 1year to 4years.
6. Reduced electrical consumption by 1500 units per annum.

Major Options Implemented:

1. Furnace oil (F O) used for melting is being filtered to eliminate choking of burners. Filtering of F O reduced down time in repairing burners. The impurities in FO used to get deposited on Crucible forming scale reducing heat transfer efficiency and also the life of crucible which is avoided.
2. The pressure in F O burners is increased from 0.2 Kg/cm^2 to 0.5 Kg/cm^2 by increasing the height of F O storage tank to 15 ft from 6-8 ft to improve fuel atomisation and thereby increasing combustion efficiency.
3. The pressure in F O burners is increased from 0.2 Kg/cm^2 to 0.5 Kg/cm^2 by pumping FO with a gear pump.
4. F O was heated to 100 ^oC by heating coil before feeding to burners to reduce viscosity of F O which resulted in better flow of F O and saved fuel consumption by 6%.
5. Cast Iron Grate was installed in mould baking furnace scrapping Brick Grate which increased the life of furnace by 4 years from 1year for brick grate. Also in brick grate while removing ash and un-burnts bricks used to get tilted and damaged blocking the air passages effecting

the combustion efficiency and uniformity of temperature in the furnace which affected quality. These negative aspects were eliminated by using Cast Iron grate.

6. A new energy efficient furnace was installed for annealing resulting in fuel (wood) saving of 30%.
7. Modified existing annealing furnace to maintain optimum temperature range to conserve fuel (wood).
8. Incorporated Star-Delta auto controller in rolling m/c motor resulting in electricity conservation of 5 KWH per day
9. Implemented 3-stage Counter current rinsing system for rinsing pickled Brass sheets and reduced water consumption by 50%

7.19 SAGO/TAPIOCA PROCESSING

CIRCLE NO : C/46/IORG/01/SEM
SECTOR : Sago / Tapioca Processing
LOCATION : Salem
FACILITATOR : Industrial Operations Research Group, Palakkad, Kerala

WM options identified / implemented :

No. of Options generated : 20
No of Options implemented : 12

Economic Indicators :

Total investment made (Rs) : Rs 20,00,000/-
Net savings accrued per annum : Rs 11,00,000/
Payback period : About 2 years

Environmental Indicators :

Reduced energy consumption by 20%
Reduced water consumption by about 30%
Reduced COD load to ETP by 10-15%
Reduced BOD load by 8-10%

Major WM options :

1. Installed screw press for dewatering thippi -reduced water consumption by 25% and recovered starch by 2%.
2. Installed Bio-gas generation unit - reduced diesel consumption in DG set.
3. Provided special grooves in vibratory peeler to remove stones- avoided damage of rasper.
4. Installed steel bladed rasper in place of punched sheet rasper / crusher- improved yield by about 10%.
5. High pressure nozzle washing of tapioca and recycling of wash water by filtering-reduced water consumption.
6. Installed energy efficient motors and pumps.
7. Installed capacitor banks to maintain power factor at 0.9.
8. Installed hydro-cyclone for separating grit / impurities from milk (starch in water)
9. Installed water meters for controlling water consumption.
10. Procured testing equipment for measuring starch content of tapioca.

7.20 DAIRY INDUSTRIES

CIRCLE NO : C/47/IORG/02/ERD
SECTOR : Dairy
LOCATION : Salem
FACILITATOR : Industrial Operations Research Group, Palakkad, Kerala

WM options identified / implemented :

Number of WM options identified : 14
Number of WM options implemented : 9

Economic Indicators :

Total investment made (Rs.) : 3,00,000/
Net savings accrued per annum (Rs.) : 10,00,000/
Payback period : 2 months

Environmental Indicators :

Milk loss reduced by 4% .
Water consumption reduced by 15%
LDPE film consumption reduced by 10% per day
Fat & SNF wastage reduced by 80 kg per day
BOD load reduced by 200 Kg per day.

Major WM options :

1. Replaced 60 micron LDPE film by 50 micron in packing milk reducing plastic film consumption.
2. Adopted Coconut shell as fuel for firing boilers to replace fuel oil
3. Started using branded washers in milk pipe line joints to reduce leakage and longer life
4. Increased length of drip saving line and collecting drips thereby reducing milk loss in drippages.
5. Increased calibration frequency to reduce excess packing of milk.
6. Collecting steam wash condensate of milk cans for washing in first stage.
7. Introduced self-closing valves in water hoses - reduced water consumption.

7.21 STEEL ROLLING

CIRCLE NO : C/48/IORG/03/PAL
SECTOR : Steel Rolling
LOCATION : Palakkad
FACILITATOR : Industrial Operations Research Group, Palakkad, Kerala

WM options identified / implemented :

Number of WM options identified : 14
Number of WM options implemented : 7

Economic Indicators :

Total investment made (Rs.) : 3,00,000/-
Net savings accrued per annum (Rs.) : 5,00,000/-
Payback period : 8 Months

Environmental Indicators :

Water consumption : Reduced by 15%
Electricity Consumption : Reduced by 2000 units / month and reduced Maximum Demand Load by 200 KVA
Fuel Losses (LPG / Furnace : Reduced by 10 –15 % of Oil)
Solid Waste Generation : Reduced by 8-10%

Major WM options :

1. Installed appropriate Capacitor Bank of Standard Grade (ISI) to improve power factor from 0.7 to 0.9
2. Re-contracted Maximum Demand Load (KVA) and installed Maximum Demand Alarm System
3. Replaced damaged contacts / ACB and switches / starters etc.
4. Installed appropriate flywheel of 3.5 ton capacity replacing 7.5 ton flywheel in 400 HP motor to reduce electrical losses
5. Initiated purchase of suitably sized and better quality raw material (steel scrap) and improved storage and handling to reduce cutting / shearing / rusting losses
6. Improvements in housekeeping practices and installation of self closing nozzles for water pipes and plugging leakages of water / fuel oil handling / conveyance systems
7. Providing of training to operators to optimize usage / consumption of LPG / Oxygen etc during raw material preparation / cutting operations etc.

7.22 RUBBER PROCESSING

Circle No : C/51/MPC/04/MDR
Facilitator : Madurai Productivity Council
Sector : Rubber Processing
Location : Madurai
No. of Member units : 5

WM options identified / implemented :

No. of WM options Identified : 16
No of WM options implemented : 10

Economic indicators :

Investment made : Rs 1,40,000/-
Savings achieved : Rs 4,00,000/-per annum
Payback period : 5 months

Environmental indicators :

1. Reduced Fuel (firewod) consumption by 2,70,000 kg/annum
2. Reduced GHG emissions by 20%
3. Electricity consumption by 2500 KWH per annum.
4. Reduced solid waste generation by 1500 Kg per annum

Major Options Implemented:

8. Boiler optimization by using NPC's energy conservation tips on condensate collection and reuse, scales removal etc. Boiler optimization resulted in fuel (fire wood) consumption reduction from 1000 kg per shift to 600 kg per day.
9. Reducing heat loss by floating a layer of 45 mm diameter polypropylene balls on the surface of 90oC hot liquid / Condensate.
10. Replacing 40 W fluorescent tube lights by 12 W CFLs to reduce energy consumption by 750 units per annum per unit
11. Installing sensor for automatic lights switch on and off.
12. Avoiding spillages of carbon powder by keeping a tray below the bag during cutting.
13. Boiler efficiency improvements by 2 % by reducing the excess air.
14. Empty the tube by blowing the powder out from the tube immediately after powder coating. This has resulted in saving of about 80% of powder.
15. Providing side guide on the mixing machine to reduce the material spillage and thus waste.

7.23 TEXTILE SPINNING

Circle No	: C/50/MPC/03/MDR
Facilitator	: Madurai Productivity Council
Sector	: Textile Spinning
Location	: Madurai
No. of Member units	: 6

WM options identified / implemented :

No. of WM options Identified	: 28
No of WM options implemented	: 21

Economic indicators :

Investment made	: Rs. 8,40,000/
Savings achieved	: Rs. 21,00,000/ per annum
Payback period	: 5 months

Environmental indicators :

7. Reduced power consumption by 5,25,000 KWH /annum
8. Reduced usable solid waste from 4.1 % to 2%
9. Reduced water consumption by 2400 m^3/annum

Major Options Implemented:

10. Installing power suction (Variable Frequency Drive) in blow room motor
11. Changing the operation cycle (OFF:ON) of over head cleaning blowers on spinning & winding machines from 4 min : 1 min to 5 min: 1min.
12. Changing the fan blades in pneumafil fans to aluminium
13. Tapping the compressed air leakages thus reducing the compressor running hours
14. Doubling the cotton mixing rate in blow room so as to reduce the machine operation time by half
15. Transparent roofing in the carding department to reduce the power consumption in day time
16. Energy saving through installation of hydro nozzles instead of inefficient conventional ones
17. Power factor improvement by providing capacitor bank
18. Installing roving stop motor instead of suction motor in simplex to reduce power consumption
19. Removing unnecessary piping in compressed air network
20. Providing float valves in all the humidification tanks

7.24 BRICK KILNS

Circle No	: C/49/MPC/02/MDR
Facilitator	: Madurai Productivity Council
Sector	: Brick Kilns
Location	: Madurai
No. of Member units	: 6

WM options identified / implemented :

No. of WM options Identified	: 7
No of WM options implemented	: 4

Economic indicators :

Investment made	: Rs 5,00,000/-
Savings achieved	: Rs 6,00,000/-per annum
Payback period	: 10 months

Environmental indicators :

1. Reduced Fuel (lignite) consumption by 20%.
2. Reduced NO_x emissions concentration from 1.16 mg/Nm^3 to 0.92 mg/Nm^3
3. Reduced SO_x emissions concentration from 2.49 mg/Nm^3 to 1.98 mg/Nm^3
4. Reduced GHG emissions by 20%

Major Options Implemented:

1. Replacing wooden moulds by PVC moulds
2. Reuse of tarpaulins
3. Replacing movable chimney by fixed chimney
4. Use of a chemical for improving the quality of bricks
5. Controlled firing

7.25 FERROUS FOUNDRIES

CIRCLE NO	: C/57/MCH/03/HYB
SECTOR	: Ferrous Foundries
LOCATION	: Hyderabad
FACILITATOR	: Maruti Consultants

WM options identified / implemented :

Number of WM options identified	: 16
Number of WM options implemented	: 12

Economic Indicators :

Total investment made (Rs.)	: 20,70,000/
Net savings accrued per annum (Rs.)	: 74,00,000/
Payback period	: 4 months

Environmental Indicators :

Electricity consumption	: Reduced by 15% in Induction furnace
Coke Consumption	: Reduced by 30%.
Sand Consumption	: Reduced by 80%.
CO2 Consumption	: Reduced by 25 %
GHG Emissions	: Reduced by 1700 tons/annum besides improving work environment

Major WM options :

1. Erected a roof for storage of scrap – prevented quality deterioration by rusting etc and reduced energy consumption in melting.
2. Using smaller size nozzle for CO2 injection – reduced CO2 (GHG) emissions to atmosphere.
3. Optimized air fuel ratio in cupola furnace thereby conserving energy.
4. Painted mould boxes – increased life of mould box thereby reduced disposal cost.
5. Installed energy meters and optimised cycle time – increased production and reduced energy consumption.
6. Installed sand reclamation unit – reduced sand procurement and disposal cost.
7. Procured tea pot ladle furnace – reduced metal losses.
8. Provided covers for furnace and ladle – reduced heat/radiation losses.
9. Installed water treatment plant for preparation of clay for moulds etc.
10. Sizing of coke done to improve combustion efficiency in cupola

7.26 NON-FERROUS FOUNDRIES

CIRCLE NO	: C/58/MCH/04/HYB
SECTOR	: Non-Ferrous Foundries
LOCATION	: Hyderabad
FACILITATOR	: Maruti Consultants

WM options identified / implemented :

Number of WM options identified	: 11
Number of WM options implemented	: 6

Economic Indicators :

Total investment made (Rs.)	: 1,00,000/
Net savings accrued per annum (Rs.)	: 7,00,000/
Payback period	: 2 months

Environmental Indicators :

Electricity consumption reduced by 15% in Induction furnace
Coke Consumption reduced by 30%.
CO2 Consumption reduced by 25 %

GHG Emissions reduced by 300 tons/annum besides improving work environment

Major WM options :

1. Using smaller size nozzle for CO2 injection – reduced CO2 (GHG) emissions to atmosphere.
2. Fuel preparation (sizing of coke/ heating furnace oil) done to improve combustion efficiency
3. Optimized air fuel ratio in furnace thereby conserving energy.
4. Painted mould boxes – increased life of mould box thereby reduced disposal cost.
5. Monitoring energy consumption and cycle time in furnaces to reduce energy consumption.
6. Installed pit type crucible for melting.

