European Union switchasia

Sustainable Textiles for Sustainable Development

Toolkit for Sustainable Textiles Production

TRAIDCRAFT
Fighting poverty through trade

aiaca
All India Artisans and Craftworkers Welfare Association

TEX

traid

Publisher

All India Artisans and Craftworkers Welfare Association (AIACA)

Switch Asia- SUSTEX Project Implementing Partner-India,

18, Community Centre, 3rd Floor,

East of Kailash

New Delhi- 110065

India

Phone: +91.11.26416492/93/94 | **Fax:** +91.11.26416491

www.aiacaonline.org | **mail to**: contact@aiacaonline.org

under

European Commission – SWITCH ASIA 'Sustainable Textiles for Sustainable Development' Project

Research and Preliminary Editing

KAARAK Enterprise Development Services Pvt. Ltd.

3153, Sector A Pocket B & C, Vasant Kunj

New Delhi-110070, India

AIACA Editorial Team

Ravi Kharka, Project Manager, Switch Asia Project

Mayank Trivedi, Project Coordinator, Policy Research and Advocacy

Printed at

Fortune India Printers

C-5, Sector-8, Noida (U.P.)

www.fortuneprinters.com | **mail to**: fipnoida@gmail.com

PREFACE

The Toolkit for Sustainable Textile Production (TSTP) has been designed to encourage sustainable production practices amongst the textile producers through access to technical, economic and environmental resources from the textile production chain. This toolkit was developed primarily for small and medium enterprises working in the area of textile manufacturing. The toolkit would also provide insights to enterprises aiming to be part of the Government of India's Scheme for Integrated Textile Parks (SITP). Under the toolkit, three themes of sustainable production have been covered which aim at reducing pollution levels of textile manufacturing units due to effluents, improving occupational safety and health facilities and promoting the use of sustainable raw materials.

The toolkit draws technical know-how in layman's terms with regard to sustainable treatment of wastes from textile units with the help of Effluent Treatment Plants (ETPs). In this regard, the methodology includes the steps in installing ETPs and its various functions in cleansing toxic wastes from a textile plant.

Recommendations for adopting Occupational Health and Safety (OHS) norms within textile units have been elaborated in the toolkit to provide information on increasing productivity of the units and improving the well-being of the workforce.

The use of sustainable raw materials especially organic cotton and dyes has been encouraged in the textile industry for higher sustainability and to minimise the effects of toxic substances which degrade the environment and destroy community livelihoods such as fisheries. In this regard, the toolkit provides information on the varieties of sustainable raw materials and the means to procure and use them in the textile enterprises.

The usage of case-studies in each section of the toolkit illustrates the practical aspects of the modules for enhancing sustainable textile production as well as offer insights to replicate the best practices in similar contexts.

ACKNOWLEDGEMENTS

The project team wishes to express its gratitude to the European Commission for commissioning this study; to Traidcraft for extending their unstinting support and for offering valuable suggestions in this endeavour. We would especially like to thank the members of Jaipur Integrated Texcraft Park Private Limited (JITPPL) and to the Consortium of Textile Exporters (COTEX), Jaipur, especially Rahul Duggal and Vikram Joshi, for facilitating and providing insights and contribution to the case studies about the JITPPL which enabled us immensely to develop the framework and content of this toolkit. Heartfelt thanks for all partners without whose commitment and dedication this document would not have attained the level that it has today.

The project team in particular like to thank Ms. Neeti Malhotra, Country Director, Traidcraft and Ms. Amita Puri, Executive Director, AIACA for their feedback and recommendations on the toolkit. The project team would also like to acknowledge the significant support of the members and staff of the Integrated Textile Parks at Baramati, Surat, Pochampally and Barnala for their support during the data collection process and their efforts in explaining the different steps in promoting sustainable textile production.

We would also like to extend our thanks to Ravi Kharka, Manager SWITCH ASIA Project and Mayank Trivedi, Project Coordinator, SWITCH ASIA from AIACA for their expertise and coordination in designing this toolkit. We also thank them for their contribution to the case-studies within the toolkit. This toolkit would not have been possible without their support.

Brajesh Pandey
Poorvaja Kumar
Kaarak Enterprise Development Services Private Limited, New Delhi

ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	*Full Form*
ACT	Arid Communities and Technologies
AIACA	All India Artisans and Craftworkers Welfare Association
BHTPL	Baramati Hi-Tech Textile Park Ltd.
BLT	Build – Lease- Transfer
BOD	Biological Oxygen Demand
BOT	Build - Operate - Transfer
CDP	Cluster Development Program
CETP	Common Effluent Treatment Plant
CEO	Chief Executive Officer
CFC	Chloro Fluoro Carbons
COTEX	Consortium of Textile Exporters
CRS	Composite Rapid Sand Filter
CSS	Composite Slow Sand Filter
CTC	Carbon Tetrachloride
ECHA	European Chemicals Agency
ECOFERT	Ecological Fertilizer Technology
EPCA	Environment Pollution (Prevention and Control) Authority
EPI	Ends per Inch
ETP	Effluent Treatment Plant
EC	European Commission
FCB	Finned Canal Block Filter
GETPL	Gujarat Eco-Textile Park Ltd
GSM	Grammage
HCHO	Formaldehyde
ILO	International Labour Organization
IL&FS	Infrastructure Leasing and Financial Services
IOHA	International Occupational Hygiene Association
JAS	Japanese Agricultural Standard
JITPPL	Jaipur Integrated Texcraft Park Private Limited
KAARAK	Kaarak Enterprise Development Services Private Limited, New Delhi
KAl2(SO4)3.12H2O	Alum
KHAMIR	Kutch Heritage, Arts, Music and Information Resources, Bhuj
MCC	Main Compound Charcoal
MBOs	Medium Business Organizations
MBR	Membrane Bio-Reactor
MoEF	Ministry of Environment and Forests
MSD	Musculo-Skeletal Disorders
MSDS	Material Safety Data Sheets
MSME	Micro- Small and Medium Enterprises
NCR	National Capital Region

ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	*Full Form*
NEAA	National Environmental Appellate Authority
NOP	USA National Organic Program
NPOP	Indian National Program for Organic Production
OHS	Occupational Health and Safety
PAC	Project Approval Committee
PHP	Pochampally Handloom Park
pH	Hydrogen Ion Concentration
PIL	Public Interest Litigation
PMC	Project Monitoring Committee
PPE	Personal Protective Equipment
PPI	Picks per Inch
PPP	Public Private Partnership
REACH	Evaluation, Authorization and Restriction of Chemical Substances
RIICO	Rajasthan State Industrial Development and Investment Corporation
RO	Reverse Osmosis
SBT	Soil Bio-Technology
SETP	Secondary Effluent Treatment Plant
SERI	Shrishti Eco-Research Institute
SIDC	State Industrial Development Corporation
SITP	Scheme for Integrated Textile Parks
SME	Small and Medium Enterprises
SMP	Sludge Management Plan
SPV	Special Purpose Vehicle
SSI	Small Scale Industries
SS	Suspended Solids
SUSTEX	Sustainable Textiles for Sustainable Production
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TSDF	Common Treatment, Storage and Disposal Facilities
TSS	Total Suspended Solids
TX	Traidcraft Exchange, UK
UNEP	United Nations Environment Programme
UNIDO	United Nations International Development Organization
UV	Ultraviolet Radiation
VOCs	Volatile Organic Compounds
WHO	World Health Organization

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

ANNEXURES

Section 1: Introduction

Context

The All India Artisans and Craftworkers Welfare Association (AIACA) is an apex (membership based), non-profit body for the craftworkers and the craft based organizations in India (www.aiacaonline.org).

In partnership with Traidcraft(TX), United Kingdom's leading fair trade organization, AIACA has been working since 2009 on a four-year project on Sustainable Textiles for Sustainable Development (SUSTEX) under the Switch Asia Program, to explore environmental, health and safety issues relating to the textile sector in India.

The project is supported under the Switch Asia Program of the European Commission and strives to achieve the overall program mandate to reduce poverty and improve the quality of life among artisans in the textile industry of Rajasthan. Further, the project has a specific objective of promoting such sustainable production and consumption practices for textiles sector in the state that are both environment friendly and has a positive impact on the livelihood and social security of the poor artisans and communities.

As one of the important components of the project, this toolkit has been developed to promote and disseminate information on the sustainable production practices that may be adopted to enhance the efficiency of the textile production value chain.

Kaarak Enterprise Development Services Private Limited (KAARAK), an advisory and professional services firm based in New Delhi, has developed this toolkit after an in-depth study done through using secondary data, envisaging technical support from other project partners and also the primary data collection from the various textile parks.

About the Toolkit

The Toolkit on Sustainable Textile Production (TSTP) is an instrument to promote sustainable production practices amongst the textile producers through use of technical, socio-economic and environmental data from the textile production chain. The primary audiences of this toolkit are the micro, small and medium enterprises involved in the textile production functioning either in clusters or individually throughout India.

The toolkit may especially be helpful to those enterprises that have either applied or are willing to apply for Scheme for Integrated Textile Parks (SITP) of the Government of India. The toolkit covers three major areas of sustainable production i.e. Effluent Treatment, Occupational Health and Safety and Sustainable Raw Materials.

Effluent Treatment Plants (ETPs) are being promoted for sustainable treatment of waste from textile units and also for water use efficiency. This toolkit shall provide technical and management related information to its readers' for setting up an ETP and also to provide an in-depth understanding on ETPs from the installation up to the maintenance phase. Under this section, topics such as ETP functions, types of ETP, the advantages and the related issues related to the same from installation phase to maintenance phase, have also been covered.

Occupational Health and Safety (OHS) in textile units has emerged as one of the major area of concerns. Realizing the importance of addressing the OHS issues in promoting the well-being of the workforce and their families and consequently their direct relation in enhancing the productivity of the units, the toolkit also provides information on the occupational hazards and risks and also the recommendations for adopting healthy OHS practices.

The toolkit in its final section highlights the potential of adopting sustainable raw materials by textile units, focusing specifically on organic cotton and natural dyes. Information on different categories, the price segments as well as procurement conditions of sustainable raw materials is also provided under this section.

The toolkit is kept simple in expression for presenting the technical information in an easy to understand format. This user friendly nature of toolkit makes it a useful ready to reference document for the textile enterprises and integrated parks which are unaware of these sustainable practices.

The section-wise case studies further highlight these practices as they are implemented and thus impart an understanding on the feasibility and adaptability of the methods in reality. In addition, the questions provided at the end of each section, would further help the readers to revisit and review the learning and information dealt with under that section. This toolkit would thus serve to be an effective guide for the textile enterprises to adopt sustainable production practices in practice.

Section 2: Textile Value Chain and Sustainable Production: Gap Analysis

India is ranked second in the production of textiles and garments after China. Presently, India is the third largest producer and the second largest consumer of cotton, the largest producer of jute, the second largest producer of silk, the second largest producer in cellulosic fibres and the fifth largest producer of synthetic fibres/yarn in the world. The textile industry has a very special place in the Indian economy, as it is one of the largest and the oldest manufacturing sectors in the country. It employs about 35 million people second only to agriculture. It also contributes significantly to the foreign exchange (18% of export earnings in 2009). Post liberalization, the Indian textile industry has witnessed significantly high growth rates in which MSMEs have played a very significant role. The total market size is estimated to be USD 52 billion which forms 4% of the total global trade.

The textile value chain starts from the raw material (fibres) and extends to the production of final products (clothing and made-ups). The major intermediate processes of this value chain are spinning, weaving, knitting and processing.

Environmental Hazards of the Textile Industry

The textile industry has been condemned as being one of the worst polluting industries given the high usage of chemicals and water resources at each step of processing. The textile industry, is also regarded globally, as the second biggest water polluting industry after agriculture and also as one of the most chemical intensive industries.

On an average, it takes about 1893 liters of water to produce just enough fabric to cover one sofa. Many countries have adopted environmental standards which are mandatory and restrict the use of harmful chemicals. India is one of the countries to have pioneered constitutional provisions for environmental protection. However, though legislations are in place yet their compliances still remains weak, and consequently putting question marks on the relevance and the adequacy of those very legislations.

Chemicals

Around two thousand different kinds of chemicals including dyes and transfer agents are used in the textile industry. In practice, the fabrics tend to retain the residues of chemicals used during their manufacture. Some of these chemicals are carcinogenic or may cause harm to children in pre-natal stages, while others may trigger allergic reactions in older people.

Table 1: Average water consumption for various types of fabrics

Average water consumption for various types of fabric		
Processing sub-category	**Water consumption (m^3/ton fibre material)**	
	Minimum	**Median**
Wool	111	285
Woven	5	114
Knit	20	84
Carpet	8.3	47
Stock/yarn	3.3	100
Non woven	2.5	40
Felted fabric finishing	33	213

Water

Water, an already depleting resource, is used substantially at every step of the textile manufacturing process. Water is first used to transfer chemicals and later to wash them out. This water containing chemical additives is then expelled as wastewater; which in turn pollutes the environment.

The waste water generated is thus saturated with dyes, de-foamers[1], bleaches, detergents, optical brighteners, equalizers and many other chemicals. Textile mills discharge millions of litres of effluents each year, loaded with harmful chemicals such as formaldehyde (HCHO), chlorine, and heavy metals (such as lead and mercury), which are significant causes of environmental degradation and health hazards.

[1] A defoamer or an anti-foaming agent is a chemical additive that reduces and hinders the formation of foam in industrial process liquids.

Polluting Processes in the Textile Value Chain

The processes and wastes generated are mentioned in the tables below:

Table 2: Waste generated during textiles manufacturing

Process	Emission	Wastewater	Solid Wastes
Fibre preparation	Little or none	Little or none	Fibre waste and packaging wastes;
Yarn Spinning	Little or none	Little or none	Packaging waste; sized yarn; fibre waste; cleaning and processing waste
Slashing/sizing	VOCs	BOD; COD; metals	Fibre lint; yarn waste; packaging wastes; cleaning waste; size unused starch based sizes
Weaving	Little or none	Little or none	Packaging waste; yarn and fabric scraps; off-spec fabric; used oil
Knitting	Little or none	Little or none	Packaging waste; yarn and fabric scraps; off-spec fabric
Tufting	Little or none	Little or none	Packaging waste; yarn and fabric scraps; off-spec fabric
Desizing	VOCs from glycol ethers	BOD from sizes lubricants; biocides; anti-static compounds	Packaging waste; Fibre lint; yarn waste; cleaning and maintenance materials
Scouring	VOCs from glycol ethers and scouring solvents	Disinfectants, insecticide residues; NaOH; detergents; oils; knitting lubricants; spin finishes; spent solvents	Little or none
Bleaching	Little or none	H_2O_2, stabilisers; high pH	Little or none, even if little, the impact could be considerable
Singeing	Small amounts of gases from the burners	Little or none	Little or none
Mercerising	Little or none	High pH; NaOH	Little or none
Heat setting	Volatilisation of spin finish agents synthetic fibre manufacture	Little or none	Little or none
Dyeing	VOCs	Metals; salt; surfactants; organic processing assistants; cationic materials; colors; high BOD; high COD; sulphide; acidity/alkalinity; spent solvents	Little or none
Printing	Solvents, acetic acid – drying and curing oven emissions combustion; gases	Suspended solids; urea; solvents; colour; metals; heat; high BOD; foam	Little or none
Finishing	VOCs; contaminants in purchased chemicals; formaldehyde vapours; combustion gases	High COD; suspended solids; toxic materials; spent solvents	Fabric scraps and trimmings; packaging waste; Paper, sheets, general domestic wastes; Fibre, wasted sludge and retained sludge

Table 3: Waste generated during textiles manufacturing

Process	Source	Pollutants
Energy production	Emissions from the boiler	Particulates, Nitrogen oxides (NOx) Sulphur dioxide (SO_2)
Coating, drying and curing	Emission from high temperature ovens	Volatile organic components (VOCs)
Cotton handling activities	Emissions from preparation, carding, combing, and fabrics manufacturing	Particulates
Sizing	Emission from using sizing compound (gums, PVA)	Nitrogen oxides, Sulphur oxide, Carbon monoxide.
Bleaching	Emission from using chlorine compound	Chlorine, Chlorine dioxide
Dyeing	Disperse dyeing using carriers Sulphur dyeing, Aniline vapours	Carriers H_2S Aniline dyeing
Printing	Emission	Hydrocarbons, Ammonia
Finishing	Resin finishing heat setting of synthetic fabrics	Formaldehyde carriers – low molecular weight Polymers – lubricating oils
Chemical storage	Emissions from storage tanks for commodity and chemicals	Volatile organic components (VOCs)
Wastewater treatment	Emissions from treatment tanks and vessels	Volatile organic components, toxic emissions

Regulating Environmental Impact of the Textile Industry

Globally there is a strong movement by different governments to regulate and control the environmental impact of the textile industry. One of the earliest measures taken by western governments has been to ban the hazardous Azo-dyes[2].