7.27 EARTHERN TILES

Circle No : C-III/01/MCH/01/NUZ
Sector : Earthen tiles
Location : Nuzwid
Facilitator : Maruti consultants

WM options identified / implemented :

No. of WM options Identified : 9
No of WM options implemented : 5

Economic indicators:

Investment made : Rs 1,26,000
Savings achieved : Rs 5,04,000 per annum
Payback period : 3 months

Environmental indicators :

1. Reduced fuel consumption (rice husk) by 1296 tons per annum
2. Reduced solid waste(tiles waste) by 450 tons per annum
3. Reduced fuel wastage (rice husk) by 179 tons per annum

Major Options Implemented:

1. Improved storage and handling of rice husk.
2. Installation of thermocouple for monitoring kiln temperature.
3. Use of ground rejects to partially offset use of rice husk ash.
4. Control of Air fuel ratio by blocking part of the inlet air inlet.
5. Monitored and reduced moisture content in green tiles.

7.28 STEEL RE-ROLLING

Circle No **: C-III/03/EET/02/IND**
Sector **:** Steel Re Rolling
Location **:** Indore
Facilitator **:** Essen Energy Technologies (P) Ltd

WM options identified / implemented :

No. of WM options Identified : 41
No of WM options implemented : 7

Economic indicators:

Investment made : Rs 5,00,000
Savings achieved : Rs 40,00,000 per annum
Payback period : 2 months

Environmental indicators:

1. Reduced electricity consumption by 39840 kWh per annum
2. Reduced fuel consumption (furnace oil) by 7 tons per annum

Major Options Implemented:

1. Replaced bulk coal firing with pulverized coal firing in the furnace.
2. Belt alignment for drives with vee belts viz swing grinders, compressors, fans etc.
3. Replaced foot valve with Normex make foot valves for better operations of pumps.
4. Replaced rolling scrap raw material with plates from ship breaking industry to avoid bearing failure.
5. Adopting lower stack of raw material in the furnace reducing burning loss.

7.29 ELECTROPLATING

Circle No **: C-III/04/EHS/01/DWS**
Sector **:** Electroplating
Location **:** Dewas
Facilitator **:** EHS Consultants

WM options identified / implemented :

No. of WM options Identified : 56
No of WM options implemented : 36

Economic indicators:

Investment made : Rs 1,93,000/
Savings achieved : Rs 2,57,196 / per annum
Payback period : 9 months

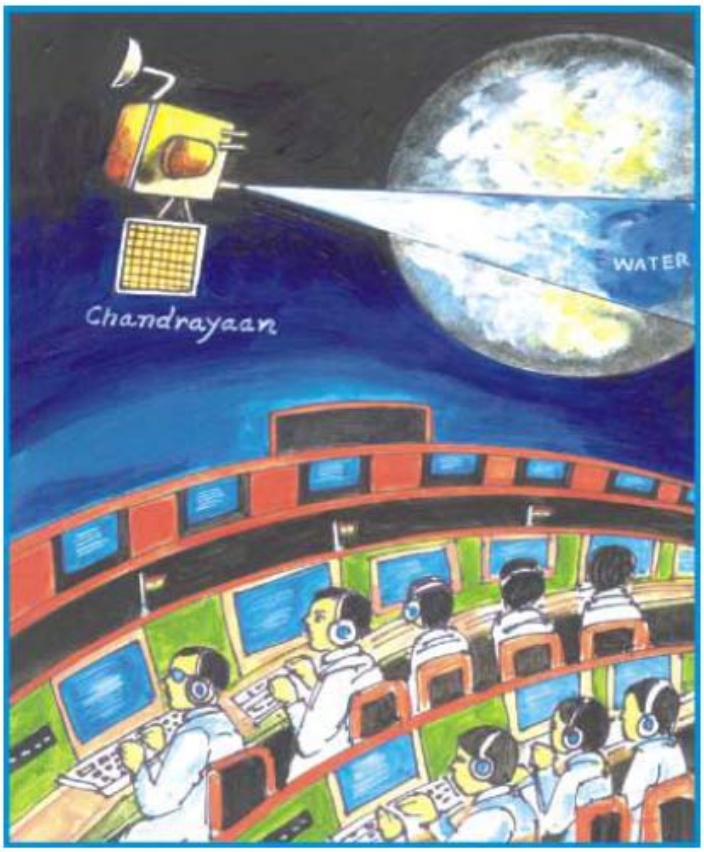
Environmental indicators:

1. Reduced water consumption by 136 m^3/month.
2. Reduced waste water generation by 112 m^3/month.
3. Reduced solid waste generation by 1.5 tons/month
4. Reduced lime consumption by 670 kgs/month.
5. Reduced Hydrochloric acid consumption by 180 litres/month.
6. Reduced hexavalent chromium and other metallic salts consumption by 0.5 tons per month.

Major Options Implemented:

1. Replaced leaking and broken equipment for water transportation.
2. Changed the practice of water rinse with pipe.
3. Developed operational control procedure for regular maintenance of rectifiers and heaters.
4. Setting up of chemical solution discards criteria.
5. Conducted competency and awareness training for workers involved in the job.
6. Prepared standard operation procedure (SOP), operational Control Procedure (OCP) to various equipment.
7. Modified shop floor by civil construction to reduce water consumption and recovery of spilled chemicals.
8. Installed buzzer to prevent over plating.
9. Substitution of chemicals in plating and waste water treatment area.

Results at a Glance



It is campaigns and cooperative initiatives that count !

8. Overall Results and Outputs / Outcomes

The WMC programme has been a low cost high impact project developed by MoEF and NPC with nested Public Private Partnership Model, substantive Capacity Building features and significant economic and environmental benefits being obtained across industrial sectors through three Phases of focused successful implementation and attaining planned objectives.

The achievements are categorized as follows:

a) Number of Circles established and summarized results
b) Capacity building (development of training packages, training of Facilitators, training of Circle Members)
c) Information dissemination (initial and final workshops of each Circle, publication of newsletters, preparation of video films, posters, development and updation of WMC Website and conduction of regional workshops)

8.1 LIST OF WM CIRCLES

Table : 8.1 : The complete list of WMCs established in the WMC programme (phases I to III)

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
Phase - I			
1	Hosiery	Kanpur,Uttar Pradesh	National Productivity Council (NPC)
2	Pulp and paper	Muzaffarnagar, Uttar Pradesh	NPC
3	Electroplating	Ludhiana, Punjab	NPC
4	Cotton Dyeing	Ludhiana, Punjab	NPC
5	Electroplating	Ludhiana, Punjab	NPC
6	Textile Hosiery	Tiruppur, TamilNadu	NPC
7	Textile weaving	Erode, Tamil Nadu	NPC
8	Metal finishing	Chennai, TamilNadu	NPC
9	Tannery	Pammal, TamilNadu	NPC
10	Man-Made Textiles	Surat, Gujarat	NPC
11	Metal Finishing	Mumbai, Maharashtra	NPC
12	Hotels	Mumbai, Maharashtra	NPC
13	Tannery	Vaniyambadi, TamilNadu	NPC
14	Tannery	Vaniyambadi, TamilNadu	NPC
15	Tannery	Vaniyambadi	NPC

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
Phase - II			
16	Khandsari	Bijnaur, Uttar Pradesh	IPPCON Consultants
17	Pulp & Paper	Muzaffarnagar, Uttar Pradesh	Green Enviro Consultants
18	Pulp & Paper	Modinagar, Uttar Pradesh	Green Enviro Consultants
19	Refractories	Muzaffarnagar, Uttar Pradesh	Green Enviro Consultants
20	Dye & Dye int.	Mumbai, Maharashtra	Corporate Insight
21	Foundry	Belgaum, Karnataka	Energy Economy & Environmental Consultants
22	Electroplating	Mumbai, Maharashtra	Corporate Insight Consultants
23	Hotels	Bhopal, Madhaya Pradesh	ENVIRO Consultants
24	Foundry	Delhi	SYCOM Consultant
25	Forging	Delhi	SYCOM Consultant
26	Distillaries	Sangli, Maharashtra	Environmental Protection Research Foundation
27	Cotton Textiles	Sangli, Maharashtra	Environmental Protection Research Foundation
28	Hotels	Shimla, Himachal Pradesh	Himachal Productivity Council
29	Dairy	Calcutta, West Bengal	Energy Economy & Environmental Consultants
30	Foundry	Calcutta, West Bengal	Energy Economy & Environmental Consultants
31	Paints	Vadodara, Gujarat	Kadam Environmental Consultants
32	Resins	Vadodara, Gujarat	Kadam Environmental Consultants
33	Bulk Drug	Chandigarh	Corporate Insight Consultants
34	Pulp & Paper	Chandigarh	Corporate Insight Consultants
35	Marble & Slurry	Udaipur, Rajasthan	Indian Environmental Society
36	Rice Mills (Raw)	Nizamabad, Andhra Pradesh	Maruti Consultants
37	Rice Mills (Par boiled)	Nizamabad, Andhra Pradesh	Maruti Consultants
38	Rubber processing	Trivandrum, Kerala	Institute of Human Resources Development for Electronics
39	Electroplating	Bangalore, Karnataka	Four Dimension Environmental
40	Steel Rolling Mills	Vadodara, Gujarat	Metro Environ Chem
41	Pesticide Formulation	Ahmedabad, Gujarat	Corporate Insight Consultants
42	Printed Circuit Board	Ahmedabad, Gujarat	Corporate Insight Consultants
43	Battery Manufacturing	Bangalore, Karnataka	Four Dimension Environmental
44	Electroplating	Vadodara, Gujarat	Kadam Environmental

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
			Consultants
45	Edible oil	Virudhunagar, TamilNadu	Madurai Productivity Council
46	Electroplating	Cuttack, Odisha	Consortium for Environmental Enterprises
47	Ply Board	Dehradun, Uttarakhand	Green Enviro Consultants
48	Foundry	Rajkot, Gujarat	National Productivity Council
49	Solvent ext. - Edible oil	Chitradurga, Karnataka	Energy Economy & Environmental Consultants
50	Textile dyeing	Faridabad, Haryana	Poush Consulants
51	Foundry	Kolhapur, Maharashtra	Adept Consultants
52	Electroplating	Ludhiana, Punjab	Punjab State Council for Science & Technology
53	Engg sector	Bhilai, Chattisgarh	MC Jain Associates
54	Hand process	Ichalkaranji, Maharashtra	Ecofriends Consulting
55	Khandsari	Bijnaur, Uttar Pradesh	IPPCON Consultants
56	Al. Utensil Manufacturing	Jagadhari, Haryana	National Productivity Council
57	br. utensil manufacturing	Jagadhari, Haryana	National Productivity Council
58	SS Utensil Manufacturing	Jagadhari, Haryana	National Productivity Council
59	Agro Based P&P	Rajahmundary, Andhra Pradesh	Indian Agro Paper Mills
60	Electroplating	Pune, Maharashtra	Engineering & Management Consultant
61	Sago / Tapioca Processing	Salem, TamilNadu	Industrial Operations Research Group
62	Dairy	Erode, Tamil Nadu	Industrial Operations Research Group
63	Steel Rolling Mills	Palakkad, Kerala	Industrial Operations Research Group
64	Brick Kilns	Madurai, TamilNadu	Madurai Productivity Council
65	Textile Spinning	Madurai, TamilNadu	Madurai Productivity Council
66	Rubber Processing	Madurai, TamilNadu	Madurai Productivity Council
67	Hotels	Mumbai, Maharashtra	Ecosmart India Limited
68	Textile Hand Processing	Dombivli, Maharashtra	Ecosmart India Limited
69	Dye & Dye int.	Dombivli, Maharashtra	Ecosmart India Limited
70	Coir Defibring	Bhubaneswar, odisha	National Productivity Council
71	Electroplating	Bangalore, Karnataka	Energy Economy & Environmental Consultants