Later the amine dyes were also banned. In 1996, the German government made chemical dyes usage a criminal offence. The Indian government has also taken several measures in compliance with the international standards to reduce the environmental impact at the local level.

The Indian context

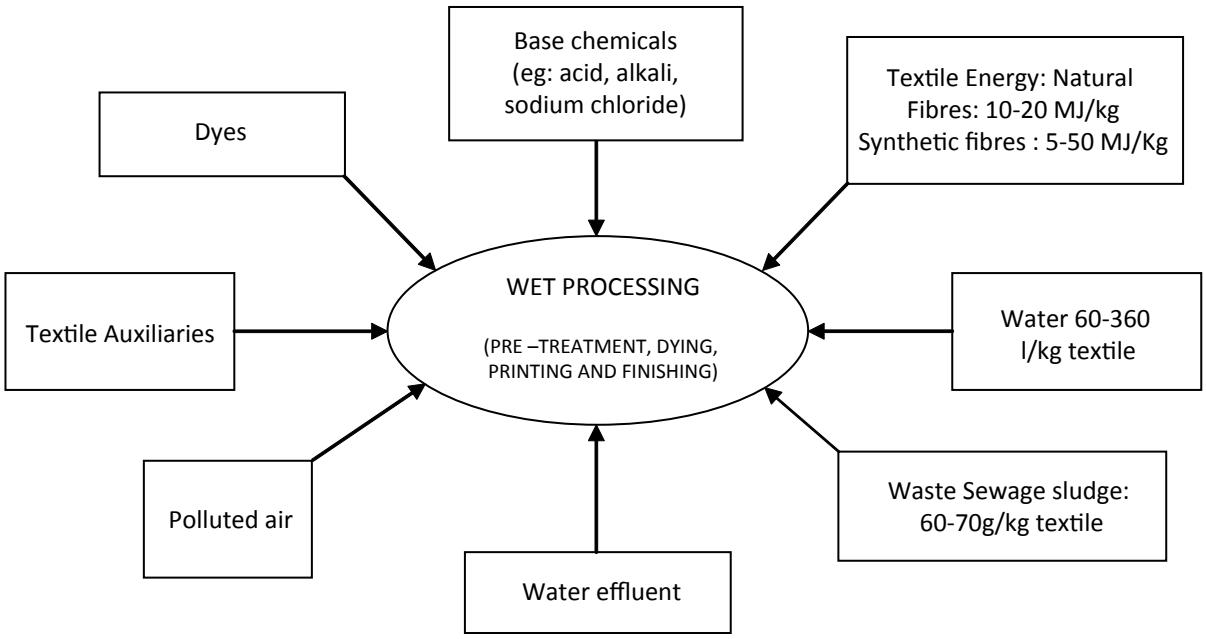
Most textile production centres in India utilise 'wet processing techniques' (bleaching and dyeing), which use huge quantities of water and various chemicals. The effluents discharged by the units are generally hot, alkaline, strong smelling and coloured and are often toxic.

Unfortunately, the majority of textile industries, especially the smaller units, do not treat their effluents properly and the untreated or partially treated effluents are discharged either into water bodies or on land. Sometimes the effluent is even used for irrigation purposes.

In many clusters around the country, textile effluents have caused serious environmental impacts on micro-ecosystem, drastically affecting the local aquatic bio-diversity impacting fisheries and the utility quotient of local water sources for human use as well as irrigation .

[2] Azo dyes are synthetic colours that contain an azo group, -N=N-, as part of the structure. Azo groups do not occur naturally. Most azo dyes contain only one azo group, but some contain two (disazo), three (trisazo) or more.

Input –Output analysis of Textile production



The Legal and Regulatory Framework for Environmental Protection in India

In India, the Ministry of Environment and Forests (MoEF) is the apex administrative body for :- (i) regulating pollution and ensuring environmental protection; (ii) formulating environmental policy framework in the country; (iii) undertaking conservation and survey of flora, fauna, forests and wildlife; and (iv) planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programmes. The Ministry is also the Nodal agency in the country for the United Nations Environment Programme (UNEP). The organizational structure of the Ministry covers number of Divisions, Directorate, Board, Subordinate Offices, Autonomous Institutions and Public Sector Undertakings to assist it in achieving all these objectives.

The responsibility for prevention and control of industrial pollution is primarily executed by the Central Pollution Control Board (CPCB) at the Central Level, which is a statutory authority under the MoEF. The State Departments of Environment and State Pollution Control Boards (SPCBs) are the designated agencies to perform this function at the State level.

A policy framework has also been developed to complement legislative provisions. The Policy Statement for Abatement of Pollution and the National Conservation Strategy and Policy Statement on Environment and Development (http://moef.nic.in/mef/policy.htm) were brought out by the MoEF in 1992 to develop and promote initiatives for protection and improvement of environment. The Environmental Action Programme (EAP) was also formulated in 1993 with the objective of improving environmental services and integrating environmental considerations into development programmes.

Existing Schemes and Programmes[3]

There are various centrally and state sponsored schemes formulated in the country for pollution abatement. The major objectives of these schemes are to ensure pollution abatement through assessment and monitoring of air and water quality, introduction of cleaner technologies for resource conservation, setting up of Effluent Treatment Plants (CETPs) at various levels (Micro-, SETP and CETP), research and development, and upgradation of laboratories etc.

[3] Report of the Working Group on Environment and Environmental Regulatory Mechanisms in Environment and Forests for the Eleventh Five Year Plan (2007-2012)

The major activities initiated under various schemes on pollution abatement are briefly summarized below for easy reference:

(i) Central Pollution Control Board (CPCB)

The CPCB undertakes projects and programmes through various allied institutions, and research organizations related to assessment and monitoring of air and water quality. For this purpose, a wide network of monitoring stations have been established. Preparation of air quality management plan for sixteen cities and source apportionment studies for six identified cities were also undertaken during the 10th Five Year Plan, the creation of environmental data bank, performance evaluation of Common Effluent Treatment Plants (CETPs) and undertaking programmes for capacity building and awareness[4].

The Pollution Control Boards (both Central and State) have further laid down a number of norms regarding permissible limits for air and water pollution including the composition of the effluents. The other significant measures include banning of CTC (Carbon Tetrachloride), CFC (Chloro Fluoro Carbons) and benzidine-based dyes.

(ii) Industrial Pollution Abatement through Preventive Strategies

The scheme consists of three components namely; Environmental Audit, Adoption of Clean Technology in Small Scale Industries and Environmental Statistics. The objective of the scheme is to assist small scale industries in the adoption of cleaner production practices and reduction in waste generation[5] .

(iii) Establishment of Environment Protection Authorities and Environment Commission and Tribunal

Under this programme, authorities have been constituted following the various orders of the Hon'ble Supreme Court of India for ensuring the environmental compliances and the enforcement of various activities. Two of those authorities are –

- National Environmental Appellate Authority (NEAA) constituted under National Environment Appellate Authority Act, 1977, to hear appeal with respect to industries, operations or processes[6], and
- Environment Pollution (Prevention and Control) Authority (EPCA) set up for the National Capital Region for compliance relating to environmental standards, emission or discharge of pollutants, steps to control vehicular pollution, and restriction of industries etc[7].

(iv) Assistance for Abatement of Pollution and Environment Policy and Law

This scheme was started to strengthen various State Pollution Control Boards (SPCBs) and the State Environment Departments for enforcing the statutory provisions for initiating pollution abatement measures, and also to bring about an upgradation of facilities for analysis, capacity building etc. Under the scheme, most of the SPCBs were provided funds for strengthening the laboratories and to undertake various research projects[8].

(v) Clean Technology

The objective of the scheme is to provide support to introduction of cleaner production technologies through setting up of demonstration projects and the initiation of relevant Research and Development activities[9].

(vi) Creation of Management Structure for Management Substances

Under the scheme, the activities are carried out under three thrust areas namely; chemical safety, chemical accident prevention and sound management of hazardous waste and municipal solid wastes. Accordingly, the activities thus initiated include preparation of off-site emergency plans, setting up of emergency response centres, establishment of Common Treatment, Storage and Disposal Facilities (TSDF) for hazardous industrial wastes, and the preparation of hazardous analysis report, etc[10].

[4] http://cpcb.nic.in | [5] (envfor.nic.in/report/0203/chap-05.doc) | [6] http://www.moef.nic.in/legis/others/envapp97.html
[7] http://www.envfor.nic.in/legis/ncr/ncrauthority.html | [8] http://moef.nic.in/divisions/policy.html
[9] http://moef.nic.in/downloads/public-information/IP-CTF-2011.pdf | [10] http://moef.nic.in/divisions/hsmd/hsmd.html

(vii) Environmental Impact Assessment

Environmental Impact Assessment (EIA) is one of the important management tools for incorporating environmental concerns in the development projects at the planning stage. Environmental clearance has been made mandatory since January 1994 and since then the Ministry has initiated re-engineering of environmental clearance processes.

A notification on environmental impact assessment was also issued in September 2006 which replaced the earlier notification of 1994. Under the new notification, the developmental activities are categorized into Category 'A' and Category 'B' based on potential impacts instead of investment criteria[11].

(viii) Common Effluent Treatment Plant (CETP)

The objective of this scheme is to provide financial assistance to small scale industries in clusters to establish/upgrade Common Effluent Treatment Plants (CETPs) for enabling them to comply with environmental discharge standards. The programme covers the entire country and funds from the Centre are routed through respective State Pollution Control Boards[12].

Present Scenario

In 1996, Hon'ble Supreme Court passed a legislation, following which enterprises have been left with only three options, i.e. either to shut down their operations, to build their own Effluent Treatment Plant (ETP); or to join a group of enterprises in building a Common Effluent Treatment Plant (CETP). Despite the existence of stringent environmental laws and regulations, compliance by the Indian textile industry (especially the processing units) has overall been rather poor.

This is primarily because the escalating costs made the investment in greener technology and processes unprofitable, especially for those producer groups and manufacturers whose operations are either small or medium scale or cater to the domestic market where eco-requirements are not yet particularly strict.

The Indian judiciary, however again took a serious note of this situation and reacted stringently on the complaints filed leading to the closure or shifting of units to newer locations. In February 2012, over 700 textile-processing units in 'Tirupur cluster' were closed following a Madras High Court order for not achieving zero liquid discharge. At present about 100 of these units have resumed operations after meeting pollution control norms.

The Government of India is also making efforts through various schemes and programmes to assist the textile clusters in adopting sustainable production practices. Most of the clusters are under the lens of the government and judiciary which has put a tremendous pressure on the small and medium scale enterprises.

In one of the instances, the Ministry of Textiles in its announcement in April 2012, declared the setting up a high level committee to look into the damages caused by the textile industry to local environment and ecology at Jodhpur, Barmer and Pali. Headed by the Secretary, Textile Ministry, the Committee was to formulate economically viable technical solutions to resolve the situation.

The three districts of Jodhpur, Barmer and Pali have over 2,000 textile units engaged in printing and dyeing of cloth and which are posing a major threat to the environment and ecology in the absence of an effluent disposal and treatment. The Rajasthan High Court in its decision on a Public Interest Litigation, has asked the units located in the Barmer district to close down their operations. The Central and State governments also are now making efforts to comply with the Rajasthan High Court's order by supporting enterprises in adopting efficient effluent treatment practices.

[11] http://moef.nic.in/modules/divisions/eia/
[12] http://moef.nic.in/divisions/cpoll/cept.pdf

Case Study 1: Sanganer – A cluster at risk due to environmental pollution

Sanganer town in Jaipur district in Rajasthan is famous worldwide for its dyeing and printing industries. Sanganer houses around 473 micro and small units in which desizing is undertaken in 8% of the units, bleaching in 16%, dyeing in 25%; printing and screen washing in 54% and post-print washings at 15% units either independently or in combination of two or more units. It is estimated that more than 10,000 KL of wastewater is discharged every day. This is mostly untreated water and flows through the drains and channels into the pools and reservoirs leading into the crop fields, where this contaminated water is used for irrigation purposes.

In a study conducted at Sanganer, the results clearly indicated that the effluents and the surface water of Amani Shah drainage were not fit for agricultural or other recreational purposes. The study highlighted the seriousness of pollution problem existing in the area. Apart from the highly toxic chemicals in the effluents; the textile workers were also exposed to such polluted waters for an extended duration.

Noticing such large-scale contamination, Vijay Poonia, a lawyer, filed a Public Interest Litigation (PIL) in 1994 alleging that the dyeing and printing units were unauthorized and were causing extensive environmental damage. The court immediately passed an order asking the units to obtain permission from the State Pollution Control Board within 45 days. The order also asked the factories to close their operations in case they failed to produce the stipulated approvals.

The Sanganer Kapda Rangai and Chhapai Association (for short, 'the Association') in its reply denied the dyeing and printing units to be discharging any effluent. They also mentioned that these industries were providing jobs to lakhs of people who were not having any other source of income. This initiated prolonged legal deliberations, which are still ongoing leaving the future of the cluster in uncertainty.

The Rajasthan High Court, with reference to the Fundamental Right of citizens to pollution-free environment, directed the Rajasthan State Industrial Development and Investment Corporation Ltd (RIICO) to take requisite measures to relocate the dyeing units of Sanganer within a time frame of eight months. It also made a provision for charging fine from polluting units.

In compliance of the Hon'ble High Court's order, RIICO identified new industrial area for the relocation of the units. Meanwhile, the Association also appealed against the relocation citing that it would lead to loss of jobs. This application was rejected by the High Court following which the Association appealed before the Hon'ble Supreme Court in 2005.

The Association argued before the Hon'ble Supreme Court against relocation and suggested that the units were ready to treat the effluent and discharge at Sanganer itself. The Hon'ble Supreme Court allowed the units to run in their present locality on the condition that they would treat the effluents before discharging.

However, the units have still not been able to install the effluent treatment plants successfully and await the final judgment of the court, as the PIL is currently lying dormant. The cluster is keeping its fingers crossed but is unwilling to take steps to set up facilities to prevent and control pollution. Their hopes hinge on the slow system of judiciary, which may take years to decide on the pending litigation.

The Sanganer Rangai Chhappai Association has set up a 'Pollution Control Society'[13]. It is believed that an important reason for the units not investing in the pollution control facilities is the lack of civic amenities and the area being unauthorized. The Association has made several pleas with the state government for civic amenities but they have not met with much success.

The cases of Sanaganer, Pali, Barmer and Jodhpur reflect inadequacies of the textile enterprises in these districts to implement sustainable production. The government and enterprises need to work together.

[13] UNIDO report

There is a need to bring about a change in the thinking, production and consumption patterns of the textile industry. Finding alternatives for this resource intensive industry like various water conservation methods like water reuse and reclamation, waste water treatment, waste minimization, low cost green technologies for production and proper infrastructure and trade investments (incentives) may lead to a sustained and progressive development of the industry.

Learnings (Section 2): The reader should be able to answer the following questions after reading the above section

Q1. What are the environmental hazards caused by the textile industry?

Q2. Which legal regulatory bodies are involved in environment protection in India?

Q3. What are the existing schemes and programmes for pollution abatement? Describe in brief each of them.

Q4. Give a brief outline of the India's stand on in environment pollution caused by textile industry.

Q5. What are your learnings and take home from the Sanganer Case study?

Section 3: Sustainable Production: The Way Forward

Adoption of cleaner technologies for waste treatment and textile processing along with the use of sustainable raw materials are key components of sustainable production. From the situation described in the earlier section, it is clearly evident that that the textile units will have to adopt sustainable modes of production either willingly or enforced through various legal tools available. The other integral component of sustainable production is the Occupational Health and Safety of the workers, which is also the responsibility of the textile units. In India, there is now a Central Government policy in this regard.

The current market trend both globally as well as domestic market shows a distinct orientation and an inclination for environmentally friendly and sustainable products, which makes it a viable incentive for the adoption of sustainable production practices. A market research study was also conducted under this project. Its findings also suggest that an average buyer is ready to pay premium for such environment and health conducive products. Additionally, with the opening of retail sector for foreign direct investment , the international brands will have a greater access to Indian markets imparting cost and quality competitiveness. In addition, these international brands have very stringent norms for production practices and in their absence the local MSMEs may lose on upcoming opportunities.

In this toolkit we discuss three main strategies that every unit should adopt in order to have a sustainable production. A brief overview of the three steps to be followed is:

A) Setting up of Effluent Treatment Plants (ETPs): The conventional treatment systems like physico-chemical[14] and physico-chemical followed by biological treatment have been installed in the majority of textile industries.

Steps in Waste Water Treatment: The first step in the waste water treatment is the mixing and equalizing the waste water streams that are discharged at different times and different intervals from different stages in the processes. Equalization ensures that the effluents have uniform characteristics in terms of pollution load, pH and temperature. The chemical treatment helps in reduction of colour and suspended solids. A significant reduction in BOD and COD values is also observed. This physico-chemical treatment is followed by biological treatment process, which further reduces BOD and COD values. Textile effluents may further require tertiary or advance treatment methods to remove particular contaminant or to prepare treated effluent for reuse. Some commonly used tertiary treatment operations include removal of residual organic colour compounds by adsorption and removal of dissolved solids by membrane filtration. The waste water is also treated with ozone and other oxidizing agents to remove many other contaminants. Evaporation and crystallization are other methods to minimize effluent disposal problems. The document also talks about this method in detail in following sections. It thus becomes essential that in order to undertake such treatments, the units need to install ETPs. Experience has however shown that MSMEs are not interested in unit level ETPs due to high costs. Accordingly, CETPs are being promoted under special schemes. There are other efforts to lower the cost of unit level ETPs as well which are explained in detail under Section 4.

B) Occupational Health and Safety Measures: There are numerous health and safety (H&S) issues associated with the textile industry. These include chemical exposure from processing and dyeing of materials; exposure to cotton and other organic dusts which can affect the throat and lungs; musculo-skeletal stresses; noise exposure which can lead to hearing loss; high temperature and low ventilation which can lead to fatigue and dehydration and working hours and breaks, including access to food, drinks and bathroom facilities. Section 5 outlines some of the potential hazards of the various dyes and chemicals used in textile processing and also speak on the ways to minimize exposure to them. It provides details of some basic prevention measures that can be taken in-house in the units to minimize the risks of accidents and to ensure a safer working environment in the units.

C) Use of Sustainable Raw Materials: While designing and manufacturing any textile related product, the production and processing of fibre as the primary raw material comes as the primary requirement. If the raw material is a natural plant fibre, emphasis should be laid on the amount of water and chemicals needed to ensure a successful harvest of a high-quality material. If a manufactured fibre is being used, there are questions about the nature of the raw material and the way it is processed into fibre. The document further highlights the importance of using sustainable raw materials that come from renewable or recyclable/recycled source so as to minimize the environmental impacts. Under Section 6, the toolkit seeks to promote the use of natural chemicals as a part of sustainability in textile manufacturing. The database of sustainable raw material suppliers can be seen on - http://aiacaonline.org/policy-sustainable.asp?links=policy4

These three main practices can help in promoting the principle of sustainable production in the textile industry which is increasingly being followed by many international enterprises and is also picking up in Indian enterprises also. One such big player and also a potential role model for textile units due to its origin and growth is the case of GAP mentioned below.

[14] Physico-Chemical treatment- Any processing of wastewater, toxic substances or other materials involving a combination of physical and chemical methods, such as physical processes including air-stripping or filtration and chemical processes including coagulation, chlorination or ozonation.

Case Study 2:GAP – Role model for Textile Enterprises

Introduction

Doris and Don Fisher founded GAP Inc.[15] in 1969 in San Francisco with a single store and a handful of employees. Today GAP Inc. is a global company with five distinct brands — GAP, Banana Republic, Old Navy, Piperlime and Athleta offering clothing, accessories and personal care products for men, women, children and babies with about 132,000 employees and about 3,000 company-operated stores and about 200 franchise stores. For past four years consecutively, GAP Inc. has been getting recognized by the Ethisphere Institute as one of the World's Most Ethical Companies. The company attributes this success to its work practices that have contributed in providing collective value to employees, customers, shareholders, suppliers and society by helping to ensure the long-term health and viability of the business and communities in which they operate.

GAP: Towards social responsibility

The company has a Social Responsibility division as well which closely monitors and oversees the responsible and ethical business practices. This division has full-time staff dedicated to these issues, and partners with hundreds of factory owners and managers, NGOs, and industry associations throughout the world with expertise in social and environmental issues.

In 2009, the company conducted the first phase of environmental footprint assessment to analyze its opportunities to improve energy, water, and waste consumption in regions and in facilities where there is a control over operations. In 2010, Human Rights Policy for GAP Inc. was developed which applies globally within their wholly-owned operations, as well as within the apparel supply chain. Community Investment is being focused through involvement of more than 5,000 women in the developing world who till now participated in GAP Inc.'s signature program, Personal Advancement Career Enhancement (P.A.C.E.), which helps female garment workers' advancement in the workplace.

The company focus is more on making a difference on critical environmental issues for energy saving and combating climate change rather than just selling 'green products'. After assessing the environmental impact of its entire supply chain the company has set both the short and long-term goals to operate more efficiently and address climate and regulatory risks effectively.

The company is also participating in the Sustainable Apparel Coalition which seeks to establish standards in such areas as sustainable materials, as well as the working conditions inside factories. GAP is also a member of Business for Innovative Climate and Energy Policy (BICEP).

GAP primarily follows two most significant corporate mantras:

Code of Vendor Conduct (COVC) which seeks to safeguard workers' rights in the factories of GAP Inc. brand. Since 1996, the company has made progress in ensuring that these factories abide by a strict set of social and environmental criteria. There is a team of Social Responsibility Specialists which works with the factories to ensure that COVC requirements are met.

Code of Business Conduct (COBC) is the foundation for promoting a responsible and ethical work environment. The COBC sets forth the company's expectation that the employees do what's right and act with integrity in all that they do. Among other things, the COBC informs employees on how to prevent conflicts of interest, ensure legal compliances and protect the company's information and assets. The COBC encourages employees to speak up if they have any questions about the COBC or see improper conduct or behavior.

[15] GAP doesn't sell eco-friendly textiles

Brand building through responsible and ethical business practices

GAP being a frontrunner as a clothing retailer has always tried to remain committed to and work for setting business standards which are not only replicable but also establish norms of best practice. One such example is their on-going support for the United Nations Global Compact and its ten guiding principles. Top priorities amongst these are :

a) Reducing impact on environment, whereby one hundred percent of GAP branded denim is made in compliance with Water Quality Program so that the wastewater from denim laundries is properly treated before being discharged. In addition to this, they also commit to reduce absolute greenhouse gas emissions from their operations in the United States.

b) Partnering for Better Work, is of serious consideration to the company. GAP is founding member of the International Labour Organization and International Finance Corporation's Better Work Program, which is currently operational in seven countries, and

c) Enforcement and monitoring, which is the key to their functioning. To ensure this, the Social Responsibility Specialists play an indispensable role working directly with factories around the world. They ensure that the factories meet the standards outlined in Code of Vendor Conduct. Only those factories which meet GAP enforced business standards, including those outlined in COVC are approved. COVC is a rigorous process starting with an initial audit of the unit's working conditions. Also, improvements and modifications are made on a regular basis in these monitoring techniques.

GAP's Vendor Development Program

In 2010, a pilot project was initiated to help selected vendors producing GAP Inc. branded apparel, develop and improve their human resource management systems. This pilot initiative resulted in the formulation of the Vendor Development Program. The use of social and environmental responsibility certification has also been incorporated under the key elements of this program. Some of GAP suppliers are working with Verite – an independent organization monitoring labor rights in global markets – to help them assess and build socially responsible human resource management systems in alignment with GAP's own Vendor Development Program strategy.

Conclusion

GAP has tried to establish norms for a global retailer which is very important for a conscientious business which actively works towards improving working conditions, and decry child labour and unfair labour practices by vendors. GAP has been able to set a benchmark in adhering to environmental, social and human rights laws while promoting advancement of women at the workplace. It has been able to ensure that there is no discrimination, no inhumane practices, wages and benefits along with working hours and working conditions are met as per OHS norms.

This way of doing business is what has been the demand of such conscientious customers and markets, where fair play forms the core of business ethics. GAP has thus been able to set the standards for other retailers to follow in some ways.

The Indian market is also learning from such cases and making a positive move to promote sustainable development. Though there are a lot of challenges involved but the country is taking steps to overcome them, and one such step has been the formulation of the 'Scheme for Integrated Textile Parks (SITP)'.

Coming Together: The Integral Step

Textile units especially the micro, small and medium ones are one of the worst affected in adopting the sustainable modes of production and consumption. The situation gets aggravated given the limited awareness of the different methods and technologies being used for the purpose. These technologies are usually

expensive from the perspective of the micro, small and medium level enterprises. Generally, adoption of sustainable practices is considered as an additional expense to the enterprise and believed to decrease the cost competitiveness of units by increasing their costs of production. However, with the growing awareness regarding the harmful effects, sooner than later the textile units (of all sizes) will need to adopt and implement sustainable modes of production. However, since the textile units normally exist in clusters, it provides them with a huge opportunity to adopt sustainable practices collectively for the benefit of all.

Conventionally, the cluster level units used to come together for lobbying and advocacy; however, coming together for a common facility management is a new phenomenon. There are several advantages of coming together apart from cost efficiency, which impacts the overall profitability of the cluster and of individual enterprises as well.

Despite some successful examples of clustering and organizing in different parts of the world, promoting collective action remains one of the key challenges in most of the textile clusters in the country. As per the Cluster Development Methodology proposed by UNIDO, 'Mutual Trust' amongst the cluster stakeholders is the key component which takes the cluster forward. Accordingly, the cluster stakeholders should focus on improving the levels of trust in the cluster before initiating this exercise. The principles of collaboration as well as competitiveness can go hand in hand. While the units can compete with each other in marketing strategies, they can very well collaborate with each other in the areas of common interests. The sustainable modes of production can then fall into the common areas of interest.

Following are the key steps to follow:

a) Define the shared vision and objective of the cluster alongwith shared values. As this is partnership for long term, it is important that all cluster stakeholders are part of this visioning exercise.

b) The visioning exercise should then lead to choosing and determining leaders of the clusters who can further work upon the operating principles. At this point, it is advisable that a cluster level organization, also known as Special Purpose Vehicle (SPV) is formed which can take up operations and be responsible for overall management.

c) While the governance of the SPV can be overall responsibility of the SPV members, the day-to-day management should be handed over to a professional team and managers. This is very important as in absence of a professional team the management and operations of the common facilities gets ignored, hampering the overall growth of the cluster.

In India, there are a number of government programs and schemes to support clusters in their endeavors to come together for overall economic growth as well as in setting up high cost common facility centers. One such ambitious scheme is SITP (explained below), which aims at setting up world class textile parks all over the country. It also enables the clusters in shifting towards sustainable modes of production.

Scheme for Integrated Textile Parks in India (SITP)

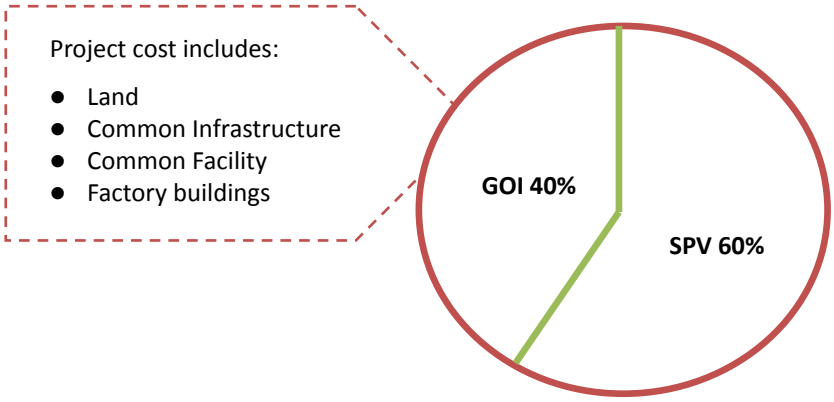
To address the growing environmental, social, legal and human concerns the Scheme of Integrated Textile Park (SITP) was launched by Ministry of Textiles, Government of India with an objective to establish Integrated / Hi-tech Textile Park with world-class infrastructure and manufacturing facilities based on Public-Private Partnership (PPP).

The project is seen as a corrective measure to improve the environment and health of workers in the textile industry, by reducing contamination of drinking water sources and improving practices that currently affect the health of local communities (such as the use of hazardous dyes).

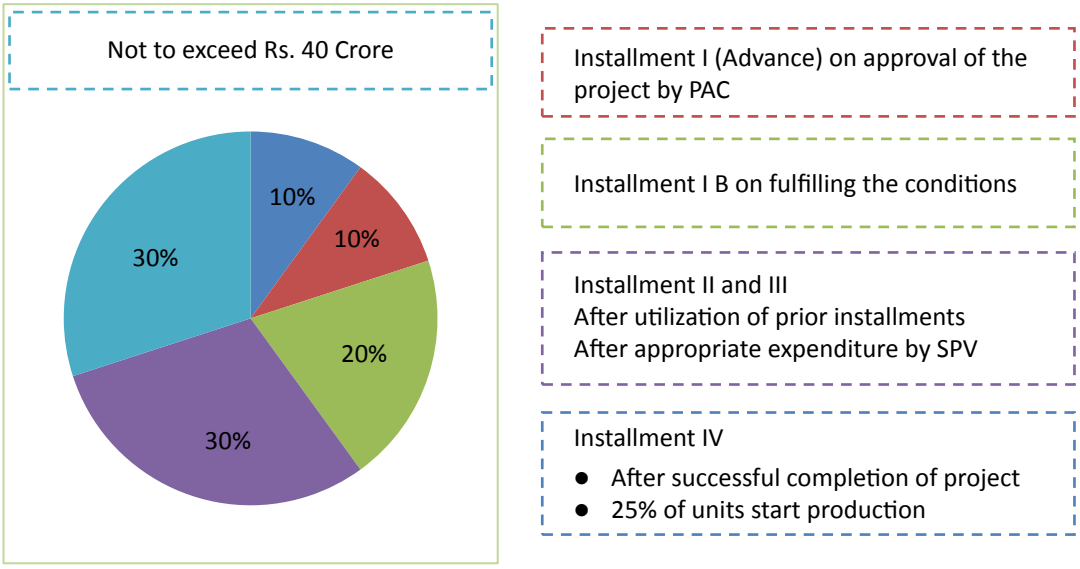
The scheme aims to establish model eco-friendly textile parks all over the country that will be an example to textile units across India. The scheme aims to bring together a range of partners or cluster stakeholders including technical service providers, textile producer groups, small textile businesses and local government representatives, so as to provide low cost technological solutions to reducing pollution from craft and textile production activities.

Through the textile parks, the scheme supports small textile businesses to become less polluting, thereby reducing damage to environment and health. The Scheme specifically supports small businesses to source sustainable raw materials, adopt eco-friendly production practices, access appropriate low-cost technology and develop eco-friendly products, and provide efficient market linkages.

Funding structure



Release of GOI Grant



Learnings (Section 3): the reader should be able to answer the following questions after reading the above section

Q1. What are the three strategies of sustainable production mentioned in the toolkit?

Q2. What do you learn from the international case study –GAP and how best can the learning's be applied to your enterprise?

Q3. What is 'Scheme of Integrated Textile Park (SITP)' for and how effective is it in promoting sustainable production with MSMEs?

Q4. Can your enterprise be benefitted by the Scheme of Integrated Textile Park? Please assess.

Section 4 - Effluent Treatment

Effluent Treatment in textile industries is largely related to waste water treatment since it largely comprises of waste generated during the process. Accordingly, effluent treatment in simple terms is the removal of wastes from water and its proper disposal so that it doesn't cause any damage to the environment.

What are Effluent Treatment Methods?

Effluent can be treated in a number of ways depending on the level of treatment required. Effluent treatment, also referred to as the waste water treatment (in this case) is a series of steps employed for the treatment of waste water using one or more treatment processes and/or types of equipment.

The major categories of treatment are referred to as preliminary, primary, secondary and tertiary (or advanced) treatments depending upon the nature of the waste water and the extent of treatment required respectively. The mechanisms for treatment can be divided into three broad categories: physical, chemical and biological, which all include a number of different processes.