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
72	Foundry (Ferrous)	Hyderabad, Andhra Pradesh	Maruti Consultants
73	Foundry (Non Ferrous)	Hyderabad, Andhara Pradesh	Maruti Consultants
74	Sanitary Fittings	Mohali, Punjab	National Productivity Council
75	Packaging Materials	Mohali, Punjab	National Productivity Council
76	Tannery	Thuthipet, TamilNadu	Central Leather Research Institute
77	Tannery	Vaniyambadi, TamilNadu	Central Leather Research Institute
78	Tannery	Ranipet, TamilNadu	Central Leather Research Institute
79	Tannery	Erode, Tamil Nadu	Central Leather Research Institute
80	Tannery	Jalandhar, Punjab	Central Leather Research Institute
81	Pharmaceutical	Bangalore, Karnataka	Energy Economy & Environmental Consultants
82	Foundry	Shimoga, Karnataka	Energy Economy & Environmental Consultants
83	Foundry	Shimoga, Karnataka	Energy Economy & Environmental Consultants
84	Electroplating	Bangalore, Karnataka	Energy Economy & Environmental Consultants
85	Knitted fabric - bleaching	Tiruppur, TamilNadu	Centre for Environmental Studies, Anna University
86	Knitted fabric - dyeing	Tiruppur, TamilNadu	Centre for Environmental Studies, Anna University
87	Knitted fabric - dyeing & bleaching	Tiruppur, TamilNadu	Centre for Environmental Studies, Anna University
88	Yarn dyeing	Tiruppur, TamilNadu	Centre for Environmental Studies, Anna University
89	Yarn bleaching	Tiruppur, TamilNadu	Centre for Environmental Studies, Anna University
90	Packaging materials	Indore, Madhya Pradesh	Essen Energy Technologies P Ltd
91	Alkyd resin	Indore, Madhya Pradesh	Essen Energy Technologies P Ltd
92	Pharmaceuticals	Indore, Madhya Pradesh	Essen Energy Technologies P Ltd
93	Roofing tiles	Malur, Karnataka	NPC
94	Ceramics	Khurja, Uttar Pradesh	Central Glass and Ceramic Research Institute

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
95	Ceramics	Khurja, Uttar Pradesh	Central Glass and Ceramic Research Institute
96	Hotels	Chandigarh	K.S. Consultancy Service
97	Textile dyeing	Salem, TamilNadu	Industrial Operations Research Group
98	Fertilizer	Salem, TamilNadu	Industrial Operations Research Group
99	Safety match box	Palakkad, Kerala	Industrial Operations Research Group
100	Flour mills	Salem, TamilNadu	Industrial Operations Research Group
101	Dairy	Palakkad, Kerala	Industrial Operations Research Group
102	Sago / tapioca processing	Samalkot, Andhra Pradesh	SRC Systems Consultants
103	Textile printing	Hyderabad, Andhra Pradesh	SRC Systems Consultants
104	Electroplating	Pune, Maharashtra	Engineering & Management Consultant
105	Electroplating	Pune, Maharashtra	Engineering & Management Consultant
106	Screen printing	Chennai, TamilNadu	National Productivity Council
107	Sugar	Sangli, Maharashtra	Environmental Protection Research Foundation
108	Flour mills	Panchkula, Haryana	National Productivity Council
109	Ceramics - crockery ware	Ahmedabad, Gujarat	Central Glass and Ceramic Research Institute
110	Ceramics - glazed tiles	Morbi-Wankaner, Gujarat	Central Glass and Ceramic Research Institute
111	Hotels	Madurai, TamilNadu	Madurai Productivity Council
112	Textile dyeing	Madurai, TamilNadu	Madurai Productivity Council
113	Brass foundry	Jamnagar, Gujarat	National Small Industries Corporation Limited
114	Brass foundry	Jamnagar, Gujarat	National Small Industries Corporation Limited
115	Refractory	Ramgarh - Jharkhand	National Productivity Council
116	Refractory	Ramgarh - Jharkhand	National Productivity Council
117	Dye & Dye int.	Surat, Gujarat	POLLUCON Laboratory
118	Textile processing	Surat, Gujarat	EN-PRO Services
119	Ceramics - sanitary ware	Thangadh - Gujarat	Central Glass and Ceramic Research Institute
120	Dye & Dye int.	Surat, Gujarat	Pollucon Laboratories

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
121	Dye & Dye int.	Surat, Gujarat	EN-PRO Services
122	Plastic Components	Chandigarh	National Productivity Council
123	Foundry	Coimbatore, TamilNadu	Energy Economy & Environmental Consultants
124	Printed circuit board	Bangalore, Karnataka	Energy Economy & Environmental Consultants
125	Printed circuit board	Bangalore, Karnataka	Energy Economy & Environmental Consultants
126	Electroplating	Hosur, Karnataka	Energy Economy & Environmental Consultants
127	Academic institution	Ahmedabad, Gujarat	Vipul Shah
128	Dye & Dye int.	Naroda, Gujarat	Vipul Shah
129	Dye & Dye int.	Ahmedabad, Gujarat	Vipul Shah
130	Sago / tapioca processing	Salem, TamilNadu	Salem Productivity Council
131	Electroplating	Jamnagar, Gujarat	Nansey and Associates
132	Electroplating	Chennai, TamilNadu	National Productivity Council
133	Electroplating	Chandigarh, Punjab	National Productivity Council

Phase - III

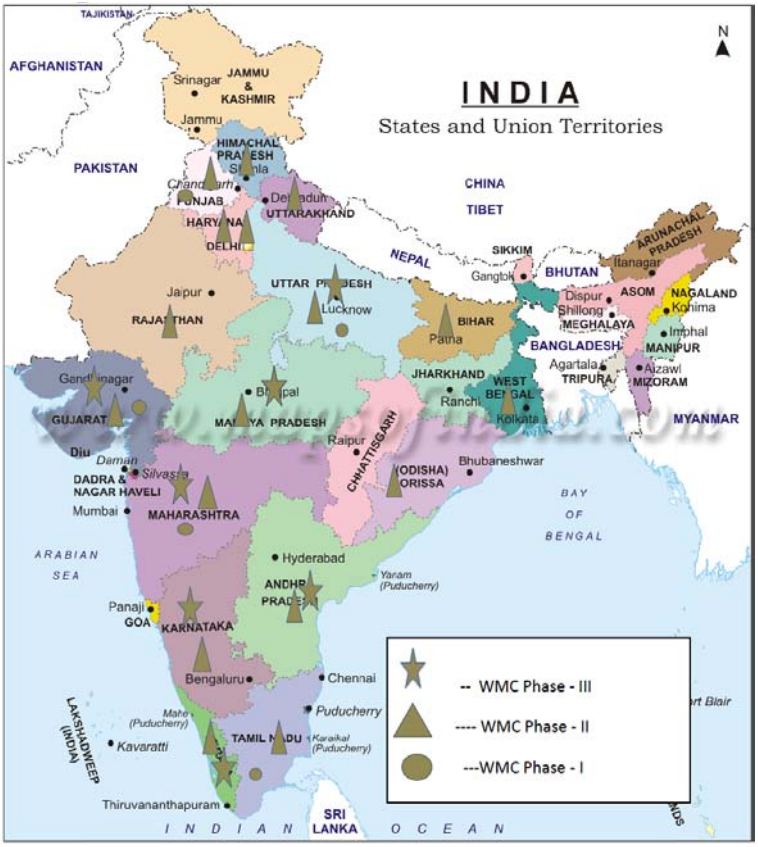
134	Earthen Tile	Nuzwid , Andhra Pradesh	Maruti Consultants
135	Foundry	Pithampur, Madhya Pradesh	Essen Energy Technologies Pvt. Ltd.
136	Steel Rolling	Indore, Madhya Pradesh	Essen Energy Technologies Pvt. Ltd
137	Electroplating	Dewas, Madhya Pradesh	EHS Consultants
138	Engineering	Dewas, Madhya Pradesh,	EHS Consultants
139	Cotton Seed Oil	Dhule, Maharashtra	Eternal Solutions Pvt. Ltd.
140	Brass Foundry	Jamnagar, Gujarat	Nansey and Associates
141	Steel Rolling	Nagpur, Maharashtra	Essen Energy Technologies Pvt. Ltd.
142	Steel Rolling	Trichur, Kerala	Industrial Operations Research Group
143	Ceramic Tiles	Trichur, Kerala	Industrial Operations Research Group, Kerala
144	Sponge Iron	Hyderabad, Andhra Pradesh	Administrative staff college of India
145	Steel Rolling	Hyderabad, Andhra Pradesh	Administrative staff college of India
146	Textile Processing	Ujjain, Madhya Pradesh	Essen Energy Technologies P Ltd

CIRCLE NO.	SECTOR	CITY /STATE OF ESTABLISHMENT	FACILITATOR
147	Steel Rolling	Indore (Madhya Pradesh)	Essen Energy Technologies P Ltd
148	Foundry	Indore, Madhya Pradesh	Essen Energy Technologies P Ltd
149	Paints	Hyderabad, Andhra Pradesh	Maruti Consultants
150	Resins	Hyderabad, Andhra Pradesh	Maruti Consultants
151	Pharmaceuticals	Trichur, Kerala	Industrial Operations Research Group
152	Foundry	Trichur, Kerala	Industrial Operations Research Group
153	Hotel	Mumbai, Maharashtra	Tawde Associates
154	Chemicals	Dewas, Madhya Pradesh	EHS Consultants
155	Foundry	JamNagar, Gujarat	Nansey and Associates
156	Porcelain Insulators	Khurja, Uttar Pradesh	Central Glass and Ceramic Research Institute
157	Crockery Ware	Khurja, Uttar Prades	Central Glass and Ceramic Research Institute
158	E-Waste Management sector	Bangalore, Karnataka	National Productivity Council

8.1.1 The regional spread of WMCs in India (States reached)

The Waste Minimisation Circle program and projects in three phases has made a pan India footprint as in figure below:

Figure 8.1 : The pan India reach of WMC program through three phases



8.2 Environmental and Economic benefits from the programme

Table 8.2 : Broad results of the WMC programme (phases I to III)

No. of circles established	158
No. of WM Options generated	1000 +
No. of WM options implemented	400 +
Investments by SME units	> Rs 8.5 Crores
Savings	> Rs. 5.0 Crores p.a.
Environmental Benefits achieved	
o Reduction in water consumption	5-35%
o Reduction in electricity consumption	5-20%
o Reduction in fossil fuel consumption	3-15%
o Reduction in raw material use	2-20%
o Reduction in waste water generation	5-30%
o Reduction in Air Emissions (GHG)	5-10%
o Reduction in solid waste generation	5-20%
o Yield improvement	1-5%

8.2.1 Associated results

- Demand creation for more WMCs (and potential newer models). It can be indicative that the Lean manufacturing programme being implemented by NPC and launched with support from Ministry of MSME effective year 2009, has evolved on a group consulting format that WMC program has successfully demonstrated. It is indicated that the Lean manufacturing project has added SPV aspects in the newer format / model as part of its Structure. The WMC project related workshops accordingly served as a forum for deliberations regarding lean manufacturing project and enabling development of industry interest in such alternative initiatives

- Engendering networking etc., where research institutions, State Pollution Control Boards (SPCBs), Local Productivity Councils (LPCs), private consulting firms and industry interacted through the WMC Framework sponsored by MoEF / World Bank and executed by NPC towards laying a strong and firm foundation for a WM movement.

- A range of newer initiatives such as inter sectoral partnerships and towards achieving developments / facilitation of technology migration across sectors being explored. An initiative in this direction includes Management Representatives implementing ISO 9000 or ISO 14000 or OHSAS 18000 standards in different types of firms from different industrial sectors amongst SMEs in particular have also initiated partnering under WMC project with WMC Facilitator support for undertaking inter-firm audits for WM / CP implementation

- In addition to building networking across stakeholders there were opportunities for WMC member units to visit modern facilities and larger enterprises in their sector to observe the application of advanced technologies and to explore possibilities of undertaking similar initiatives in their units as well

- In respect of undertaking WM / CP assessments where needed, inter-sector co-operation amongst firms, such as analysis of material and or testing equipment etc being undertaken in advanced laboratories that some foundry WMC member units have for cause identification of technology issues in steel rolling sector being enabled by WMC Facilitator. This undertaken such that laboratory infrastructure in some of the units or in scientific institutions with latent capacity could find utility across industrial sectors.