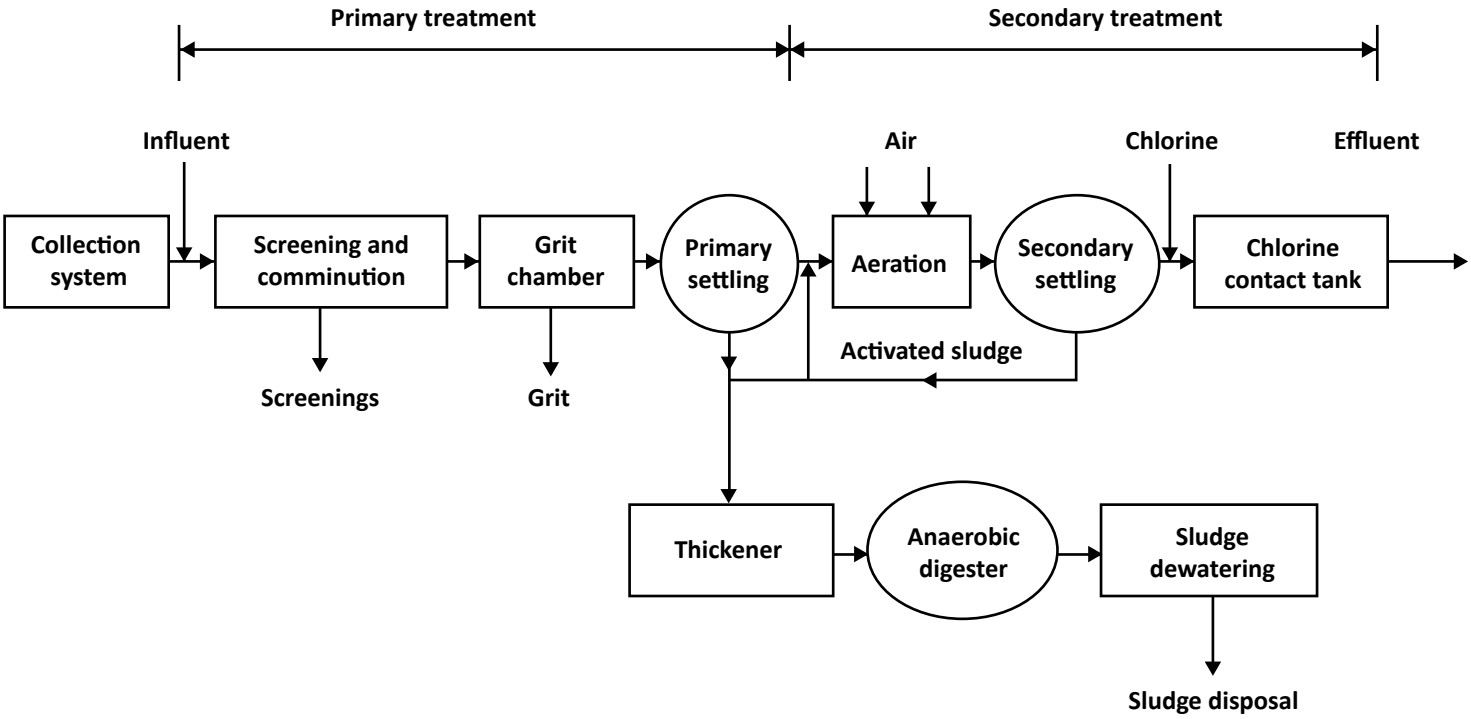
Table 4: Wastewater Treatment Levels and Processes

Treatment Level	Description	Process
Preliminary	Removal of large solids such as rags, sticks, grit and grease that may damage equipment or result in operational problems	Physical
Primary	Removal of floating and settle able materials such as suspended solids and organic matter	Physical and chemical
Secondary	Removal of biodegradable organic matter and suspended solids	Biological and chemical
Tertiary/advanced	Removal of residual suspended physical, solids / dissolved solids	Chemical and biological

What is Effluent Treatment Plant (ETP)?

An ETP is a set of equipment and processes used to treat wastewater at any one or multiple levels as mentioned above.

What are different types of ETPs?



The nature and type of ETP depends upon the level of treatments that the plant is undertaking. There are ETPs which undertake only primary treatment whereas there are ETPs which undertake treatment up to secondary level or some at tertiary or advanced levels. The type of ETP also depends upon whether the treatment is being undertaken at the unit/enterprise level or at the cluster where the waste of a number of enterprises/units is treated collectively. The cluster level ETPs are commonly known as Common Effluent Treatment Plants (CETPs). Additionally, there are ETPs which depend upon different kinds of technologies of effluent treatment. Some innovations have been in practice in which eco-friendly technologies are being used to treat the effluents.

What is a Common Effluent Treatment Plant (CETP)?

Common Effluent Treatment Plant is mainly used for a cluster of MSME industrial units for treating effluents collectively. The main objective of CETP is to reduce the treatment costs for individual units while protecting the environment.

What are the advantages of a CETP?

- Reduces the cost of pollution abatement for individual factory
- Professional control over wastewater treatment can be affordable
- Solves the problem of lack of space by having a centralized facility
- Relatively better hydraulic stability
- Homogenization of wastewater
- Reduces the problems of monitoring for Pollution Control Boards
- Organizes the disposal of treated wastes and sludge to improve recycling and reuse possibilities

Who is essentially required to set up a CETP

Such MSMEs who

- do not have individual wastewater treatment plant because of the scale of operations or lack of space or technical manpower and have huge amount of wastewater discharge
- do not have the capital to construct their own ETP
- do not have the capital to operate their own ETP

What needs to be considered before Setting up a CETP?

The setting up of CETP requires selection of technology, selection of a consultant as well as selection of contractor to undertake the entire task. It is important for the units (organized into cluster level organization) to have a fair awareness and knowledge of the basics of CETP, as they would be the ones who would play a key role in their operation and maintenance. Though some of the elements are technical in nature, yet the cluster stakeholders should make an effort to develop an understanding on the technical aspects of the CETP. An exposure visit to any other CETP can be of very good help in this regard

Some of the key points are mentioned below:

What comprises Feasibility Assessment of CETP?

The feasibility assessment involves gathering information on existing proposed institutions, environment and infrastructural issues and conducting a waste inventory in a particular geographical area. Such a feasibility study plays a key role in influencing the design of the plant.

Proposed institutions, environment and infrastructural issues

1. Number of Firms: More number of participating firms helps in reducing the unit cost.
2. Location of Firms: Close proximity of firms reduces the transportation cost and influences the cost factor of a CETP.
3. Presence of Sewer system: The area requires proper laid out sewer lines and good roads.
4. Volume and strength of waste: Firms that produce small volume of waste more likely to benefit from CETP than firms that produce large volume of waste.
5. Firm Size: Small firms often lack the ability to raise the capital needed to install pollution control equipment.
6. Existence and enforcement of waste water regulations

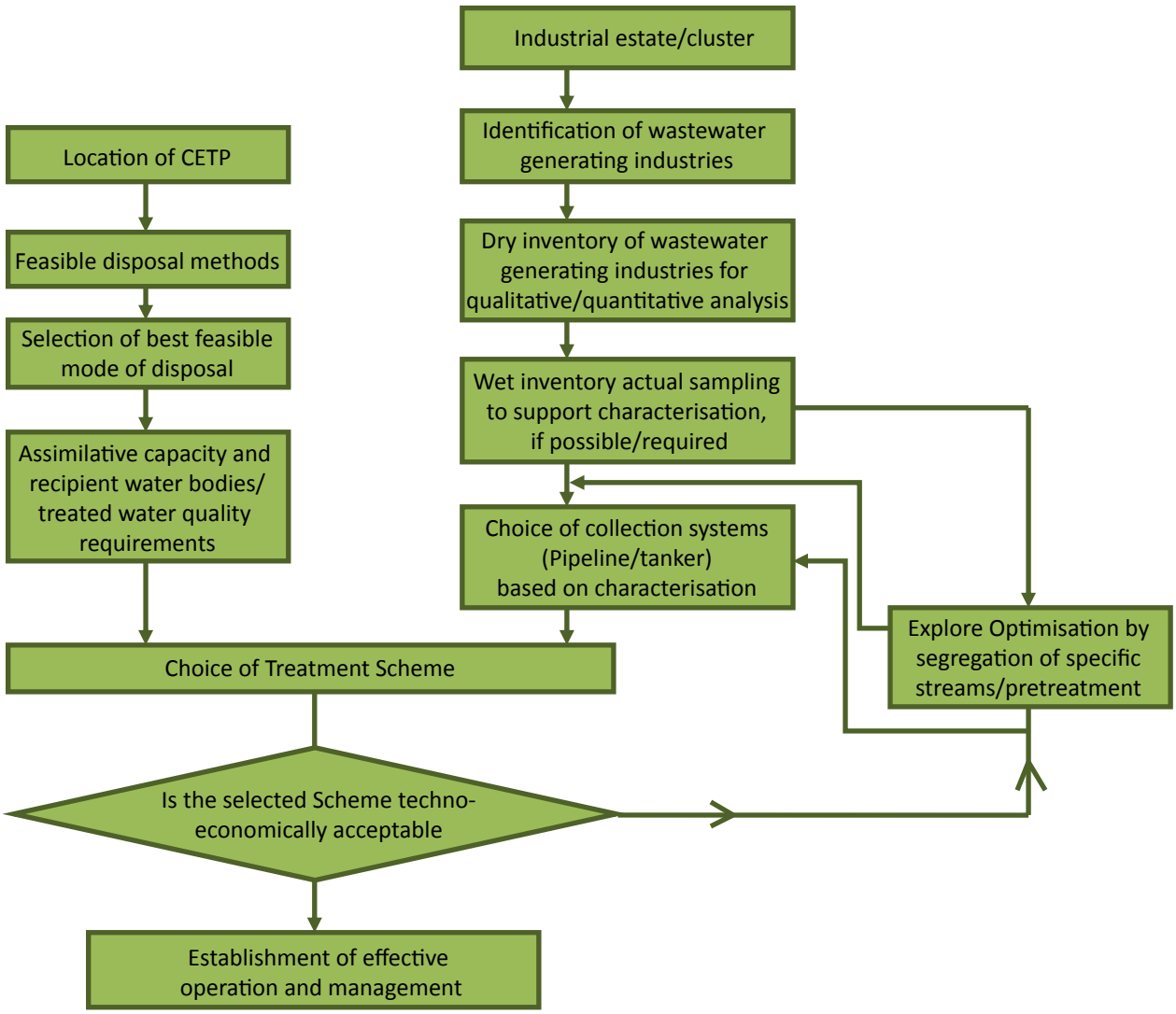
What is Waste Inventory and its steps?

1. Identifying industries in the geographical area: Potential user of the CETP, determining number and types of industries.
2. Types and volumes of waste generated: Organic or inorganic. Volume of diluted and concentrated waste and total waste and Hazardous or Non Hazardous (helps in designing and managing the CETP).
3. Estimate future waste loads: would determine plant capacity and help in planning for new industries
4. Identify treatment options: after identifying the volume and types of waste generated
5. Evaluating cleaning technologies: to reduce waste generation

What are key steps in the Planning process of CETP?

Factors which influence the proper planning and operation of the CETP include:

1. Categories of effluent generating member industries
2. Qualitative/Quantitative fluctuations of effluent (equalization/homogenization/modules)
3. Pre- treatment requirements
4. Segregation of effluent streams at individual member industry
5. Collection and monitoring mechanism
6. Treatability choice of technology and bio-degradability[16]
7. Mode of disposal and;
8. Charging system



What is the Design Basis of a CETP?

Design of an industrial CETP is highly site specific. Major general considerations are site characteristics and wastewater characteristics.

Site Characteristics

Topography, soils, geology, hydrology, climate and land use are to be considered while designing a sewer network and a CETP.

1. Topography and depth of bedrock strongly influence the cost of sewer installation.
2. Elevation distribution that allow gravity flow and adequate depth for burial of pipe most desirable.

[16] Bio-degradability, the capacity of some substances to decompose readily by biological process.

3. Soil thickness and characteristics such as clay content, sand content, organic matter and permeability are major considerations when certain treatment options are being considered for CETPs (land and lagoon treatment or granular media filtration etc).
4. Climatic factors such as precipitation and evaporation are important when inflow is a problem with sewers and when treatment processes being considered rely on evaporation of treated waste.

Unfavorable hydrological conditions at the site include:

1. Aquifer recharge zones
2. Flood-prone areas
3. Wetlands
4. Seasonally high water table
5. Proximity to water supply wells or reservoirs

Wastewater Characteristics

Key characteristics of wastewater that must be considered in designing CETPs include the flow of water and the physical, chemical and biological characteristics of the wastewater.

1. Flow: Wastewater flow, commonly expressed as m^3/day, determines the size of the CETP.
2. Physical characteristics include:
   - ***2.1*** Solid (floating debris, grease and oil slicks indicates pollutant level)
   - ***2.2*** Temperature (affects chemical and biological reactions and solubility of gases such as oxygen)
   - ***2.3*** Colour and odour (indicates the degree of pollution)
3. Chemical Characteristics: Significant chemical characteristics include organic, inorganic in solution and gases. These are indicated by BOD (mg/l) and COD (mg/l)
   - ***3.1*** Pre-treatment standards: It is mainly required when
     - **a)** Waste water is carried through sewer lines to minimise corrosion and clogging of sewer lines.
     - **b)** It reduces the efficiency of the biological treatment process and also in the toxic effects by separating toxic concentration of organic and inorganic substances.
   - ***3.2*** Conveyance system: Industrial effluents may be transported to CETP by tankers, piping system or a combination of these two.

What are options for construction and management of CETP?

There are different methods of building and operating CETP. They are briefed below:

- ***BOT (Build - Operate - Transfer):*** a company builds a facility, an infrastructure project gets to operate it for a while and is paid for that, and finally transfers it back to the public sector at the end of certain period, which is determined by when the construction company is believed to have been paid a satisfactory amount.
- ***BOOT (Build – Own – Operate – Transfer):*** A BOOT structure differs from BOT in that the private entity owns the works. During the concession period the private company owns and operates the facility with the prime goal to recover the costs of investment and maintenance while trying to achieve higher margin on project.
- ***BOO (Build – Own – Operate):*** maybe the trickiest of these because here there's at least, up front, no government involvement whatsoever. The private sector builds the project, owns it and operates it.
- ***BLT (Build – Lease- Transfer):*** Under BLT a private entity builds a complete project and leases it to the government. In this way control over the project is transferred from the project owner to the lessee.

What are the cost factors of CETP?

The cost of construction of the plant depends on some basic factors. They are:

- Kind of processing followed for the treatment (primary, secondary, tertiary treatments)
- Kind of fabric
- Kind of dye (substantive/direct dyes, VAT dyes, mordant dyes): Price of dye is dependent upon cost of raw material which in turn depends upon its availability.
- Area available (Cost of land)
- End use of treated water (Reverse Osmosis (RO) and Thermal evaporator system to treat the RO rejects)

After the technology for the plant gets finalized, the best and most cost effective way is to consult some consultants and manufacturers for constructing the CETP. There are many national and international consultants who have wide range of experiences in construction of treatment plant as per different requirements.

How different technologies affect the cost of CETPs?

Table 5: Comparative statement of fixed and recurring cost CETPs based on various technologies

Technology →		**Biological Treatment**	**Oxidation Reduction by Chlorination**	**Membrane Bio-Reactor (MBR)**	**Ozonation**	**Electro Flocculation**	**Soil Bio-Technology (SBT)**
Cost ↓							
Fixed cost per MLD of effluent (Rs. in Crores)	Pre treatment (Stage I)	3.0-3.5	2.0-2.5	4.0-4.5	4.5-5.0		
	Recycling Plant (R.O.Plant) (stage-II)	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0		
	Reject Management (Stage-III)	2.0-2.5	2.0-2.5	2.0-2.5	2.0-2.5		
	Total	**6.5-8.0**	**5.5-7.0**	**7.5-9.0**	**8.0-9.5**	**0.6-0.7**	**1.5-2.0**
Recurring cost (Per MLD) in Rs.		40,000/-	42,000/-	45,000/-	65,000/-	Rs. 1.5 lakh per month for this particular plant	25,000/-

What are Ownership and Management Options for CETP in a cluster?

Formulation of appropriate institutional arrangements and specifying applicable government jurisdictions for the ownership and operation of a CETP respectively is as important as a good engineering design of the plant.