- Also advanced training workshops undertaken for Steel Rolling and Foundry sectors such that common areas of concern such as furnace efficiencies, insulation materials etc could be addressed.

- Eco-friendly product promotion aspects were being undertaken through WMC project and various awareness, review and final workshops have led to detailed discussions regarding Eco-products developments.

- The Regional Workshops under WMC project have been serving parallelly as effective platforms for deliberations towards new models of WM / CP and Cleaner Technology support desired by industrial units and also a forum for exploring advanced training needs for SMEs and State Pollution Control Boards and other government departments / institutions at Central and State levels. Further growing interest from industry in participation towards new green public private partnerships for engaging in green growth objectives and keenness on engaging with Eco-Products development and participation in Eco-Products Directory and Eco-Products International Fair etc.

- The WMC project also led to deliberations on need for strengthening middle management in SME sector. The scope and demand for suitable volunteer programmes to address this need also emerged where willingness to share upto 50% of the costs of engagement of volunteers by SMEs were also indicated.

- The WMC project also finding substantive international interest and serving as significant case study from India for UNIDO / UNEP initiatives on Promoting Resource Efficiency in SMEs and for reference in other UNEP projects that are being developed or forthcoming.

- The WMC project and newsletters being much appreciated by national and international institutions and industrial units including UNEP / APO and various NPOs / USAID / Local Productivity Councils and small, medium and large companies etc., and demand for producing WMC newsletter in various other regional languages received.

8.2.2 Perspectives on crowding in of investments by WMCs in phase III

The following charts depict private sector investments induced for average public investments made (or allocated) per WMC set being analysed and also in respect of private sector savings vis a vis public sector investments, whereby indicating the financial investment productivity from

the project as obtained for different WMCs. These are also indicative of the mantra of Waste to Profits ideology that the program has been professing since inception and conceptualization.

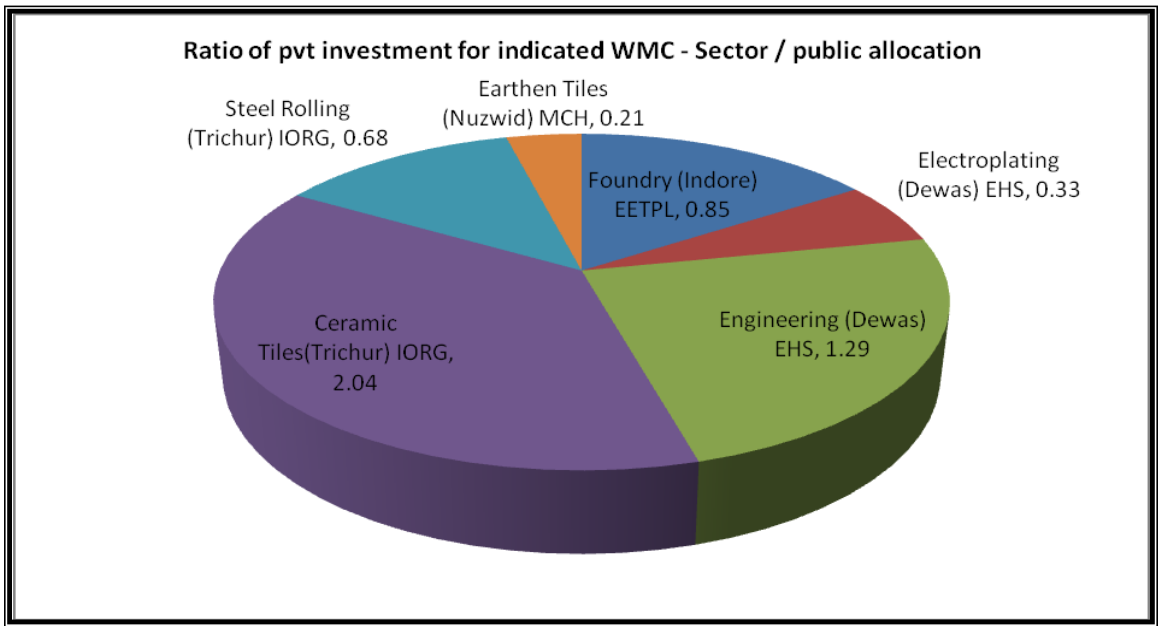


Figure 8.2 : Investment Multiplier for selected WMCs for given Sector and region

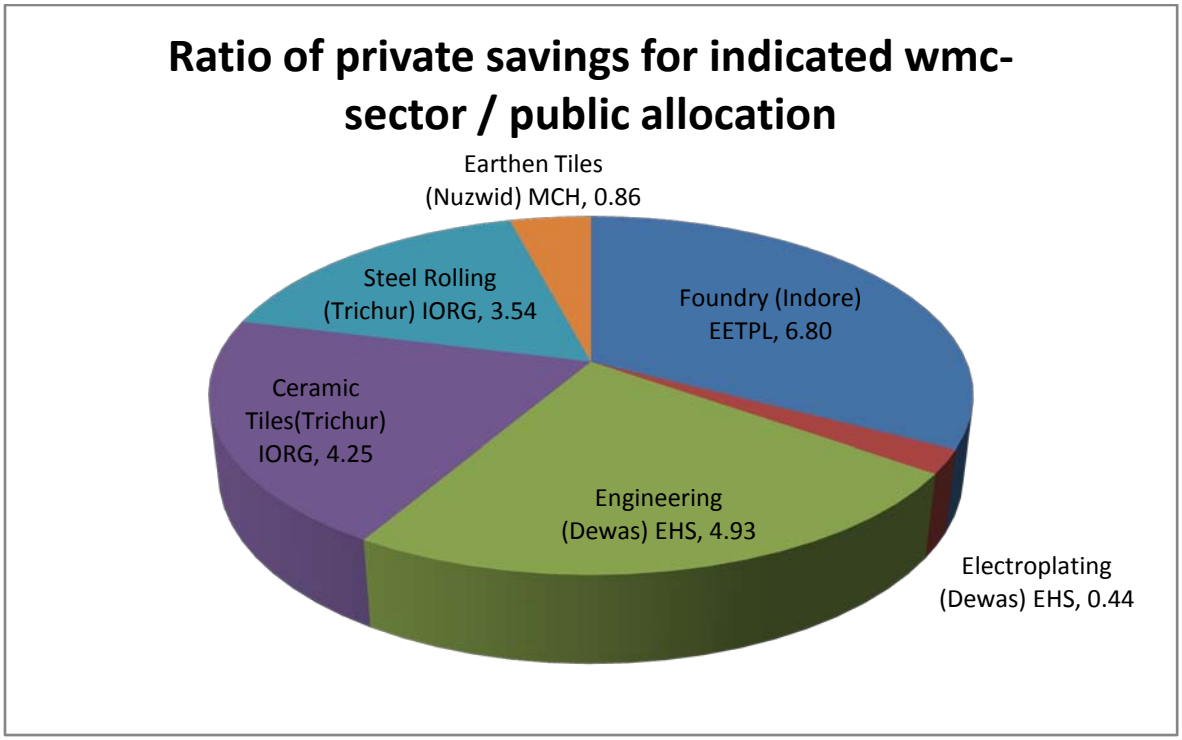


Figure 8.3 : Savings Returns Ratio Vis a Vis Public Investments per WMC

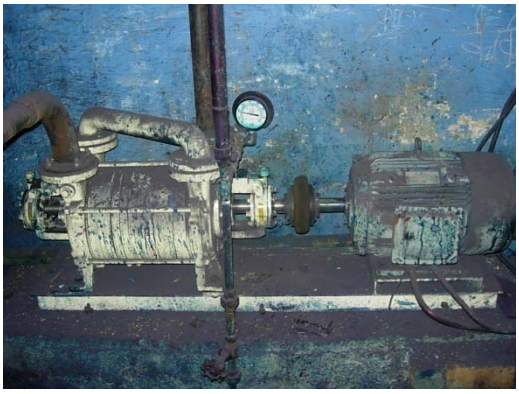
8.2.3 Indicative plates from the production processes in WMC units

Towards visuals from manufacturing processes observed in some WMC units plates are presented in Figure 8.4.

Figure 8.4 plates from production processes in some of the WMC member units

	
Installation of Air Pollution Control Device by a WMC member unit in steel rolling sector at Pithampur (M.P.)	Manufacturing in progress at WMC Units in Brass Foundry sector at Jamnagar (Gujarat)
	
Raw material for secondary steel re-rolling unit (Tiruchur -Kerala)	Runners and risers removal – Foundry unit (Pithampur)

	
Production process in Electroplating unit at Dewas, Madhya Pradesh	Installation of Timer (Electroplating unit, Dewas)
	
Production in progress at Tile manufacturing WMC member unit at Trichur - Palakkad belt (Kerala)	Tile manufacturing unit at Trichur, kerala
	
Hot ingots for rolling – Steel Rolling unit (Indore)	Improved conveyance mechanism, Indore

	
Problem of leakage of oil in Engineering Unit, Dewas	Status of pump in Chemical unit, Dewas
	
Inventory management of crockery, Khurja	Dry and wet process for crockery, Khurja
	
Cyclone installation at Brass Foundry, Jamnagar	Brass scrap for recycling at Jamnagar WMC unit

	
International experts also facilitating process improvement and slag / flux management in Brass Foundry WMC, Jamnagar	Inter-industry teams of Management Representatives facilitating WM / CP initiatives at Dewas Units

8.3 Capacity Building activities

Twelve intensive training programmes of four to five-day duration were organized in which there were 204 participants representing about 125 organizations including NPCs departments and regional offices. Further, for every Circle, the waste minimization team of the Circle members were trained towards identification and implementation of Waste Minimization options. Plates from a Training program for WMC facilitators are presented in Figure 8.5.

Figure 8.5 : Photographs from WMC Facilitator Training Program]

	
Session on Energy Auditing and Energy Conservation	Participants of 1st WMC Facilitator Training Program

Tips by Saurabh Diddi, Dy. Director (EM), NPC	(Phase III) engaged in case exercise
	
Presentation by Phase II WMC Facilitator Shri K.R. Chary, Director SRC Consultants and Advisor (EM), NPC on Sago Manufacturing WMC	Discussions on Facilitator Action Plan by Shri M.J. Pervez, Director (EN Group), NPC
	
Discussions on WM and WMC Barriers – session by Shri M.J. Pervez, Director (Environment Group), NPC	Towards Waste Minimisation practice and WMC concept : Exercise on manufacturing Thermostrips

	
Presentation by Shri Ajay Chandak from Eternal Solutions, Dhule, Maharashtra, during Open Discussions & Facilitator Selection	Group Photograph WMC Facilitator Training Program

In addition to capacity building for WMC facilitators a large number of awareness workshops and training programs were organized for representatives of industrial units that would lead to establishment of WMCs. It is indicative that over 150 Awareness workshops and training programs were organized in industrial clusters where WMCs were established. As part of these workshops on average about 30 participants were present in each that led to multiplier effects through over 4500 participants to many industries in the clusters. A few plates from these awareness cum training workshops are presented in figure 8.6.

Figure 8.6 : A few photographs indicative of the Awareness / Training workshops in industrial clusters where WMCs established.

	 NARODA CENTRE. 168 & 169, NARODA INDUSTRIAL ESTATE AHMEDABAD 382 330. AWARENESS WORKSHOP/ TRAINING PROGRAMME ON WASTE MINIMIZATION & WASTE MINIMIZATION CIRCLES FOR CERAMIC INDUSTRY IN GUJARAT STATE SPONSORED BY NATIONAL PRODUCTIVITY COUNCIL, NEW DELHI MINISTRY OF ENVIRONMENT & FORESTS GOVT. OF INDIA
	 FINAL WORKSHOP WASTE MINIMIZATION IN SMALL & MEDIL 25 - 9 - 200 ORGANISED BY
 METAL FINISHERS' ASSOCIATION OF INDIA WELCOMES YOU PUNE METAL FINI ASSOCIA	 WASTE MINIMIZATION CIRCLES REVIEW MEETING TEXTILE, BRICKS & RUBBER INDUSTRIES 9 & 10 - 5 - 2002 RUN BY : MADU AI PRODUCTIVITY COUNCIL

	 FOR PROFITS THROUGH INCREASED PRODUCTIVITY AWARENESS WORKSHOP
	
 Wel-Come "Awareness Workshop" on "Waste Minimisation in Small and Medium Industries" "Training Workshop" for	

8.4 Review Workshops for WMC units

As the WMC programme and WMCs progressed review visits to WMCs were undertaken to facilitate implementation of solutions being identified to waste management problems and to explore the developments taking place in the field. A few indicative plates from review visits are presented in Figure 8.7.

Figure 8.7 : Some indicative plates from review visits to WMCs

Review visit to WMC in Chemical (Dye and	Review visit to WMC in crockery /

Dye intermediate manufacturing) sector Dewas (M.P.)	whiteware sector at Khurja (U.P.)
	
Review in progress in WMC of Chemical sector, Dewas	Reviewing and observing product quality issues in Engineering units, Dewas
	
Deliberations for new project models with industry representatives at Dewas	Review and observation visit by UNIDO official at Foundry unit WMC, Indore
	
Observing brass foundry furnace, Jamnagar	Handling finished product, brass foundry, Jamnagar

	
Review of Dairy WMC units, Palghat	Observation of Coconut shell based furnace at Dairy, Palghat
	
Observation of steel ingots, Trichur	Review visit and observation of in plant awareness creation at Engineering unit, Dewas
	
Review of ceramic insulators manufacturing unit, WMC, Khurja	Deliberations regarding review visit to Foundry unit at Indore

8.5 Dissemination of results

Towards dissemination of progress and results regarding WMCs various activities were undertaken such as Final Workshops, Newsletter publications of case studies, Posters, WMC website, WMC video etc.

8.5.1 Final Workshops

A few plates in respect of Final Workshops for WMCs meeting project objectives are presented in Figure 8.8.

Figure 8.8 : Some plates from Final workshops

	
Final Workshop of Foundry WMC at Indore	WMC Final Workshop for ceramic sector at Khurja (U.P.)
	
WMC final workshop for Foundry Units, Pithampur and Indore	Certificate distribution, Chemical WMC, Dewas

8.5.2 WMC Newsletters

A total of 32 WMC Newsletters printed and published of which 11 Nos WMC Newsletters developed and printed under Phase III and readership expanded to over 3500 personnel from industry / institutions (national / international) etc especially as pdf documents being actively and substantively emailed. A few visuals of WMC newsletters published are presented as Figure 8.9.

Figure 8.9 : Information dissemination - sample set of WMC Newsletters

WASTE MINIMISATION CIRCLE news

WMC News - Vol. 5, No. 5 | For Private Circulation Only | April 2011

CONTENTS

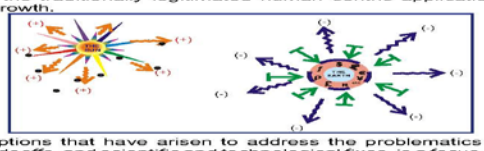
Published by :
National Productivity Council
Utpadakta Bhawan,
5-6 Institutional Area, Lodhi Road
New Delhi-110003
(With NCPC India Contributions)

Sponsored by :
Ministry of Environment & Forests
Government of India
Paryavaran Bhawan, CGO Complex,
Lodhi Road, New Delhi-110003

The Colour of Wealth !

The grand human organisation towards modernisation and civilizational advance with a focus especially on the idea of wealth creation has been witnessed. What has been achieved during this endeavour to ostensibly securitise ourselves is the continuous conversion of public goods and common properties and resources i.e green ecological wealth and the prism that accentuates the rainbow, into different forms of material / economic wealth outcomes and their symbols. According has emerged an expansive but different palette, complete with hues of our obsessive search and structuring of versions of human freedom(s) made vide expressions in human choice(s)- regarding privatised material wealth.

In the scenario the intellectually privileged humanity is seemingly flailing - and paradoxically so - to once again reorganise itself, as it struggles to find solutions for internal contradictions. On the one hand burgeoning inequalities plague and create strife within, on the other the world resources essentially taken for granted appear to increasingly diminish or become difficult to harness in the traditionally legitimated human centric applications and for economic growth.



Amongst options that have arisen to address the problematics within our logics of tradeoffs, and scientific and technological fixes, is a focus on a newer propositioned facilitative cure i.e. the pinning of hopes on the theme that has been christened "eco-finance" or "green finance" ! Can this idea or proposition work? Can we possibly think beyond the tendencies towards business risk creation and distortions, beyond sub components such as foreign exchange risk, political risk, credit risk, technology risks etc. Do we have the ability to actually address real ecological risks for ecology's sake ?

It is apparent, human intellect and humanity's collective wisdom is on test, whether we wish to make sustainable peace with earth, or continue fundamentally exploitative trade in natural resources or in masked forms in its derivatives. That is, whether we can rework our footprints on the sands of time!

Editor's Desk
National Productivity Council

WASTE MINIMISATION CIRCLE news

WMC News - Vol. 5, No. 3 | For Private Circulation Only | October 2010

CONTENTS

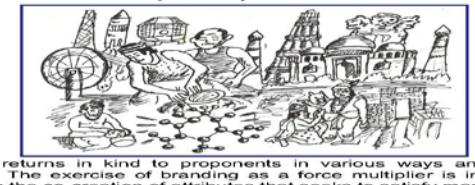
Published by :
National Productivity Council
Utpadakta Bhawan,
5-6 Institutional Area, Lodhi Road
New Delhi-110003

Sponsored by :
Ministry of Environment & Forests
Government of India
Paryavaran Bhawan, CGO Complex,
Lodhi Road, New Delhi-110003

Transcendental Branding - Going beyond Intent !!

Be it advertisements or slogans, in print or audio-visual mediums, showcasing distinctions on the products and packagings, demonstrating worth and inviting trial runs, indicating certifications as comparators and engaging brand ambassadors to endorse the assurances explicit or implicit etc., the focus has hovered and evolved towards content that would relate to consumers and clients for meeting their needs, demands and dreams through such offering with underlying hopes of receiving returns such as market leadership and a slice of economic pies.

Of course the virtues of branding have correlated with the promise of quality, reliability and trust etc. The labels put forth have arisen from private and public sectors. The markets sought and those created through niches and differentiation have served as drivers of virtuous cycles for enhancing growth and relevance of subjects in myriad formats and have been justifiably



enabling returns in kind to proponents in various ways and in good measure. The exercise of branding as a force multiplier is increasingly viewed as the co-creation of attributes that seeks to satisfy markets - both real and virtual / visible and invisible, conscious / cognate and subliminal etc - through agents and agency of supply and demand.

It is beyond these apparent and cognizable markets that lies the domain of transcendental branding, that shapes eternal appeal and values which go beyond the returns orientation towards a substance higher and beyond intent, potentially **ontological / deontological** arenas, by embedding contributions to human endeavour and that serve as milestones in human / economic / technological and other developments, and which bridge over confining boundaries that shape the sequenced markings of progress through indelible inks.

Editor's Desk
National Productivity Council

WASTE MINIMISATION CIRCLE news

WMC News - Vol. 4, No. 4 | For Private Circulation Only | April 2009

CONTENTS

Published by :
National Productivity Council
Utpadakta Bhawan,
5-6 Institutional Area, Lodhi Road
New Delhi-110003

Sponsored by :
Ministry of
Environment & Forests
Government of India
Paryavaran Bhawan, CGO Complex,
Lodhi Road, New Delhi-110003

Human Capital

The driving force of economies, an aggregation of a civilization's potential and advance, founded in the essence of work, the accumulation of skill, of ability and capacity, of will and purpose, with provisos on the nature of experiences and much more... it is *human capital* as a stock and flow and the core dynamic at play, as division of labour pans out.

Further, as snapshots on the road to development and progress, incorporating transitional phases in man's road to valuation (relative and absolute) - from childhood to riparian age, human capital is serving as a key means of expression and a measure of individual and collective power to innovate and change.

Editor's Desk

National Productivity Council

For Private Circulation Only

WASTE MINIMISATION CIRCLE News

Vol. 1 No. 4 | April 1997

CONTENTS

Published bi-monthly by :
NATIONAL PRODUCTIVITY COUNCIL
Utpadakta Bhawan, Lodi Road
New Delhi - 110 003.
Ph.: 469 0331 / 2 / 3, 461 1243
Fax : 91-11-461 5002, 462 5013

Sponsored by :
MINISTRY OF
ENVIRONMENT & FORESTS
Government of India

National Productivity Council

WORLD BANK'S ASSISTANCE IN INDUSTRIAL POLLUTION PREVENTION ACTIVITIES

M. J.Pervez
Deputy Director
NATIONAL PRODUCTIVITY COUNCIL

The post independence era has witnessed rapid industrial growth in India. These industries have contributed significantly in boosting up the country's economy. The vast industrial expansion has however been accompanied by substantial increase in consumption of chemicals, water and energy and also rising pollution levels. It has been proven that Waste Minimisation provides a valuable tool for dealing with environmental problems associated with the industries. A number of projects to promote waste minimisation have been initiated by the Indian Government. These include projects which promote activities on research and technology development, technology transfer, capacity building and technical development in the field of Waste Minimisation in India.

World Bank is providing financial support to strengthen the Waste Minimisation activities undertaken by the Government through the Industrial Pollution Prevention project which was initiated by World Bank in 1994. The prime objective of the Industrial Pollution Prevention project is to assist the Indian Government in the implementation of its policy on

For Private Circulation Only

WASTE MINIMISATION CIRCLE News

Vol. 1 No. 1 April 1996

From the Director General

With increased industrial activities, natural resources tend to deplete rapidly. In many instances, this also leads to environmental pollution. For sustainable development, optimum utilisation of resources and minimisation of waste assume significance.

The need is even greater for small scale industries (SSIs) which tend to consume relatively more raw materials, and generate more waste which affects the environment and, also then our profitability. In this context the idea of Waste Minimisation Circle (WMC) has been conceived to assist their sustained development.

This Newsletter *provides a forum for the circle members to share their experiences in waste minimisation. It also encourages other industries to make this concept a movement.*

So far, about a dozen Cirdes have already been established in India. This project is supported by the Ministry of Environment and Forests (Government of India) and the World Bank.

This issue of the Newsletter *highlights the basic concept of WMC, activities carried out by the Circles and related information. We would appreciate articles of interest pertaining to the waste minimisation. These articles will be published in this bi-monthly* Newsletter.

I hope the SSI units will be significantly benefited from this Newsletter *in their endeavour towards the cause of environment and productivity.*

(P. G. Mankad)

WASTE MINIMISATION

M. J. Pervez (Deputy Director)
(NATIONAL PRODUCTIVITY COUNCIL)

Environment Management has conventionally relied upon setting up Pollution Control Equipment to treat the effluents or gaseous emissions and bringing down the concentration of pollutants to within the stipulated limits. However, this approach is proving to be inadequate because :

(I) It mostly changes the physical for/media of pollution viz., Gaseous pollutants into solids (SO_2 into Gypsum), Liquids to solids (Sludge from waste water treatment plants) or solid wastes into gaseous (Incineration).

(Ii) It is cost intensive with, hardly any benefits to the Entrepreneur leading to an unavoidable dent in profits.

CONTENTS

Published by :
NATIONAL PRODUCTIVITY COUNCIL
Utpadakta Bhawan, Lodi Road
New Delhi - 110 003.
Ph.: 469 0331, 2, 3, 461 1243
Fax : 91-11-461 5002

National Productivity Council

8.5.3 WMC website

In order to spread information regarding WMC programme to a larger number of industries beyond WMC members and beyond regions where WMCs were established and also to reflect the outcomes to international organizations / agencies a WMC website was created. The website contained case studies, downloadable WMC newsletters, Training package and material, posters etc. The outline and Home page of the WMC website is presented in Figure 8.10.