Main questions to be answered in this connection are:

1. ***Which or how many governmental jurisdictions should be involved?***
2. ***Should the form of ownership be public, private or a combination of the two?***

Ownership options

1. Public sector
2. Public – private tripartite, and
3. Private sector (cooperative)

Table 6: CETP ownership options for industrial estates in India

Option	Advantages	Disadvantages
Public sector	• The necessary management and technical expertise would be relatively easy to obtain from internal resources • As the State Industrial Development Corporation (SIDC) maintains other services for the estate such as water, power, roads, and drainage, the operation of a CETP could conveniently become part of the Corporation's service program • Because of this control over other services, the enforcement of legal and financial obligations on the individual industries may be less difficult than by other arrangements • The enforcement may also be enhanced through ease of coordination and cooperation with other government agencies such as water and electricity boards	• Potential inefficiency in public sector enterprises • Environmental regulatory agencies may be more reluctant to impose standards and enforce compliances on another government agency • Lack of flexibility in operation and choice of staff
Public – private tripartite arrangement	• Necessary private expertise to design, construct and operate facility is immediately available • The controlling public sector agencies and the individual waste-producing industries do not have to deal with day to-day operational problems • Contracting company does not have to assume financial risk of construction • Public agency ownership provides more leverage for enforcing compliance with pre-treatment standards as compared to only private ownership	• May be more expensive to waste-producing units as compared to the cooperative private sector option because of the fees being set to give profit to the contractor.

Private sector (cooperative)	• If operated on a cost recovery basis only, it will be possible to ensure the lowest cost of treatment to individual waste producers • It is beneficial that the industries producing the waste for treatment have a direct financial and legal involvement in the company managing the CETP • There could be better transfer and use of technical know-how and personnel and the possibility of using member industries' materials and equipment to overcome short-term problems at the CETP • The increased awareness of environmental responsibilities by the industry association and the individual industries will increase the probability of success of the CETP by an active involvement in the operation and management	• With a large number of industries participating, it could take a long time to constitute such a company as that satisfies all parties, bearing in mind the considerable variation in size and type of industries • There could be potential conflict of interest between an individual industry's involvement in its own production and the cost and performance of the CETP

What are the Financial Apportionment Methods?

"Polluter Pays" principle, i.e. the industry must pay the cost of treatment and disposal of waste in an environmentally acceptable manner. It therefore follows that the cost of operating a CETP must be borne by the industry being served by the CETP.

Methods:

- ***Quantity based Method***

This method is suitable for those industrial estates having wastes which are uniform in composition.

- ***Quantity-Quality Method***

The applicability of this method considers both the quantity and qualitative characteristics of the waste generated from the Industrial Park. Selection of a specific method needs detailed analysis and discussions with all the stakeholders for an easy implementation.

What are the government standards for inlet effluent quality of CETP?

Standards laid by Ministry of Environment and Forests, Government of India for Common Effluent Treatment Plants as per Environment (Protection) Rules, 1986

Table 7: Primary treatment

Primary Treatment	
Parameter for inlet effluent quality of CETP	**Standards (Concentration in mg/l)**
pH	5.5 - 9.0
Temperature °C	45
Oil and Grease	20
Phenolic Compounds (as C_6H_5OH)	5.0
Ammoniacal Nitrogen (as N)	50
Cyanide (as CN)	2.0
Chromium Hexavalent (as Cr+6)	2.0
Chromium (total) (as Cr)	2.0
Copper (as Cu)	3.0
Lead (as Pb)	1.0
Nickel (as Ni)	3.0
Zinc (as Zn)	15
Arsenic (as As)	0.2
Mercury (as Hg)	0.01
Cadmium (as Cd)	1.0
Selenium (as Se)	0.05
Fluoride (as F)	15
Boron (as B)	2.0
Radioactive Materials:	
Alpha emitters, Hc/mL	10-7
Beta emitters, He/ml	10-8
Note: 1. These Standards apply to the small scale industries, i.e. total discharge upto 25KL/Day	
2. For each CETP and its constituent units, the State Board will prescribe standards as per local needs and conditions; these can be more stringent than those prescribed above. However in case of clusters of units, the State Board with the concurrence of CPCB in writing, may prescribe suitable limits.	

What are the government standards for treated effluent quality of CETP?

Table 8: Government standards for treated effluent quality of CETP

Parameters	**Into inland surface waters**	**On land irrigation**	**Into Marine Coastal areas**
pH	5.5-9.0	5.5-9.0	5.5-9.0
BOD [3 days at 27 °C]	30	100	100
Temperature	Shall not exceed 40°C in any section of the stream within 15meters down steam from the effluent outlet	-	45 °C at the point of discharge.
Suspended Solids	100	200	(a) For process wastewater-100 (b) For cooling water effluent 10 percent above total suspended matter of effluent cooling water
Dissolved Solids (inorganic)	2100	2100	-
Total residue chlorine	1.0	-	1.0
Ammoniacal Nitrogen (As N)	50	-	50
Total Kjeldahl Nitrogen (as N)	100	-	100
Chemical Oxygen Demand	250	-	250
Arsenic (as As)	0.2	0.2	0.2

Mercury (as Hg)	0.01	-	0.01
Lead (as Pb)	0.1	-	1.0
Cadmium (as Cd)	1.0	-	2.0
Total Chromium (as Cr)	2.0	-	2.0
Copper (as Cu)	3.0	-	3.0
Zinc as (Zn)	5.0	-	15
Selenium (as Se)	0.05	-	0.05
Nickel (as Ni)	3.0	-	5.0
Boron (as B)	2.0	2.0	-
Percent Sodium	-	60	-
Cyanide (as Cn)	0.2	0.2	0.2
Chloride (as Cl)	1000	600	-
Fluoride (as F)	2.0	-	15
Sulphate (as SO_4)	1000	1000	-
Sulphide (as S)	2.8	-	5.0
Pesticides	Absent	Absent	Absent
Phenolic Compounds (as C_6H_5OH)	1.0	-	1.0
Note: All efforts should be made to remove colour and unpleasant odour as far as possible [Concentration in mg/l except pH and Temperature]			

Govt. Incentives and Regulations

For setting up of CETP a proposal for project proponents may be sent to the State Pollution Control Board (SPCB) and the State Govt. for approval and State subsidy and to the Ministry of Environment and Forests, Govt. of India for Central subsidy. The project proponent for CETP (company) may also obtain loan from any nationalized bank.

Criteria for Assistance

Ordinarily in an industrial estate or cluster of SSIs one CETP will be promoted. This may vary on case to case basis. Central assistance will be available only for cluster of SSIs.

Projects for assistance will be prioritized on the basis of

a. Toxicity of pollutant
b. Pollution load treated
c. Number of units covered

- The project should be self-financing for servicing of the loan and meeting operation and maintenance costs of aquatic species.
- The project must formulate adequate institutional arrangements for cost sharing, recovery of dues and management and to ensure the compliance with the prescribed standards.
- The scheme must have technical recommendations of the State Pollution Control Board.

Pattern of Assistance

- Central assistance upto 25 percent of the total cost of the CETP would be provided as a grant to the Common Effluent Treatment Plants on the condition that the State Govt. provides a matching contribution. The remaining cost should be met by equity contribution by industries and loans from financial institutions.
- Central assistance will be provided only for capital cost. No assistance will be provided for recurring cost. The assistance will be released in installments.
- Central assistance will generally be limited to 25% of the capital cost of the project, subject to other conditions such as matching grant of the State Govt.
- It may be of advantage to combine some components of CETP with the municipal system. In such a scheme the municipalities are also required to contribute their share of cost.

Procedure

The company will obtain loan from IDBI or any other financial institutions. The project proponent for CETP (company) will approach the State Govt./Central Govt. for their contribution of subsidy. The subsidy would be released into the account of the company opened in IDBI (or any other financial institutions).

Table 9: CETP Setting up Checklist

S. No.	Check List	Status	Comments
1.	Is the CETP Meant for an industrial estate or a cluster of small scale industrial units?		
2.	Whether no. of SSI provided?		
3.	Whether types of SSI provided?		
4.	Whether medium and large industries proposed alongwith SSI form part of 17 categories of highly polluting industries?		
5.	Whether managing body for the CETP constituted and registered as a SPV?		
6.	Whether the proposal/DPR of the CETP for Central funding has been forwarded /recommended through the concerned SPCB/PCC?		
7.	Whether conveyance system has been proposed for the CETP?		
8.	Whether the CETP has a sludge management plan (SMP) in place?		
9.	Whether guarantee of performance at full design load has been ensured by the concerned SPCB upfront before grant of Consent to Establish (CtE) with conditions as mentioned at paragraph no. 7.10 of the guidelines?		
10.	Whether an environment management plan (EMP) has been prepared and documented?		
11.	Whether a legal agreement between the SPV and its member units executed?		
12.	Whether necessary clearance obtained from the concerned SPCB for discharging the treated effluents?		
13	Whether hazardous waste disposal plan is in place and clearance obtained from concerned SPCB?		
14.	Whether DPR has been technically appraised?		
15.	Whether commitment of the State Govt. to bear 25% of the capital cost has been received?		
16.	Whether the cost recovery formula developed for the CETP project has been ratified by all member units?		
17.	Whether the level of treatment technologies has been identified?		
18.	Whether the land allotment deed is available?		
19.	Whether the CETP is a fresh case or an up gradation proposal? In case of latter, is the time gap adequate?		
20.	Whether setting up of a laboratory is envisaged in the DPR?		
21.	Whether timeframe/ bar chart for the implementation of the CETP has been provided?		
22.	Whether the possibility of recycling/ reuse of treated effluent from the CETP has been explored and documented?		
23.	Whether any funds have been released by the State Government?		
24.	Whether forward and backward linkages of the CETP have been provided / committed by the State Government or its agencies?		
25.	Whether member industries have committed towards meeting the treatment cost and O and M of CETP?		
26.	Whether the CETP operator has entered into a MOA with the participating industrial units as mentioned in Para no. 5 of the guidelines?		

Case Study 3: Setting up and Managing a CETP: Case of Gujarat Eco Textile Park Limited, Surat

GETPL Profile

Incorporated in October 2005, Gujarat Eco-Textile Park Ltd (GETPL) is a Special-Purpose Vehicle (SPV) promoted by the Luthra group of companies to set up a textile park near Surat (Gujarat). It is based at Pandesara in Surat.

GETPL is among the first textile parks to be approved under the Scheme for Integrated Textile Parks (SITP), supported by the Ministry of Textiles, Government of India. The Park has been set up over an area of 104 acre, at a cost of Rs. 129 Crores. It aims to attract an investment of Rs. 705 Crore, to produce textile products worth Rs. 850 crores annually, and more importantly to provide employment to 25,000 people. All 33 units of the park have been sold off. Of these, 20 units are currently in operation and 6 are under construction; the remaining 7 units are yet to be constructed.

The GETPL provides basic infrastructure to companies for setting up their own units in the park. The companies are provided with space, building and 24 hours power supply through its own 8.5 MW Group Captive Power Plant. It also provides infrastructure facilities like road, storm water drainage, compound wall, training centre, workers' canteen, bank, hospital etc. for the common usage of its members. The GETPL has an incineration plant and a Common Effluent Treatment Plant (CETP).

Common Effluent Treatment Plant at GETPL

The Gujarat Pollution Control Board has permitted the CETP under its authorization to treat effluents at the SITP itself. The CETP at GETPL has 60 MLD capacity, which is expandable to 100 MLD. The recycling of the treated effluent is done by latest technology of 'reverse osmosis, ultra filtration and multiple effect evaporation'. The power plant was procured from Rolls Royce and CETP is designed using C Tech technology of SFC Inc, Austria. The GETPL-CETP was built with an investment of about 50 crores. In case individual units set up their individual plants, it would cost the companies more than 25 lakhs each besides the recurring operational costs every month.

The CETP at GETPL is managed by its sister concern 'Gujarat Enviro-Protection and Infra Ltd'. The management team is responsible for the management of solid wastes; hazardous wastes, waste water treatment, and the treatment of industrial effluents and sewage.

Management and Membership

Any company can become a member of the Common Effluent Treatment Plant (CETP) by paying a membership fee of Rs. 4 lakh. The members have to pay 10% of the capital costs for the CETP. In GETP, the textile ministry gave a subsidy of Rs. 40 Crore to the SITP for the setting up of CETP. Individual units can avail CETP facility by paying a monthly rent of Rs 12000/- per chamber.

Process of CETP

The receiving tank has an online pH meter to show the pH of the raw effluent that flows into the receiving tank through a Gravity Pipe. Smaller pipes from each of the 30 units (at present 24) are connected to this gravity pipe which empties into the tank. 3 floodgates are attached to the tank which helps in maintaining the flow of the water from the gravity pipe to the Mechanical Screens. The mechanical screens helps to filter the effluent water which flows from the floodgates. It removes all the foreign objects like plastic cups, packets or any other form of garbage or anything, which could clog the machines in the receiving tank. There are 3 mechanical screens for filtering the water, of which two are automatic and one is manual. There are two sensors on the floodgates to automatically start the mechanical screens once the level of effluent water rises and the foreign objects need to be removed. After the effluent water is being filtered, it is directed through

the second flood gate situated behind the mechanical screens and which help filter the water before it finally flows into the filtration tank.

The water is then thrown in the receiving tank, which has three large suction pipes going deep into the tank. These suction pipes suck water and send it to the cooler above to cool the temperature of the water before it is sent to the Equalisation Tank.

The meter capacity of the equalisation tank is 1250 m^3/hour, which is sucked in by the suction pump. The capacity of the Sludge Blanket Clarifier (SBC) is 8 MLD. The SBC has a diameter of 47m and is the biggest tank for sludge in all of Gujarat. The tank water is fed with Poly Aluminium Chloride and is used as a cheaper alternative for the lime, ferrous and polymers. The Coagulation and Flogging method is used after the sediments precipitates due to gravity and clear water remains on the top. The sludge from the tank is collected in another sub tank which sends it out as sludge. The sludge is then carried out of the SITP for treatment. From the SBC clear water is released to the pH correction tank. This is done to treat the pH value of the water if it is more than 7.

The water is then passed to the C-Tech Basin which feeds urea and DAP into the water which is important for the bacteria in the Treatment tank. The bacteria works upon the water and cleans it further.

The tank is divided into 4 parts which takes total 90 minutes for filling and aeration while it takes 45 minutes each for settling of sediments and in the decantation process. The tank has a selector zone in which water comes from 4 channels. The water is then treated for the removal of nitrogen through the process of nitrification and denitrification, where nitrogen gets converted to ammonia and then to nitrite and nitrate subsequently getting converted to nitrogen oxide which is released into the air. CO_2 and O_2 are also released after the treatment. The tank has two pumps: SAS pump and RAS pump. These pumps help in further cleaning of the water. The clean water from the tanks is then released from the tubes attached into a deeper tank which measures the impurities through an electronic meter. The water is then released into the outlet which meets with the main water source.

Advantage of CETP

The CETP is more effective than the conventional method of treatment in terms of its cost-effectiveness and electricity consumption. The decanter used in the current CETP is made of stainless steel which does not get corroded and has long life. The Automation system further helps to alert the system about any discrepancy or problem.

Monitoring

A team of 25 people manage the CETP through a centralised system. The observation room is fixed with 6 LCD screens, which are fed with regular updates of the tank and the whole system. The Gujarat Pollution Control Board has also installed cameras at the stack point so that regular monitoring of the quality of water being disposed can be done.

Way Forward

The water released from the deep water tank is clearer but requires further treatment to be made available for drinking. The GETPL is not installing RO system and other available technologies for making the water reusable in the SITP or making it available for drinking as the process is costly and the units are not ready to contribute for the same. However the GETPL is trying to pursue the units and the government to help with subsidies to get it installed .

Case Study 4: Need to promote Effluent Treatment Plants at the individual enterprise level in artisanal cluster: A Case of Balotra

Introduction

In Rajasthan, fabrics were indigenously dyed and printed with herbal dyes by manual process in cottage industries but nowadays, mechanical process and chemical dyes are used which generate pollutants. In the state there are huge concentrations of small scale units for textile dyeing and printing which indiscriminately discharge water containing chemical pollutants. This waste water has not only rendered the surface and ground water non potable and harmful for human/animal consumption, but has also affected the land close to the disposal points or those irrigated with contaminated water. Various mechanical processes and chemical/synthetic dyes are used and a considerable amount of wastewater is discharged from these textile units. This water contains harmful dyes to the extent of 20% and which has led to the degradation of water quality in this water scarce semi-arid region of the country. The report 'Performance Status of Common Effluent Treatment Plants in India' published by the Central Pollution Control Board in 2006, stated that in Rajasthan hazardous waste generated from CETPs is either stored within their premises or injudiciously discharged on land elsewhere.