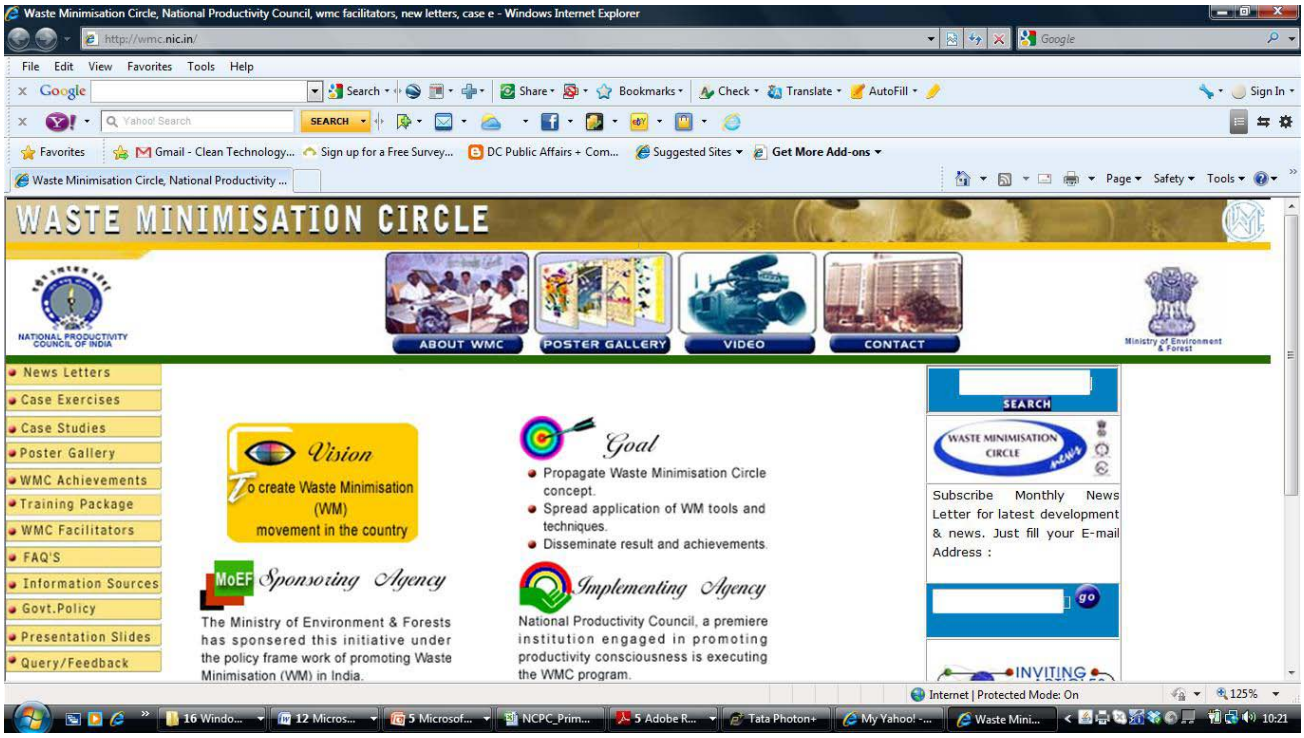


Figure 8.10 : The WMC project Website highlighting Vision and Goals of the program (http://wmc.nic.in as accessed on 5th November 2012)

8.5.4 WMC Video

A video has been developed to present results from various units that established WMCs and achieved successes. The cases included from tannery sector, dairy sector, ceramic sector etc. The video also described the WM methodology and aspects concerning mechanisms and constraints to overcome during WMC formation. The video also highlighted perspectives from senior officials of the Ministry of Environment and Forests to encourage the industrial units to adopt WM practices. An image of the WMC video highlighting it to be an innovative pathway is presented as Figure 8.11.

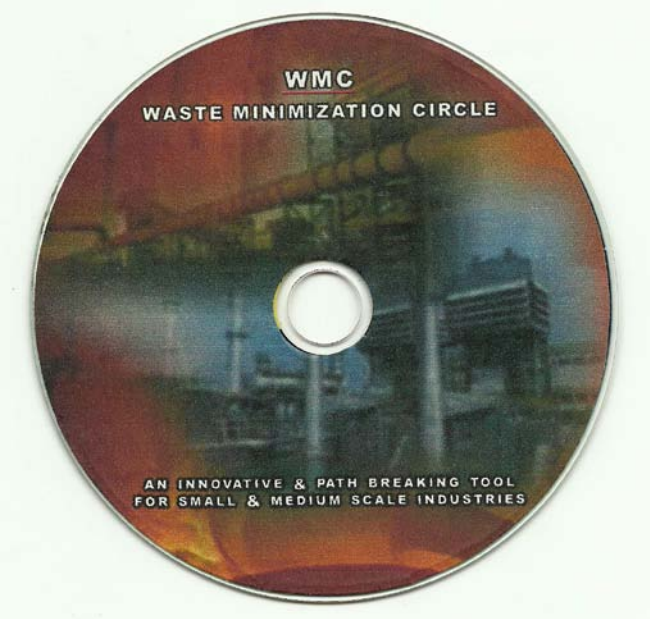


Figure 8.11 : A scan of the WMC project Audi – Visual CD

8.5.5 Posters for information dissemination and exhortation of industry

A number of posters were developed for exhortation of industry to initiate efforts for energy conservation, addressing safety aspects in the units, following good industrial relations practices and regarding WMC programme structure etc. One of the posters regarding need for good industrial relations is presented in Figure 8.12.

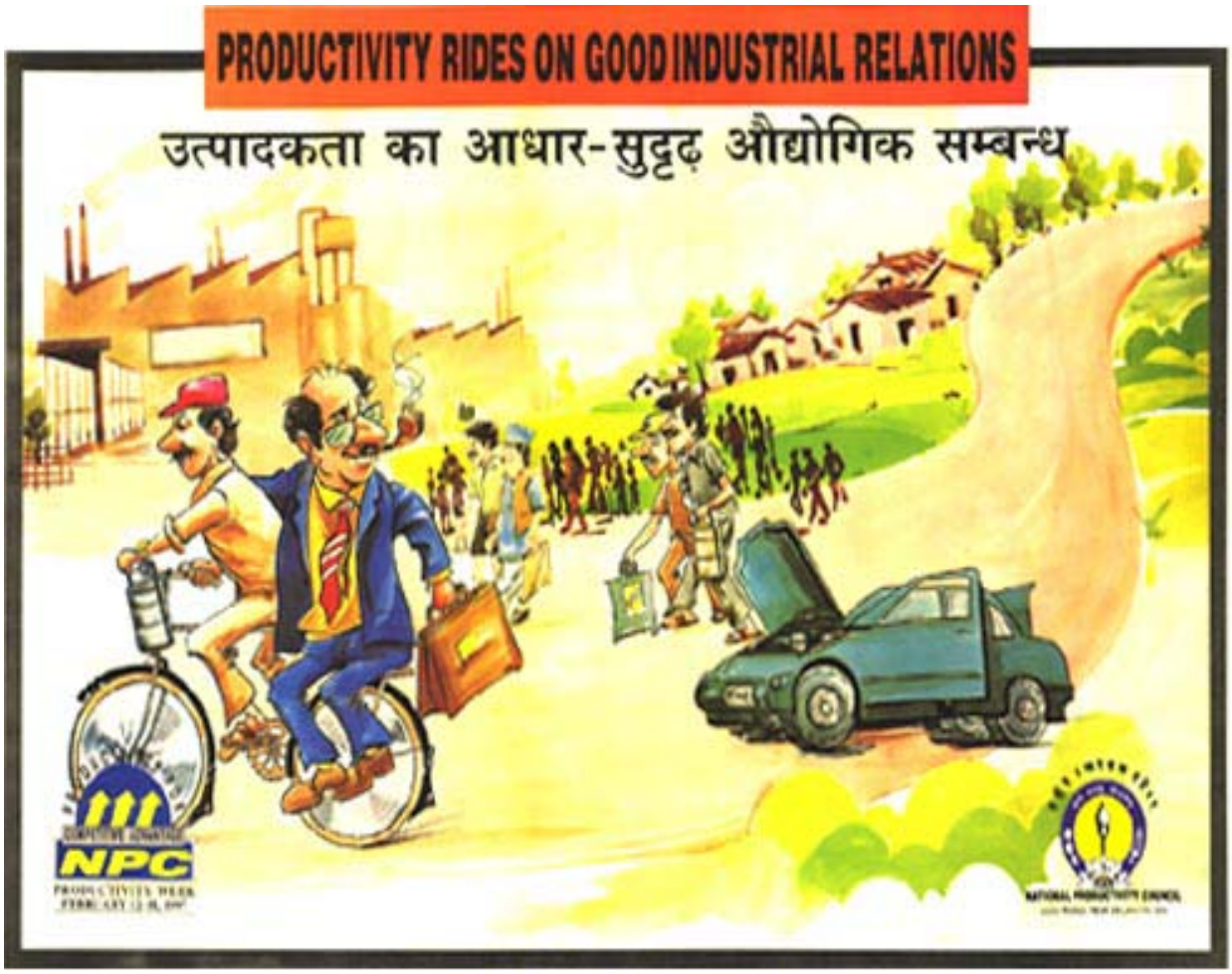


Figure 8.12 : A poster promoting good industrial relations

8.5.6 Words of Encouragement and appreciation for the project and WMC Newsletters and information dissemination efforts

The WMC programme and project activities and case studies were through the dissemination efforts reaching a very wide spectrum of industry personnel, academicians and institutions. During the course of the project several appreciation letters had been received and excerpts from some of these were also published in the WMC newsletters. A few such words of encouragement are presented in Figure 8.13 that reflected on the project related communications.

Figure 8.13 : Appreciation and testimonials concerning WMC programme and information dissemination efforts for the project

Vol.3 No.1 March 2002 issue

WASTE MINIMISATION CIRCLE *news* 12

A word from our reader's...

I find the newsletter quite informative and useful to all those involved in industrial promotion activities.

P.G. Mukundan, Director General, Indian Agro and Recycled Paper Mills Association, New Delhi

The presentations of the newsletter are very good and I am sure this will be good for the user industry.

Y.K. Saxena, Asstt. Vice President (Environment), Gujarat Ambuja Cements Limited. New Delhi

The articles are quite educative and useful for our day to day activities.

Dr. D.K. Behera, Env. Scientist - I, Orissa Pollution Control Board, Bhubaneswar

Your WMC newsletter is very interesting and I am keeping it in our library for wider appreciation.

P.K. Sikdar, Director, Central Road Research Institute (CRRI), New Delhi

The newsletter deals with problems faced at the plant level and will definitely help in expanding knowledge in this important area of waste minimisation.

A.K. Ghose, Vice President, Vam Organic Chemicals Ltd., Noida (U.P.)

Your newsletter deals with a wide range of subjects of importance from productivity point of view and reveals sincere efforts in bringing it out in the most presentable manner.

Naren Sen, President, National Front of Indian Trade Unions, Kolkata

I am greatly impressed by the newsletter, there are a number of industries in Tirunelveli District where the WM / CP concept can be applied.

K.S. Raman, President, Tirunelveli Productivity Council, Tamil Nadu

Yours is a great crusade for control of wastages, we are with you all the way in your crusade.

Dion Fernandes, Executive Director, Tool and Gauge Manufacturers Association (TAGMA), Mumbai

ENCOURAGEMENTS

Your newsletter will play a vital role in educating the people not only on waste management but also on protecting the environment. The newsletter is informative, educative, interesting and useful.

G.P. Sinha, Director
Central Mechanical Engineering Research Institute, Durgapur

Your newsletter is a good effort to create an awareness about the ways and means for waste minimization in various sectors to utilize resources optimally and to maintain the environment.

K.K. Singhal, Head, Dairy Cattle Nutrition Division
National Dairy Research Institute, Karnal

WMC Newsletter contains interesting resource material and greatly enriches knowledge on waste management in industry.

Dr. T.K. Guha Roy, Deputy Director & Incharge
Chemical Processing & Product Development Divisions
Indian Jute Industries' Research Association, Kolkata

The WMC newsletters have been very good reading material and goes a long way in promoting consciousness on the importance of waste management. Besides industry the initiative can help in inspiring other sections of the society as well.

G.S. Srivastava, Director
Bihar State Productivity Council, Patna

Your newsletter is informative and enables us to learn about the ongoing work. Our institution is also focusing on developing environmental technologies for various sectors and it would be a pleasure to share experiences with your Council.

C.M. Lin
General Manager, Environmental Management Division
Hong Kong Productivity Council

We admire your resourceful attempt in creating awareness on waste minimization in industry.

Manu Leopairote, Permanent Secretary,
Ministry of Industry, Thailand

Letters and Encouragements

The WMC newsletters are found to be very useful especially to those engaged in waste minimization research and development, and our institute looks forward to continued receipt of these documents - **Dr. T. Chakrabarti, Acting Director, National Environmental Engineering Research Institute, Nagpur (Madhya Pradesh)**

The WMC News is a good effort and should be used as a tool for a war on waste and should have wider circulation. It would be useful to have portions in Hindi and other languages as well for reaching the WM message to more individuals and organizations. It may also contain state wise / area wise brief news items about WM / WMC initiatives as well. Achievements on WMCs may be summarized for each calendar year. Letters to editor may also be published and motivation approaches for operational personnel in firms and organizations may be continually and increasingly addressed - **Shri U. C. Jain, Honorary Secretary General, Rajasthan State Productivity Council, Jaipur (Rajasthan).**

I would like to congratulate the Environment Group at National Productivity Council for coming out with these high quality publications. The newsletters provide information in simple yet succulent manner which exemplifies how waste minimization can improve bottom line for SMEs which play a key role in the Indian economy - **Mr. Dan Miller, Director, General Development Office, USAID, New Delhi, India**

It is very interesting and informative. I request you to please send it to us regularly and kindly include more case studies to highlight the success of the WMC program - **Mr. Vinay Jathar, Sr. Partner, J. P. Foundries, Belgaum (Karnataka / Maharashtra)**

The concept and objectives of the WMC project are found to be very useful. BSPC in collaboration with Bihar Industries Association and Regional Directorate of NPC looks forward to formulating future action plans in respect of WMC concept application with support of state government stakeholders and industrial units of Bihar. We look forward to more details and inputs towards newer initiatives - **Shri B. K. Sinha, Honorary Secretary General, Bihar State Productivity Council (Bihar)**

The newsletters have provided application oriented insights on Waste Minimisation initiatives as observed in Earthen Clay Tiles sector, Phenolic waste water treatment and Reed Switch manufacturing case etc. Additional areas for improvements in the respective sectors could be explored / undertaken, including for example :- use of simulated software intervention for furnace efficiency assessments and prototyping for kilns in Tiles sector ; Suitable / advanced temperature control and maintenance arrangements towards assisting fuller conversion and degradation of phenolic constituents in UASB reactors for phenolic waste water treatment; Material substitution initiatives for combinations of metals including ruthenium and other scarce / rare metals - **Shri P. Ray, Director, MSME - Development Institute, Ministry of Micro Small and Medium enterprises, Gangtok (Sikkim)**

The WMC publications are really worthy and useful and will go a long way in benefiting a lot of Small Scale manufacturers. The publication could be released in regional languages also, which will have untold impact to improve productivity in SMEs in all regions of our country - **Shri N. Ravindran, Industrial Engineer, The Coimbatore Productivity Council, Coimbatore (Tamil Nadu)**

CHAPTER 9

Suggestions and Recommendations

9.1 Towards future initiatives – suggestions and recommendations

The WMC programme in its present structure with objectives for facilitating a WM movement in the country has been effective in making progress in this regard through three phases as yet. However, in view of the vast SME sector in India where approximately 3 Million manufacturing units are functioning that are spread across over 1000 very active industrial clusters, there is a need for further efforts to induce Waste Minimisation and Cleaner Production practices. The WMC programme establishing 158 WMCs is thus a drop in the ocean. Indeed, the adoption of WM techniques needs to be ingrained as part of the DNA of industrial operations. To achieve further progress in this regard more such initiatives are desirable. To achieve this end there is potential for newer mechanisms to be designed besides refining the WMC project framework for further phases as indicated below.

(a) Introduction of Special Purpose Vehicles in group consulting programe and shaping new Green Public Private Partnerships

The lean manufacturing programme under way as part of the initiative by Ministry of Micro Small and Medium Enterprises is a good example of a fresh design towards group consulting initiatives that is apparently a refined form of WMC programme. The lean manufacturing programme to promote application of 10 Lean Manufacturing Techniques has caught the imagination of many industrial units across several clusters already. This project has as part of its core structure the establishment of Special Purpose Vehicles that bring several strengthened features. These include contributions by participating industries (i.e. a group of 8 to 10 MSME units) to partially share the cost of consulting and institutional service on the subject. This process helps build a great deal of ownership and responsibility amongst all stakeholders including the manufacturing units, Lean Management Consultants, Ministry of Micro Small and Medium Enterprises and the nodal agency implementing the project such as NPC Process Management Group and now also Quality Council of India.

Accordingly a new expanded phase of the WMC programme with introduction of Special Purpose Vehicles for promoting application of WM methodology and WM Techniques could lead to a strengthened initiative that could be taken to a vast range of clusters so far yet to be reached. As part of this effort newer criterion may also be established such that the selection of WMC facilitators be undertaken by the participating industrial units from a pool of trained consultants. Further, efforts could be made for identifying those participating units which have not been engaged in structured institutionalized programmes say for a period of five years so that inclusion – exclusion errors are minimized and the programme reaches more units needing such structured support and manufacturing extension services. It may be mentioned that process of enhanced budgetary components for such structured programmes will also find greater involvement of varieties of stakeholders.

(b) Green Supply Chains and Resource Conservation initiatives for enhancing value chain productivity

The scope for designing programs that focus on supply chains / value chains for enhancing productivity and greening of industries across nodes is vast. The supply chains have various tiers of operations vis a vis other large and medium scale units in various regions. Indeed, supply chains are highly cross linked and the scope for green interventions at significant nodes that are spread in various parts of the clusters and regions can be addressed. The advantages of such a focus could be the potential for technology migration across sectors that would be found to be interlinked. The demand for clean technologies could be accordingly met as part of such an initiative that goes beyond the policy of cluster approach. As part of such programmes as well green public – private partnerships could be induced such that operations at various nodes are facilitated both from institutional system and private sector consulting and medium to large industrial units who seek to strengthen the vendors and various tiers in the drive towards green growth and towards development of eco-friendly products.

It is relevant to indicate here that the traditional supply chains and application of standards for production had also limiting aspects where scope for process innovations and continuous improvement ideology were often found to be constrained. In addition the problem of locking of vendors with in a given supply chain used to occur. These barriers could also be overcome through well designed green supply chain programmes.

(c) The scope for chemical leasing programmes

It is important to highlight that a vast variety of chemicals are core ingredients in the production and manufacturing systems. The chemical industry itself including basic chemicals and specialty chemicals is of the size of over USD 3.4 trillion worldwide and that Indian chemical industry sector is of the size of over USD 108 billion. As per common practice chemicals manufacturers have supplied chemicals to user industries and let the problems thereafter regarding management and disposal of spent chemicals to be at the users end. This practice has a potential to change via suitable programmes such as Chemical leasing system. Chemical leasing is the practice of recovery and recycling of spent chemicals by manufacturers and suppliers by taking back the supplied chemicals or their wastes and refining them or disposing responsibly. The user industry does not procure the chemicals but these are taken on lease for their usage whereby essentially the functionality of the chemicals and the knowhow is procured. It would be indicative to submit here that a wide range of chemicals can easily be subjected to chemical leasing programmes such as oils and greases, solvents, and potentially various catalysts. There is a need for a deeper focus on green chemistry and chemical leasing programmes could be mechanisms to enable such efforts towards greening industry and greening the economy as the responsibility of managing chemicals and their toxicity is enhanced across stakeholders,.

(d) Addressing Clean Technology applications in industrial sectors and voluntary units

There has been scope for application of refined old technologies and newly emerging technologies across industrial sectors. Some of these include scope for application of super-

critical fluids such as supercritical CO_2 that has scope for being used as solvent for enabling dyeing operations and reducing water consumption in textile processing sector, or in vegetable oil recovery / refining such as in Soya bean oil manufacturing etc. In addition is the scope for application of micro-wave technology and plasma technology in various sectors where currently not commonly applied. For example, the scope for applying plasma technology in the recovery of aluminium from tetra-packs recycling process has been discovered and innovations such as these have scope for application in Indian industry. The scope also of focusing on industrial equipment per se for improving operational practices such as for boilers, screw conveyors, presses etc also lead to structured programmes that address improvements in equipment use across sectors.

(e) The scope of developing suitable frameworks for cleaner production / waste minimization and clean technology interventions could be strengthened through **promotion of pro-activity in SME sector**. Accordingly, are developed some indicative principles towards voluntary efforts by SME units. These may be structured as voluntary guidelines parallel to the National Voluntary Guidelines developed by Ministry of Company Affairs in association with Indian Institute of Company Affairs. The pro-activity principles themselves are indicative of newer project formats or elements that could be included in new initiatives.

A set of 20 SME pro-activity principles being propositioned for informing future WMC programme / policy action are :-

Principle (a) : SMEs shall engage in piloting of technology convergence action

SMEs shall pro-actively invite research institutions to contribute to grounded research action and convergent initiatives for technology commercialization and upgradation, and ecological modernization initiatives via technology fertilization through technology convergence and technology migration action.

Principle (b) : The SME sector shall commit to the development of middle management to strengthen growth dynamics

SMEs shall pro-actively develop middle management for the sub-sectors to enable mass employment generation while facilitating demographic dividends in the country and accordingly strengthening professionalism and capacity to modernize the said sectors that would help expand the base and shape newer foundations for marching towards transformational frontiers

Principle (c) : The SMEs (manufacturing and consulting) shall participate actively in consortiums towards improved natural resources management

The SME sector shall display willingness to participate in all natural resource management initiatives (as part of consortiums and in association with institutions where needed) such as to strengthen the economic basis of the country alongside the reworking of productive and distributive efficiencies in the economy

Principle (d) : The Micro Small and Medium Enterprises shall shape entrepreneurial vision beyond national boundaries

SMEs shall seek to reshape and improve entrepreneurial vision and capabilities by focused outward internationalization initiatives (beyond the export markets and access ideologies) and be willing to setup manufacturing and consulting bases in new shores and further take action beyond collaborations to potentially re-energise and revitalize and transform foreign firms as well in various countries that may be needing such support and intervention from Indian Micro, Small and Medium enterprises

Principle (e) : The said sectoral leaderships and associations shall address and overcome inclusion – exclusion difficulties in programmatic action designed and developed for and by SMEs

SMEs shall take collective action to higher levels of benchmarks and enable proactive inclusiveness in firm by firm participation in national initiatives amongst the members which would include engaging in institutionalized programs that would highlight the equitable formats

Principle (f) : SMEs shall steer multi-stakeholder policy action by innovatively and comprehensively engaging with larger corporations and civil society

It would be the added responsibility of SMEs to be willing to acquire stakes in larger corporates in India and abroad (in individual and collective capacities), such as to ensure reformist voices from all regions and stakeholders and glocal communities are made to be heard and adhered to in apex forums (national, bilateral, and multilateral), such that suitable outcomes are realized from the policy actionables so developed here and agreed upon and accordingly for the quality of national and international entrepreneurship to achieve higher benchmarks in the eyes of national and international communities and stakeholders.

Principle (g) : The sector shall contribute to industrial policy development related legislative action

SMEs shall seek to collectively contribute to or participate in the development of suitable legislations and legislative activity via the agency of policy entrepreneurship and policy intrapreneuship facilitated by private and public institutions and related departmental entities and systems

Principle (h) : The SME sector shall strive to facilitate overcoming various market failures and promote fair trade practices

The responsibility of taking forward and enabling newer positive frontiers in the discipline of business services is another major arena for SME action to emerge. In this regard SMEs shall endeavour to facilitate overcoming of market failures such as in respect of services rendered by Chartered Accountancy and various financial services, legal services provisioning and also of technology provisioning agencies etc., such that ethical and transparent business services

delivery is ensured and financially productive outcomes achieved amongst participants to the services and beyond.