The small and medium textile units in Jasol, Bithuja (washing centre for Balotra) and Balotra areas of Barmer district produce effluents much beyond the capacity of the 4 Common Effluent Treatment Plants (CETP). Consequently, it finds its way into the Luni river basin, and as a result the river has almost ceased to exist. The capacity of all these 4 CETPs put together is 50.5 MLD, whereas the total effluent discharge from the textile units is about 86 MLD.

Balotra: About the Cluster

Balotra is a city in Barmer district about 100 kms from Jodhpur. It is famous for its hand block printing and textile industry. Balotra has also been a leading centre in India for processing and trading of various types of fabrics. Majority of the industries in Balotra are cotton textile processing units comprising mainly of dyeing and printing. There are more than 5000 units of textile processing and an estimated number of more than 70,000 workers are employed in these units. Balotra is one of the biggest and vibrant textile SME clusters in India catering to the domestic markets for dyed cotton and synthetic fabrics in bulk. Bithuja, 10 kms west of Balotra city is mainly a washing centre for Balotra textile industry, and has been generating large quantity of waste water.

The development of industrial complexes and auxiliary units in Rajasthan are undertaken by RIICO. The industrial estate developed by RIICO at Balotra has been demarcated in four phases. All these phases have approximately 800 industrial units. This cluster spread over 3 industrial areas (RIICO phase-1-2-3), are all connected to a CETP of 18MLD capacity; and the remaining one has a plant of 30 MLD. The example of a private trust managing the ETP with good package of practices in a cost effective manner makes it a good case study for dissemination.

The Key Issues

The problem in Balotra is that the groundwater is very hard and renders it unsuitable for use in dye/print operations. As such, the water for all processing operations except washing and bleaching is bought by all units which increases the cost of production and makes industry vulnerable. The water consumption in the area is as high as 80 MLD/day and it makes the capacity of existing CETP largely inadequate to meet this demand.

Following the Rajasthan High Court's order in 2004, the Rajasthan State Pollution Control Board banned the discharge of the treated industrial effluent into the Luni River in Balotra as it was deteriorating the

sustainability of the river basin especially with regards to its ecological dynamics and the groundwater quality. The Luni river was badly contaminated due to the indiscriminate discharge of thousands of gallons of industrial effluent containing heavy acidic toxins into its basin.

Around two lakh labourers have become unemployed and nearly five lakh people associated indirectly with the industry have been affected. The normal processing of around 12-15 lakh metres of cloth which yielded an annual turnover of 7,500 crore also came to a halt. Balotra Udyog Bachao Sangharsh Samiti led a protest march on 6 April 2012 and called for a bandh to restart the closed factories. They submitted a memorandum to the Chief Minister asking for solutions to resolve the issue. The community is well aware of the outcomes of this legal action and is thus proactively seeking expansion of CETP through tertiary treatment and welcoming new proposals for the same.

The Interventions and Way Forward

The SWOT analysis of the cluster diagnostic study highlighted legal notices and a PIL against the cluster pending in SC as threats. The threat of the impact on the water table of the nearby regions and its effect on the water quality due to the water being bought from about 20kms distance practically by all units was also stressed upon. It was also envisioned that another low cost SETP be established separate from the parent CETP, and which would be able to meet the requirements of the washing/bleaching cluster at a distance from the parent cluster. This may prove to be a solution to reopen the present dysfunctional units and provide for 300 new jobs. In addition, processing at a single place would further help to recycle 90 % of the water leading to big savings.

There are many other new techniques emerging in treating the effluents in a textile industry. The toolkit further talks about such options also.

Eco Friendly Effluent Treatment: Soil Scape Filter Technology or Eco-Fert

It is believed that the polluted waters even after treatment by conventional systems like STP / ETP remain as 'Dead Water' and cannot support any living organism. Shrishti Eco-Research Institute (SERI) Pune has developed a technique using ecosystem approach and eco-technology to restore the quality of wastewater, streams, rivers and lakes. They have been working in this field for the last 16 years with a clear focus on innovating eco-friendly techniques to minimize the use of electricity and chemicals in purification of wastewater.

What is Eco Technology or ECOFERT?

Eco technological treatment system is the system in which natural materials are used along with bacterial mixtures for treatment of polluted water. Eco-technological treatment systems are used for the treatment of polluted waters from both the point (domestic/industrial units) and non-point sources. The present day eco-technological treatments don't use any machinery, electricity or chemicals and hence no machinery maintenance or replacement is required. There are no running costs either and it also does not require any space or land for treatment. Besides, this technology also does not need any trained personnel for plant operations.

What are advantages of the new Eco-technology?

- Economical.
- Becomes operational in 2 to 4 months time.
- First results within 90 days of completion.
- Eligible for Carbon Credits – Zero Electricity and Zero Methane discharged into the atmosphere.
- Fast return on investment.
- Tailor made solutions.

- Treated water quality as per Pollution Control Board Norms.
- Achieves 99 % odour control.
- Over 70 % reduction in Foam formation.
- Reduction in mosquitoes.
- Reduction in health related problems.
- Improvement in the quality of underground water.
- Rejuvenation of entire Eco – System i.e.
  - Revival of aquatic species.
  - Restoration of fishing activity.
  - Arrival of different species of birds and animals.
- Restoration of spiritual activity on the banks.
- Complete hyacinth eradication in a couple of years.
- Good quality water automatically encourages water sports.
- Breeding of social responsibility and ownership in nearby residents.
- Enhanced interaction amongst the residents leading to a healthier and a cohesive society.
- Creation of a multifarious activity zone.

What is Soil Scape Filter?

'Soil Scape Filter System' is an eco-friendly technique requiring less electricity, less or negligible routine maintenance, no production of hazardous waste, and hence is called "GREEN STP" system. This technology was patented in 1998 and the patent has again been registered for the reduction of colour from the industrial wastewater as per application no.1748/MUM/2012 and for reducing COD and BOD pollutants from the high strength industrial wastewaters as per the application no.1747/MUM/2012.

How is Soil Scape Filter System eco-friendly?

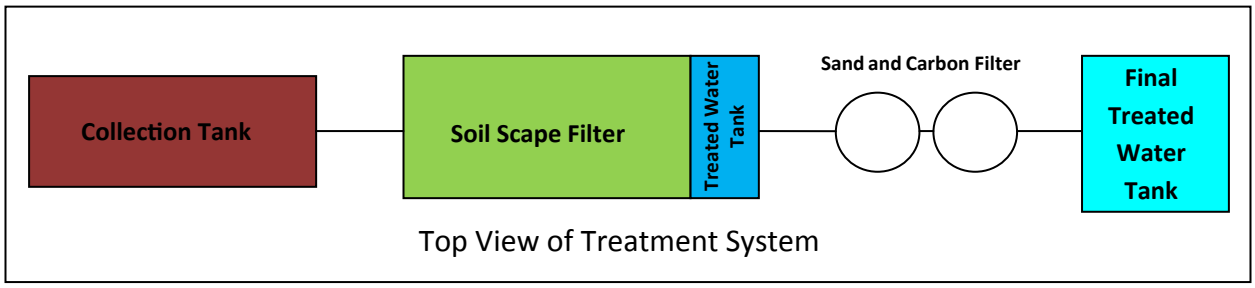
Soil scape process is an eco-technological treatment involving the filtration of wastewater through the biologically activated soil filtration medium supported by sand and gravel. It is based on ecological principles of biodegradation, biotransformation and bioconversion at various tropic levels occurring in detritus food chain by treating, transforming and detoxifying the pollutants using solar energy. The bio-fertilizer and treated water are the products of this process.

In Soil scape filter, combination of green plants and bacterial culture is used to remove organic matter and pollution. Soil scape filtration is vertical eco-filtration system of water or wastewater through the layers of bio-active (i. e. biologically activated) soil - ORGANOTREAT - developed from non-toxic and non-hazardous wastes and fragmented rock materials below which is found purified water in the form of groundwater. As the wastewater passes through the layers of biologically activated filtration medium the pollutants are absorbed and degraded. This biodegradation process releases nutrients in simple forms which can be absorbed by plants for their growth. So there is no production of any kind of sludge in this treatment system.

How does Soil Scape Filter Technology works?

The wastewater initially is collected in collection tank. The wastewater shall be taken to inlet chamber of Soil Scape Filters. In this filtration system, the biodegradable organic matter along with oil from the wastewater (BOD/TSS/colour) is consumed by bacteria present in the specialized top layer of the filter. The numbers of soil scape filtration units is based on the pollution load into the wastewater and end use of the water. Dual Media filter is provided to remove remnant solids and odour from partially treated water. Treated water shall be pumped from treated water pump for gardening and other non-consumption purposes. Here pumping can be eliminated if a natural slope is available, thus eliminating electricity cost.

This process is presented below in a diagrammatic form –



Top View of Treatment System

Operational Units:

The treatment will include the following units / equipments given below;

a) Screening chamber:

The screen chamber is installed at the start of the system, to remove the floating material. A coarse or fine screen will be provided.

b) Collection Tank / Chamber

After screening, raw/untreated wastewater from buildings/industrial units will be collected into the collection tank, where the solids separate from the liquids.

The only condition is that the wastewater fed to the filtration unit has to be neutral. In case of domestic waste water, overflow of the septic tank will be directly sent to the soil scape filter unit. But in case of industrial waste water, pH of the wastewater will not be neutral for which additional neutralization system will be required.

c) Soil Scape (SS) Filter

It is a vertical filtration of wastewater through layers of biologically activated filtration medium which absorbs pollution. The wastewater shall be spread on SS filter beds having several layers of different thickness. At the bottom there is a layer of rubbles, above that a layer of gravel, above which a layer of coarse sand, followed by fine sand and finally the top layer of OrganoTreat.

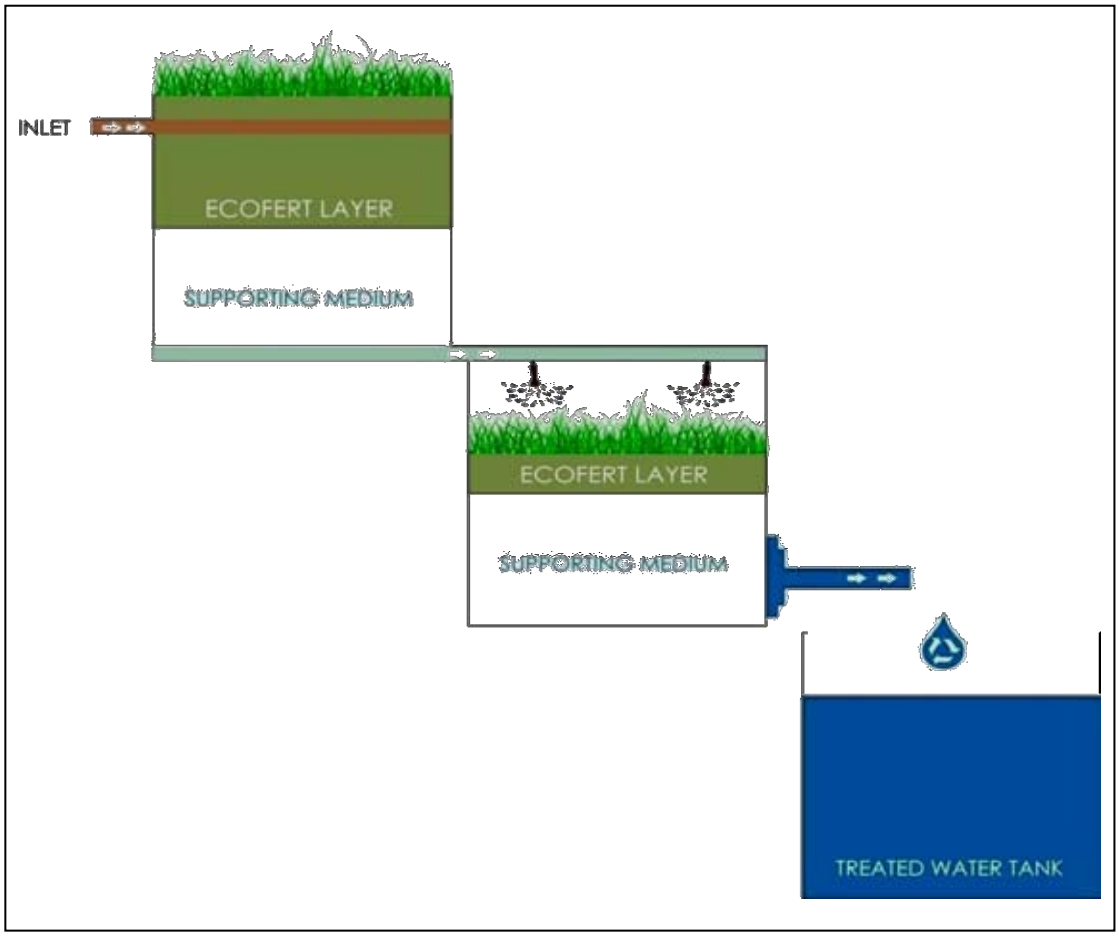
Biodegradable solids will be degraded in these filtration units. In this filtration system, the biodegradable organic matter from waste water (BOD/TSS/colour) will be consumed by bacteria present in the specialized top layer of the filter. This biodegradation process releases nutrients in simple form which can be absorbed by a plant for their growth. As such there is no production of any kind of sludge in this treatment system.

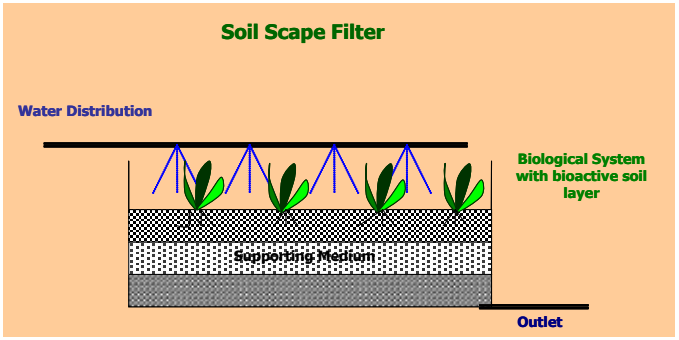
Treated water shall be collected into treated water pump which is directly used for gardening purpose. After it passes through sand and carbon filter it is used for flushing, car washing purposes etc.

After periodic intervals, the growing plants on the bed of soil scape filter can be cut and these cut parts can be sent to composting unit for manure formation.

Accessory unit for Soil Scape Filter

- Water sprinkling system with holes in horizontal pipes
- Supporting material for SS Filter bed - rubble, gravel, stone, coarse and fine sand
- Locally available plant species





d) Sand and Carbon Filter:

Treated water from Soil Scape filter is directly used for gardening purpose but after passing through sand and carbon filter, the treated water may be used for flushing, car washing and fire fighting purposes. The clear water from the treated water tank is pumped to sand filter followed by activated carbon filter. Sand and carbon filters are provided to remove remnant solids and odour from treated water. This treated water will be suitable for flushing purpose.

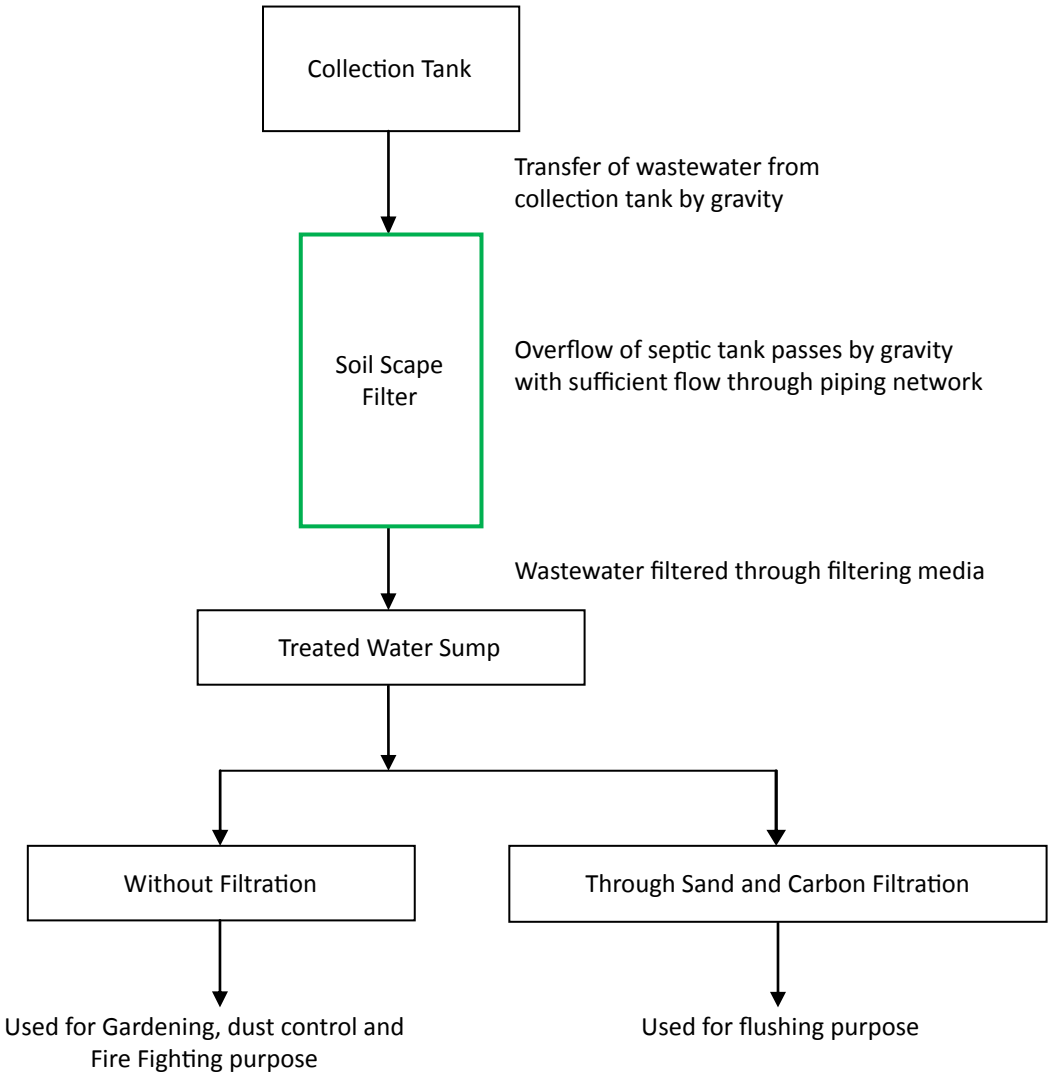
e) Filter water tank:

The filter water tank is provided to store treated effluent after final treatment of filtration from sand and carbon filter. Treated water can be reused for gardening and other purposes as described earlier.

Technical description:

It is a multi-layered filtration process system using natural materials like pebbles, charcoal and sand. It filters the water through layers of pebbles (first filtration), sand (fine filtration) and charcoal (ion exchanging material). It will effectively reduce the TDS of water by removing trash and hard materials from the waste water. Here the domestically produced charcoal is used in place of activated carbon to ensure the cost-effectiveness of the system.

D) Process Flow Chart



What are the results of the Soil Scape Filter Technology?

These results are based on application of soil scape filter for various drains, industrial and domestic wastewaters.

Total Suspended Solids	82 - 88 %
Chemical Oxygen Demand	90 - 95 %
Biological Oxygen Demand	85 - 95 %
Chlorides	60 - 70 %
Sulphate	90 – 99 %
Calcium	30 - 40 %
Magnesium	40 - 60 %

Iron	40 - 60 %
Zinc	70 - 90 %
Copper	65 - 75 %
Nickel	40 - 60 %
Colour	99.5%
% Improvement in key parameters Dissolved Oxygen	3 - 14 times

What are the advantages of Soil Scape filter?

1. Natural, eco-friendly system using plants and bacteria
2. No electricity involved in the treatment process; if gravity advantage is not available, then minimal electricity requirement only for pumping of water is required. The electricity savings will be more than 90% as compared to conventional aerobic treatment system.
3. No chemicals involved anywhere in the treatment process; the only condition is that the wastewater fed to the filtration unit has to be neutral.
4. Maintenance free, odourless process
5. No breakdown since almost all components are natural systems
6. Stabilization of the process takes only a few days
7. No nuisance of mosquitoes and other insects
8. Value addition to beautiful landscape - the flowering plants enhance the aesthetics of the surroundings.
9. Treated water available for reuse
10. Advanced ecological cost-effective technology as compared to mechanical, energy-intensive, sophisticated conventional technologies
11. Manpower requirement – hardly one hour per day to operate pumps or to cut densely grown plants
12. In the absence of wastewater inputs, the system only needs to be watered daily for the survival of the plants. This is very unlike the 'Root Zone technology', wherein the requirement of continuous wastewater supply is mandatory for survival of the system.

Case Study 4: Promoting Low Cost ETP: A Case of Khamir in Ajrakhpur

Introduction

The crafts of Kutch are facing stiff challenges because of the receding natural resource base. There is an urgent need to develop sound strategies to secure the existing natural resource base, particularly the water resource for ensuring the sustainability of traditional crafts like block printing and tie and dye. The issue has developed as a big threat to the continuity of the craft traditions. KHAMIR is a non-government organization engaged with development of traditional textile and non-textile crafts of Kutch in the Bhuj district of Gujarat. This organization took up the challenge and initiated this process of the revival of traditional crafts with the block print clusters of Ajrakhpur and Dhamadka.

A study of both the clusters with the perspective of long term water security was carried out with Arid Communities and Technologies (ACT), a technical service organization. The different requirements of both the clusters were charted out on the basis of the study.

Ajrakhpur is a new cluster established by the Ajrakh block printers of Dhamadka after the earthquake of 2001. The majority of artisans work with natural dyes based processes. A process to establish ETP with the Ajrakhpur block printers was initiated to recycle the waste water. After a village level consultation, the artisans visited the waste water recycling plant at a unit in Vadodara which was running on the basis of microbial technology using the Ecofert material developed by a Pune based firm. After an in depth discussion amongst themselves, the artisans finally agreed to replicate the process through a pilot demonstration at

Ajrakhpur village. One of the block printing units, of Mr. Osman Tar Mahommad Khatri working with both the natural and chemical dyes agreed to carry out the pilot which was funded by the All India Artisans and Craftworkers Welfare Association (AIACA).

During the planning and implementation carried out by KHAMIR, a few observations were made. It was noticed that the scale of Vadodara based technology was different from that of the unit based at Ajrakhpur. The local climatic situation and soil structure was also found to be different. It was difficult to analyze the technology in depth as the details of Ecofert were kept secret by the manufacturer, it having a business patent. The benefits regarding this experiment were ambiguous as the artisans were not sure about the recurring costs. Besides, the legal framework of the Gujarat Pollution Control Board has also been uncertain towards small scale industries.

Role of KHAMIR today

The artisans of Ajrakhpur have opted not to establish an ETP in their village and have opted for an ETP with a simple and low cost technological option which is easily replicable. KHAMIR also took up the challenge to demonstrate and successfully run a water effluent treatment system at its dyeing unit and textile laboratory. KHAMIR is doing both natural and eco-friendly chemical dyeing processes on yarn and fabrics with estimated water usage of 2500 ltr/month.

KHAMIR has replaced the Ecofert microbial technology with a simple filtration process. The design on the plant was developed in consonance with local yarn and fabric dyeing practices studied by the KHAMIR team. The team has a textile expert who had developed an ETP in West Bengal in the past. KHAMIR will establish the treatment plant, monitor it with technical human expertise and carry out necessary awareness among the artisans. Since yarn dyeing is happening along with fabric dyeing on regular basis, the plant will be useful for the yarn dyers spread out across the weaving clusters. The plant will function as a demonstration for testing the ETP concept at the micro controlled level. It will have relevance for block printers, the tie-dyers and the weaver dyeing units in the region who will be accessing this experiment to understand its applicability to their own processes. If this experiment proves successful and relevant to the practices in this region, it would have the potential to impact 3 major textile sectors of Kutch that currently engage approx 3000 households across the region. More importantly it would address the scarce water conditions of the arid region which currently affect the growth potential of these craft industries. It can emerge as a significant low cost solution for the majority of these craft units.

Treatment Process

A low cost Carbonization Filtration Technology was proposed for treating the wastewater coming from natural dyeing unit of KHAMIR.

The wastewater from process unit gets collected in the collection chamber and flows to the chemical dosing chamber containing concentrated alum solution. This water then flows into the finned canal for proper mixing, finned canal creates a turbulent flow of $KAI(SO_4)_3.12H_2O$ (solution) and waste water and avoids the use of an electric stirrer for mixing. Thereafter, the water flows into the filtration column which is the main component of the treatment mechanism. It is a multi-layered filtration process system using the natural materials like pebbles, charcoal and sand. It filters the water through layers of pebbles (first filtration), sand (fine filtration) and charcoal (ion exchanging material). It effectively reduces the TDS of water by removing trash and hard materials from the waste water. Here, the domestically produced charcoal is used in place of activated carbon to ensure the cost-efficiency of the system. From the filtration column, the filtered waste water moves to the ion exchanging column under the effect of gravity. Ion exchange resin column controls the suspended particles and coloring materials remain in the waste water. The treated wastewater is pumped into a reservoir, situated above the ground level. This treated water can now be reused (50% fresh water + 50 % treated wastewater) for production process.

Impact

This pilot will impact the block printers, the tie and dye units and the weaver dyeing units in the region. It has a potential to impact the 3 major textile sectors of Kutch that currently engage approximately 3000 households across the region. More importantly, it would further address the issue of water scarcity in the arid region which currently affects the growth potential for these craft industries. This pilot thus has a great prospect to emerge as a significant low cost solution for the majority of these craft units.

Replication Plan

The technology being used at KHAMIR treats the wastewater coming from the natural dyeing units. A replication plan has also been proposed to further replicate this technology in the region. This technology treats the community wastewater of the dyeing units of Ajrakhpur village. In addition, the technology also has a slow sand filter, two rapid sand filters, a charcoal filtration chamber and a chlorination chamber to treat the wastewater generated from the chemical and natural dyeing processes undertaken by the textile production units. The detailed plan on operation and maintenance of the system is given in Annexure 1.

Learnings (Section 4): the reader should be able to answer the following questions after reading the above section

Q1. What do you mean by Effluent treatment and what is the need for it?

Q2. What are the different Effluent treatment methods?

Q3. What is an Effluent treatment plant and what are its types?

Q4. What is a CETP? What are its benefits?

Q5. Who is essentially required to set up a CETP?

Q6. What needs to be considered before setting up a CETP?

Q7. What is waste inventory and are its steps?

Q8. What are key steps in the planning process of CETP?

Q9. What is the design basis of a CETP?

Q11. Based on your understanding what are the costs involved from establishing up to the management of a CETP. Analyze it in reference of your enterprise.

Q13. Which category of ownership and management does your enterprise fall in and what are the benefits and disadvantages of setting up a CETP in your kind of an enterprise?

Q14. Assess the effluent discharge of your enterprise. Does it fall with in the minimum government standards formulated for the effluents?

Q15. Assess the possibility of taking financial assistance for setting up CETP for your organization? What are the steps involved and criteria required?

Q16. What is your learning from the case study of :-

a) GETP and
b) Balotra

Q17. Give a brief overview of your understanding of the eco friendly techniques of treating effluents.

Q18. What are your learnings from the case study of KHAMIR. Please assess the applicability of eco-friendly technique in your enterprise.

Section 5: Occupational Health and Safety in Textile Industry

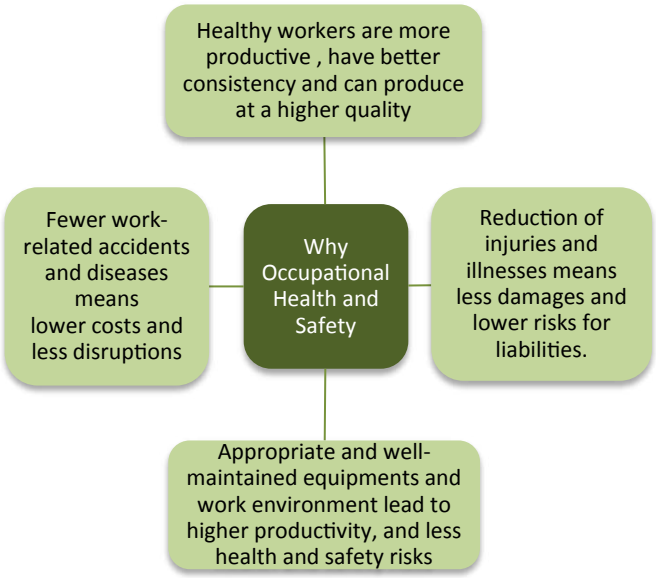
The textiles sector involves many hazards and risks to workers, ranging from exposure to noise and dangerous substances, to manual handling and working with dangerous chemicals and machinery. Each stage of processing — from the production of materials to manufacturing, finishing, colouring and packaging poses risks for workers.

This section outlines some of the potential hazards of the various dyes and chemicals used in textile processing and ways to minimize exposure to them. It provides some basic prevention measures that can be taken in the factory to minimize risks of accidents and to ensure a safer working environment. It is the responsibility of the management team and factory workers, once trained, to implement appropriate occupational health and safety (OHS) practices. This toolkit is not a comprehensive manual but has been produced to aid factories faced with H&S issues.

WHY Occupational Health and Safety?

Accidents at work and occupational health hazards and injuries represent a considerable economic burden for individuals, employers and to the society as a whole. For small companies in particular, accidents can have a major financial impact. Some of these costs, such as lost workdays or lost income, are obvious and can be expressed readily in monetary terms. However, many of the economic consequences of accidents are either hidden to some extent or cannot be easily quantified.

Figure 1 Benefits of OHS measures



An efficient and integrated management of occupational safety and health is closely related to business excellence and profitability. It not only benefits employees and the employers alike, but also helps the wider society, by reducing the burden on healthcare systems.

With time, the importance of workplace health promotion is only increasing. The Government of India declared a 'National Policy on Safety, Health and Environment at Workplace' on 20 February 2009. This policy seeks to protect workers' right to a safe working environment in all units in the organized as well as informal sector.

Thus, it is the responsibility of management to develop a protocol through which it implements these laws. It may also be necessary to consider the requirements of certain buyers, who may have codes of conduct that include aspects of H&S, corporate social responsibility and environmental responsibility. The protocol given in this toolkit should provide a good basis for this and if implemented correctly may improve the safety of the working environment in most factories. The need is to help people stay healthier for longer, and to achieve this, employers and employees will have to work together, to create a healthy working culture.

WHAT is Occupational Health and Safety (OHS)?

According to the comprehensive definition adopted by the Joint ILO/WHO Committee on Occupational Health at its First Session (1950) and revised at its Twelfth Session (1995), occupational health should

"aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations".

For the International Occupational Hygiene Association (IOHA),

"Occupational hygiene is the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace, and which could impair the health and well-being of workers, also taking into account the possible impact on the surrounding communities and the general environment".

As per the World Health Organization (WHO) report 2002, occupational health risks are one of the leading causes of morbidity and mortality in the world in general and developing countries in particular. In India, there is a lack of awareness about occupational safety and environmental hazards that severely affect the vulnerable and marginalized working population.

WHAT are the hazards and risks in the Textile Industry?