Principle (i) : The SMEs shall be highly active in facilitation of employee actualization and achievement of advancements and realization of aspirations of its teams and personnel

SMEs owe it to their employees and society that they take appropriate risks and grow larger via active response to socio-economic change (and thus not stagnate), such as to provide best growth for their employees and further meet aspirational expectations of all stakeholders via suitably redesigned redistributive value sharing practices that are acknowledged by all businesses and institutional entities

Principle (j) : SMEs shall strive to go beyond existing green industry norms and set higher standards towards sustainable development focus and lead the inter-generational equity movement ahead

SMEs to not only adopt advanced green practices and green factories' norms (such as multi-storeyed factory investments) but also to contribute to additional ways in advancing industrial land productivity via pro-active employment creation for any residually displaced communities that may be affected by larger scale land acquisitions for industrial development activities. In this respect MSMEs to actively partner with large scale industry sector and national and international institutions in setting higher standards, norms and practices that internalize and lead to practice of larger public interest.

Principle (k) : SMEs shall strive for factor reduction in resource use and application

SMEs to strive for factor reductions as per Weizsacker (2009-10) individually and collectively and include the achievements as part of environmental disclosures

Principle (l) : Contribute to and adopt IT applications for SMEs

SMEs to develop IT infrastructure collectively or in consultation with large scale units and IT firms and institutions engaged in IT services such as to develop applicable and effective SME Enterprise Resource Management software and application for improved firm management processes that may enable reflections on resource productivity assessments in aggregate basis from the sample reference structures so developed.

Principle (m) : Professionalise and contribute to development finance and Tobin funds

SMEs to encourage application of Tobin Tax or Tobin type Tax on financial transactions that occur on stock exchanges which reflect capitalization and performance metrics of key economic entities in countries, such that there is continuous stream of development finance support including for social, economic and environmental responsibilities achievement support and also for building sovereign funds that may enable outward internationalization of India and its economic entities.

Principle (n) : Focus on enhancing entrepreneurial performance

SMEs to continuously strive for enhancing and improving entrepreneurship quality in India in multi-dimensional ways as may be a dynamic feature to strengthen the basis of regional and national economic growth and development, including in the domain of shaping advanced initiatives in social entrepreneurship, besides also in the arena of venture capital productivity enhancement frameworks

Principle (o) : Demand improved public and private systems

SMEs may be amongst front runners in demand creation for higher quality of services from public system and in value chains across enterprises. This shall become a reflection of improving indices regarding Indian governance architecture and socio-economic parameters vis a vis the world statistics and measurements being undertaken and those that may evolve further ahead as economies modernise

Principle (p) : Strengthen institutional services

SMEs may actively extend institutional capacities to educate and apprise consumers of consumer rights such as to ensure demand creation for sustainability initiatives, including towards seeking eco-friendly products development and production and provisioning, addressing of life cycle costing and promoting life cycle thinking for strengthening green procurement practices

Principle (q) : Engage in, support / adapt and lead fair trade practices

SMEs may take the lead in the process of enabling fair trade practices and balance the import and export processes with cognizance of the principles of comparative advantage amongst nations and economies. In this respect exploration of trade relationships with economies that have been traditionally marginal trade partners so as to strengthen the trade balances in evolving goods and services markets context, and also in achieving a greater balance between indigenisation vis a vis import content in products

Principle (r) : Usher green growth and green economy

SMEs to strive to lead the ushering of the green economy in India and in facilitating the large scale units as well in such initiatives and processes in this regard. In such an evolving effort the SMEs may offer respective firms and units for evaluation and monitoring such as to enable identification of strengths in SME domain, and improving prospects of practices also in the large scale sector through collectively addressing gaps in achieving closed loop systems and balance in public-private goods cycles that are embedded in the institutional matrix.

Principle (s) Engage in knowledge creation

SMEs to engage with the process of creation of new knowledge proactively and strive to be born global enterprises and potentially transformable into green global corporations that lead green technology applications into other countries and economies and be harbingers of highly

responsible corporations of the future that could also turn around stagnating and ailing companies in other countries and be amongst the employment generators and life long learning organizations and accordingly bringing global acclaim to Indian enterprise

Principle (t) : Strengthen civil society initiatives

SMEs shall proactively engage with civil society to facilitate effective quasi public and quasi private actions and activities that seek to effectively bridge citizen gaps in economic activity that may be found and need to be overcome with community action and deliberative democratic principles in practice such that a balance in regional development is achieved and active balanced citizen participation across all sections of society so enabled. In the process also foster improved SME institutional responsibility and reversible Institutional SME responsibility in newer dimensions as well via the agency of entrepreneurship and intrapreneurship of higher quality across domains.

9.2 Potential and scope for additional sectors for WMC establishment

There has appeared further scope for development of the WMC programme and its structure and mechanism considering that new range of models of public – private partnerships are emerging for application in industrial clusters or supply chains etc.. In addition industry feedback is indicative of scope for additional sectors to be covered as part of the WMC programme in a potential extension phase in case considered viable by MOEF. A few indicative sectors to which WMC project could be extended include the following.

1. Sponge Iron plants and mini steel plants (medium scale units) (eastern region – Jharkhand / Bihar etc)
2. Gums and resins processing / manufacture (by a sectoral / research institution)
3. Tea industry (production/processing/manufacture) (eastern region – Assam / Darjeeling etc)
4. Medium scale mining units (various mineral ores) (Eastern region – Jharkhand / Chhatisgarh etc)
5. Stone crushers (clusters spread across various parts of India)
6. Wineries (and possibly Breweries as well)
7. Cashew nut processing / manufacture (eastern and southern India)
8. Wire drawing industries (e.g. Copper wire drawing units)
9. Construction / Infrastructure sector hardware units (e.g. plumbing items manufacture; pipes and steel tubes production etc)
10. Ginning and pressing units
11. Construction material Grinding units (e.g. for soapstone; china clay processing etc)
12. Groups of Small / Medium scale Hospitals and clinics
13. Power generation units (small scale thermal power and Non-Conventional / Renewable energy generating units including from biomass / biodiesel etc)
14. Fish processing sector
15. Tyre retreading units
16. Automobile workshops / service stations etc.
17. Auto / Machine components manufacturing / finishing units (e.g. ancillaries to large scale units; PSUs etc)
18. Coffee processing
19. Rubber footwear manufacturing

20. Edible flour making
21. Fertilizer – single super phosphate
22. Cement manufacturing
23. Sugar manufacturing
24. Light / incandescent / other - bulb manufacturing
25. Plastics – HDPE woven sacks manufacturing and other engineered plastics etc.

References and Readings

APO. 2002. Green Productivity Training Manual. Asian Productivity Organisation, Tokyo.

APO. 2003. A Measurement Guide to Green Productivity. 50 Powerful Tools to Grow your Triple Bottom Line. Asian Productivity Organisation, Tokyo.

Bianchi, R., Noci, G., 1998. 'Greening' SMEs' competitiveness. *Small Business Economics* 11, 269–281.

Brio J. A. del and Junquera B. 2003. A review of the literature on environmental innovation management in SMEs: Implications for public policies. Technovation 23 (2003) 939-948.

Chandak S, P, Wadhwa R, Kumra, S, eds, 1994, 'From Waste To Profits – Guidelines for Waste Minimisation', National Productivity Council, New Delhi.

Chandak S.P. 1994. "DESIRE project." *UNEP IE* 17 (4): 45.

Chandak, S, P, Gupta P.K., Wadhwa R., Kumra S. 1995. From Waste To Profits – Waste Minimisation in Agro Residue Based Pulp and Paper Industry. Technical Manual Series – I. National Productivity Council, New Delhi.

Chandak, S, P, Pervez, M. J, Gupta, R, Kalathiyappan, S. 1995. From Waste To Profits – Waste Minimisation in Pesticide Formulation Industry. Technical Manual Series - II. National Productivity Council, New Delhi.

CPCB. 2002. Parivesh: 'Special issue – Climate Change', Central Pollution Control Board, Ministry of Environment and Forests. October 2002.

Goldstein, S, G, 1985, 'Organizational Dualism and Quality Circles', *The Academy of Management Review*, Vol 10, No 3.

Howarth, Richard, and John Fredericks. 2011. Sustainable SME Practice; A Reflection on Supply-Chain Environmental Management Intervention. SCEM Reflective paper 26. *Social Sciences*.

Das, K. 2008. 'SMEs in India: Issues and Possibilities in Times of Globalisation', in H. Lim (ed.), *Asian SMEs and Globalization*, ERIA Research Project Report 2007 No. 5, Economic Research Institute for ASEAN and East Asia (ERIA), Bangkok, Thailand.

Malhotra, Abhishek, and Vikash Agarwalla. 2011. "Building an advantaged green supply chain." *Sustainability outlook*, March.

Morris, S., R. Basant, K. Das, K. Ramachandran and A. Koshy (2001). The growth and Transformation of Small Firms in India, Oxford University Press. New Delhi.

National Productivity Council. Waste Minimisation Manual for Electroplating Industry.

Nyati, K, P, 1988, *Problems of Pollution and its Control in Small Scale Industries*, New Delhi : Friedrich Ebert Stiftung (Friedrich Ebert Foundation).

Russo, F, 1999, 'Strengthening Indian SME Clusters : UNIDO's Experience', Case Study Project : US/GLO/95/144.

Sakurai K (eds). 1995. Cleaner Production for Green Productivity – Asian Perspectives. Asian Productivity Organisation, Tokyo.

Saxena A.K., Pervez, M.J., Gupta R.K., Sinha, D. 1998. From Waste To Profits – Waste Minimisation in Synthetic Textile Dyeing and Printing industry.Technical Manual Series - III', National Productivity Council, New Delhi.

Thukral H. 2008. Resource Conservation and Green Dynamics in Indian SMEs : A Case of Public–Private Partnership. Third International Conference on Public Policy and Management. August 2008, IIM Bangalore.

UNEP. 1993. The Textile Industry and the Environment. Technical Report Series No. 16.

UNEP. 1994. Environmental Aspects of Industrial Wood Preservation – A Technical Guide. Technical Report Series No. 20. Prepared in association with International Programme on Chemical Safety and Food and Agriculture Organisation.

UNEP. 2000. 'Promoting Cleaner Production Investments in Developing Countries', in Financing Cleaner Production – Study on Past Investment Practices. United Nations Environment Program, Division of Technology, Industry and Economics, Production and Consumption, Tour Mirabeau, 39/43 quai Andre Citroen, 75739 Paris Cedex 15, France.

UNEP and UNIDO. 2002. *Changing Production Patterns: Learning from the experience of National Cleaner Production Centers*. Environment.

UNEP. 1994. "Cleaner Production: What is cleaner Production and Cleaner Production Programme." *UNEP industry and Environment* 17 (4): 4.

UNEP 2006. *Energy Efficiency Guide for Industry in Asia*.

UNEP IE. Cleaner Production at Pulp and Paper Mills : A Guidance Manual. UNEP Industry and Environment.

UNIDO. 1995. 'From Waste To Profits: The Indian Experience', ID/SER.0/19, Vienna. UNIDO

UNIDO. 2010. Enterprise Level indicators for Resource Productivity and Pollution Intensity.A Primer for Small and Medium Enterprises.

UNIDO. 2013. Making It- Industry for Development. No. 15, 4th Quarter 2013.

USEPA. 1992. Facility Pollution Prevention Guide, Washington. United States Environment Protection Agency.

World Bank. 2006. 'India – Building Capacities for Public Private Partnerships', (June 2006), Energy and Infrastructure Unit and Finance and Private Sector Development Unit, South Asia Region, The World Bank.

World Bank. 2006. *Reforming Public Services in India : Drawing Lessons from Success*. New Delhi : Sage. Summary.

Others – Newsletters and Project Websites

WMC News, all volumes; Productivity News. Other newsletters on Websites.
NPC: http://wmc.nic.in

Videos

UNIDO, 1996, DESIRE

APO (2002 – 2004) Green Productivity Demonstration Project Videos for Edible Oil Industry, Dye and Dye Manufacturing, Stone Crushers etc.

NPC (2005) WMC Project Video

Green interactive advisories–The harbingers of green economy and the nucleus driving green growth !