There are numerous health and safety (H&S) issues associated with the textile industry. These include:

a) Exposure to Dust and Fibres:

The exposure of workers to dust from raw materials such as silk, cotton, wool, flax, hemp, sisal and jute can occur during weaving, spinning, cutting, ginning, and packaging. Exposure to fibres and yarns may cause nasal or bladder cancer. The fatal disease of byssinosis, commonly known as brown lung, is caused due to excessive exposure to cotton dust. The symptoms of this disease include tightening of the chest, coughing, wheezing and shortness of breath.

b) *Exposure to Biological Agents:*

In some activities, such as carding and willowing, workers may be exposed to biological agents such as *Bacillus anthracis* (the causative agent for anthrax), *Clostridium tetani* (the causative agent for tetanus), and *Coxiella burnetti* (which causes Q fever). Exposure to biological agents can result in allergies and respiratory disorders.

c) *Exposure to Chemicals and Dyes:*

Workers in the textile industry, especially those engaged in the activities of dyeing, printing and finishing are also exposed to a number of chemicals. Chemicals based on benzidine, optical brighteners, solvents and fixatives, crease-resistance agents releasing formaldehyde, flame-retardants that include organophosphorus and organobromine compounds and antimicrobial agents are used in textile operations. Studies suggest links between exposure to formaldehyde and nasal and lung cancer as well as to brain cancer and leukemia, which can be fatal. In the long run, exposure to formaldehyde could lead to respiratory difficulty and eczema. Perhaps the most prevalent health problems associated with dyeing and finishing processes arise from exposure to chemicals acting as irritants such as formaldehyde based resins, ammonia, acetic acid, some shrink-resist chemicals, some optical whiteners, soda ash, caustic soda and bleach. These may cause skin irritation, itchy or blocked noses, sneezing and sore eyes. They include certain reactive, vat and disperse dyes which are also recognized as skin sensitisers.

d) *Exposure to Noise:*

Textile units often ignore exposure to noise because its effects are not immediately visible and there is an absence of pain. Lack of efficient maintenance of machinery is one of the major reasons behind the noise pollution in a majority of the units. High levels of noise have been observed in most of the units engaged in the textile industry, particularly those in developing countries. In the long run, exposure to high noise levels has been known to damage the eardrum and cause hearing loss. Other problems like fatigue, absenteeism, annoyance, anxiety, reduction in efficiency, changes in pulse rate and blood pressure as well as sleep disorders have also been noted. Electromagnetic fields may also be found in some workplaces in the textiles sector that can cause significant damage.

e) *Accidents*

The textiles sector has many hazards that can cause injury to workers, from transport in the workplace (lift truck), dangerous large work equipment, to the risk of slips from a wet working environment. Workers being struck by objects such as moving machinery parts and vehicles are a significant cause of injury in the sector. There also exists risk of fire and explosions, for example from heating plants used for vapour generation. Fire may arise from the use of flammable liquids that are easily ignited or oxidising agents that may make an existing fire more intense by fuelling it with oxygen. The presence of large quantities of dry fabric or paper can increase the risk and spread of fires. Faulty electrical wiring can also cause fires. Another source of risk is corrosive chemicals which can cause serious burns and may react dangerously with other chemicals. Violent reactions may be caused by substances which are dangerous when wet such as sodium hydrosulphite (Hydros). Hot liquids can lead to scalding accidents.

f) *Psycho-Social Issues*

Work-related stress has been defined as being experienced when the demands of the work environment exceed the workers' ability to cope with or control them. Work-related stress may be an issue in some areas of the textiles sector, being associated for example with repetitive and fast paced work and where the worker has no influence on how the job is done. This may lead to stress leading to lack of sleep, absenteeism further affecting the production.

g) *Ergonomic Issues*

Ergonomic issues are observed in a majority of units engaged in textile-related activities in India. Workers in these units face a number of problems such as unsuitable furniture, improper ventilation and lighting

and lack of efficient safety measures in case of emergencies. Musculo-skeletal disorders (MSD) like carpal tunnel syndrome, forearm tendinitis, bicapital tendinitis, lower back pain, epicondylitis, neck pain, shoulder pain, and osteoarthritis of the knees are some of the occupational diseases that have been observed among the workers on account of poor ergonomic conditions. Eyes are mostly affected due to direct impact of chemical agents like metallic fumes and physical agents like dirt, dust particles etc. Poor lighting in the workplace often creates strain in the eyes, which leads to watering and damage to eyesight.

WHAT measures can be taken?

For better productivity, the employers should develop factory specific policy, which goes hand in hand with the national policy and directives.

It is important to recognise that the management of health and safety at work is integral to the productivity, success and prosperity of the company.

OHS for Better Productivity

STEP 1: Develop an OHS policy

STEP 2: Implement the policy and monitor adherence

A policy, declaring values, principles and commitment by management to implement OHS measures at the workplace is the first step. However, constant monitoring and periodic review of the policy must follow this.

HOW to develop a POLICY?

Each factory is responsible for its own H&S policy and the project team must comply with national H&S requirements and may also need to comply with the requirements of buyers as set out in their codes of conduct. Thus, in order to design a policy the industry should be well aware of the legal and political instruments.

The ILO Constitution sets forth the principle that workers should be protected from sickness, disease and injury arising from their employment. ILO standards on occupational safety and health provide essential tools for governments, employers, and workers to establish such practices and to provide for maximum safety at work. In 2003, the ILO adopted a global strategy to improve occupational safety and health, which included the introduction of a preventive safety and health culture, the promotion and development of relevant instruments and technical assistance. The ILO has adopted more than 40 standards specifically dealing with occupational safety and health, as well as over 40 Codes of Practice. Nearly half of ILO instruments deal directly or indirectly with occupational safety and health issues. The details of conventions ratified by India are available at:

http://labour.nic.in/ilas/convention.htm,
http://www.ilo.org/dyn/normlex

Table 10: OHS policies-Key Principles and Objectives

An OHS policy should	Key principles and objectives to be included in OHS Policy
be specific to the enterprise size and nature of activity be concise, clearly written, dated and made effective by the signature of endorsement of the employer or the most senior manager in the enterprise; be communicated and readily accessible to all persons at their place of work; be updated as necessary; reflect the commitment to conduct activities in a transparent, honest and open environment in consultation with workers and their representatives respecting human rights.	Protect the safety and health of all members of the enterprise by preventing work-related injuries, diseases and incidents. Comply with all relevant laws, regulations, codes of practice, directives and applicable collective agreements. Ensure that workers and their representatives are consulted and participate in the implementation of and adherence to the OHS measures. Senior management should support this policy unequivocally and undertake resource allocation accordingly.

The Constitution of India, in its Directive Principles, recognises the right of workers to live with safety and dignity. The Factory Act 1948, for instance, covers those registered establishments employing more than 10 people with aid of power or 20 people without the aid of power. Presently, much of India's legislation for protecting the safety and health of workers is based on this Act. Please refer to relevant Acts on OHS and significant sections under the Factories Act 1948 while formulating the H&S policy. The full text of the Factories Act, 1948 is available at:

http://www.ilo.org/dyn/natlex/docs/WEBTEXT/32063/64873/E87IND01.htm

What are the roles and responsibility of Management and Employers?

Management

To formulate a policy that is specific to the factory, the management needs to conduct a risk assessment and follow certain steps in this regard. The process for carrying out a risk assessment can be broken down into a series of steps:

Step 1 Identifying hazards and those 'at risk': Looking for those things at work that have the potential to cause harm and identifying workers who may be exposed to the hazards. Using workers' knowledge helps to ensure that the hazards are spotted and workable solutions implemented. A risk assessment should cover all the workers regardless of whether they are employed on long- or short-term contracts. Risk assessment should take account of differences in workers, such as by gender, age or disability.

Step 2 Evaluating and prioritising risks: Evaluate how likely it is that the hazard will lead to harm or injury and how severe that injury is likely to be. Consider what control measures are in place and whether they are sufficient.

Step 3 Deciding on preventive action: Identifying appropriate measures to eliminate or control the risks. List the preventive measures needed in order of priority, then take action involving the workers and their representatives in the process. Targeting the underlying problems is the most cost-effective method of risk management.

Step 4 Taking actions: Put in place the preventive and protective measures through a prioritization plan (most probably all the problems cannot be resolved immediately) and specify who does what and when, and the means allocated to implement the measures. Interventions should be agreed with the workforce, either directly or through worker safety representatives. Action should be supported by appropriate training.

Step 5 Monitoring and reviewing: The assessment should be reviewed at regular intervals to ensure it remains up to date. It has to be revised whenever significant changes occur in the organization or as a result of the findings of an accident or "near miss" investigation.

Checklist – a simple tool for risk assessment

Checklists can be a useful tool in the risk assessment process, when they can be used to identify hazards. They can also be used in monitoring the performance of control measures. The model checklist attached at the end of this section cannot cover all hazards and risks and readers are recommended to identify other relevant tools on based on the national safety and health authorities and inspectorates. Please find sample checklist attached in Annexure 2.

What are the Health and Safety protocols?

Factory OHS procedures need to include aspects to ensure that all factory staff are aware of the hazards and risks and how to protect themselves and others, from them. The actions necessary to achieve this include:

For Factory floor

A) ***Material Safety Data Sheets:*** Material Safety Data Sheets (MSDS) exist to provide workers with proper procedures for handling or working with particular substances and should therefore be supplied for each individual substance. MSDS includes information as physical data (melting point, boiling point and flash point), toxicity, health effects, reactivity, required storage conditions, disposal methods, protective equipment, first aid and spill or leak procedures.

B) ***Chemical Safety / storage and Disposal of waste:*** An inventory and risk assessment of all chemicals and dyes that are present at the factory must be undertaken by the management. The Material Safety and Data Sheets (MSDS) simplify this process by providing much of the information required in this risk assessment. The risk assessment should consider how chemicals are stored and handled. The information in the inventory and risk assessment must be made available to all workers. The factory management team should remove unnecessary risks and protect against those that remain. Internationally recognised symbols should also be used and all factory workers should be trained to recognise them, this is particularly important if literacy levels are low. Waste should be treated and disposed of in a proper manner as regulated by MSDS and safety and environmental laws.

There are many general precautions which should be taken in all craft shops with respect to the storage of chemicals:

- ***Store minimum quantities:*** Do not stock more than a year's supply of chemicals.
- ***Use unbreakable containers:*** Such as plastics whenever possible.
- ***Do not use hand while mixing of chemicals:*** Use mixing equipment wherever possible.
- ***Access:*** Unauthorised access to the storage area must be prevented.
- ***Proper placement:*** Containers of chemicals should not be crowded at one place. Access to one container should not require the movement of other containers.

C) ***First Aid:*** There should always be at least one member of staff on each shift that is trained in 'First Aid' and who is made responsible for all first aid requirements during their shift. A protocol is also required to ensure that every factory worker knows who the first aid person is and their usual whereabouts so that they can contact them quickly in an emergency. At least one first aid box should be made available in an area that is accessible to all the workers. In larger factories, several boxes may be required in different areas to ensure that they can easily be reached in an emergency.

D) ***Floor surfaces and ventilation:*** Floor surfaces in the textile industry may become slippery as a result of lubricant spills, wool grease, dust, fibre or other substances settling on surfaces. In addition, cracked and uneven floor surfaces may increase when an employee is moving a trolley or tubs. Regular cleaning, repair and maintenance should be done. Use of exhaust fans and proper ventilation is also highly recommended.

E) ***Heat:*** In some processes, raw materials (eg. nylon) are heated to produce a fibre. Manual handling tasks undertaken in a hot environment may expose employees to increased risk due to fatigue. Heat resistant gloves should also be provided for this purpose.

F) ***Job Rotation:*** Job rotation must be appropriately designed to assist in reducing risk in manual handling. Effective ways to eliminate or reduce the risk include altering the workplace or environmental conditions, redesigning the job, changing the objects used in the task and providing mechanical aids. Job rotation doesn't eliminate manual handling risk but can reduce exposure time to risk.

G) ***Protective Gear and Covering (PPE):*** One of the main causes of occupational ill health in textile dyeing factories is respiratory sensitization from exposure to reactive dyes, dust and chemicals. Use of appropriate gear which include gloves, goggles or glasses, boots and dust masks should be promoted through training and compliance mechanism.

Various PPE's

Organs of human body	Sensitive to	Types of PPEs
Eye	Bright light, particles, dust, fumes	Goggles, spectacles, shields, dust screen, wire mesh, lenses
Ears	Noise and sound	Ear muffs and ear plugs
Face	Particles, chemicals, liquids, fumes, gases etc.	Face shield, helmets
Nose, lungs, respiratory system	Chemical fumes, dust, poisonous gases	Respirators, gas mask, airline helmet, hoods, chemical cartridge, mechanical filter
Head, neck and torso	Falling objects, accidental hitting	Head safeguards, hard hats, protective caps
Arms, hands and fingers	Accidental hitting, insertion in moving parts	Finger coats or stalls, gloves, band cuff
Legs and feet	Sensitive to falling objects and chemicals	Shoes, chaps, guards, safety, shoes
Body	Electric shock, heat and cold	Aprons and protective costumes
Skin	Heat and cold	Aprons
Safety against fall		Safety belts

H) Environment: The working environment needs to be kept as dry as possible to prevent accidents. Exit passageways and staircases must never be blocked or locked and all stairs should have handrails. Proper lighting and ventilation, well maintained machinery and managing sufficient head height reduce risks of accidents.

I) Equipment Handling: Most musculo skeletal injuries occur due to improper ways of carrying or moving heavy objects. This can be minimized by sharing the weight between two workers or by using wheeled trolleys and maintaining the correct posture when lifting and carrying these objects. Preventive maintenance of all equipments, including mechanical aids is essential to minimize risk. It is important to implement an effective system to identify, remove and repair damaged or faulty equipment.

J) Training: Proper training on the use and maintenance of machinery and other equipment; Health and Safety and Fire Hazards and Emergency needs to be provided. Training should be repeated regularly at least once a year. Training should also be given on equipment handling and equipment storage. Similarly, workers should be trained on fire safety and emergency evacuation. The training should also focus on psycho-social health stress, psychological violence, economic stressors and other lifestyle habits like healthy sleep, exercise and nutrition keeping in view the mental, physical and social well being of workers for better productivity.

K) Ergonomic Hazards: Proper investigation and competent personnel from designing / engineering are required for application of engineering controls. Engineering controls include modifying, redesigning or replacing of workstations and work area, materials/objects/containers design and handling and hand tools used equipment. Increasing the number of employees will help in reducing the exposure limit of posture problems to a specific individual and distribute the work load among others. It is also important to provide training in safe working postures and techniques along with monitoring, to make sure that proper work practices are being followed.

L) Signs and labels: Signs are an important means of informing and reminding staff of H&S issues. They are particularly useful when literacy levels are low among workers. Proper placement of fire extinguishers, marking 'No Food and Drink' areas, and signage for hazardous chemicals, clear labeling of inflammable substances and no smoking areas are recommended practices

Key OHS legislations

- Factories Act, 1948, amended in 1954, 1970, 1976, 1987
- Mines Act, 1952
- Dock Workers (Safety, Health and Welfare) Act, 1986
- Plantation Labour Act, 1951
- Explosives Act, 1884
- Petroleum Act, 1934
- Insecticide Act, 1968
- Indian Boilers Act, 1923
- Indian Electricity Act, 1910
- Dangerous Machines (Regulations) Act, 1983
- Indian Atomic Energy Act, 1962
- Radiological Protection Rules, 1971
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- There are also two key laws covering worker compensation and welfare. They are:
- Workmen's Compensation Law, by which a worker can claim compensation under establishments covered by the Factories Act.
- Employees Sate Insurance Act (ESI Act), a contributory social insurance scheme that protects the interests of workers in contingencies such as sickness, maternity, employment injury causing temporary or permanent physical disability or death, loss of wages or loss of earning capacity.
- Bonded Labour System (Abolition) Act, 1976
- Child Labour (Prohibition and Regulation) Act, 1986
- Children (Pledging of Labour) Act, 1933
- Minimum Wages Act, 1948
- Payment of Wages Act, 1936
- Equal Remuneration Act, 1976
- Payment of Gratuity Act, 1972
- Payment of Bonus Act, 1965
- Employees' Provident Fund and Miscellaneous Provisions Act, 1952
- Maternity Benefit Act, 1961
- Public Liability and Insurance Act, 1991
- Employer's Liability Act, 1938
- Trade Union Act, 1926
- Industrial Disputes Act, 1947
- Contract Labour (Regulation and Abolition) Act, 1970
- Inter-state Migrant Workmen (Regulation of Employment and Condition of Service)Act, 1979
- Contract Labour (Regulation and Abolition) Act, 1970
- Inter-state Migrant Workmen (Regulation of Employment and Condition of Service)Act, 1979

M) Managing the Safety and Health of Women in the Textiles Sector: Occupational safety and health should be managed in a gender sensitive way, being aware that there may be differences in the exposure of women to risks compared to men. Gender sensitive interventions should be participatory, involving the workers concerned and based on an examination of the real work situation. There has to be a real commitment from management to consider safety, health and gender issues seriously. At each step of the risk assessment process described above, gender issues should be considered. For example:

- Ask both male and female workers what problems they have in a structured way,
- Take care of unintentional gender bias when grading risks as high, medium, or low,
- Ensure that reproductive health issues are included when seeking to eliminate risk at source or when trying to substitute substances,
- Ensure that monitoring of the performance of preventive measures covers tasks carried out by both men and women.

As per the National Policy for Persons with Disabilities, India the enterprises should to maximum extent possible have buildings / places / transportation systems for public use be made barrier free. Hence, making the environment 'disabled friendly' as well.

Role of Factory Staff

Each employee should have sufficient and appropriate training and experience so that they can perform all their required job activities, where each relevant employee should:

- Be aware of the contents of MSDS and of potential H&S hazards.
- Follow all protocol in the safe handling and disposal of dyes and chemicals.
- Be aware of the fire protocol, where fire extinguishers are and where the nearest exit is and where assembly points are.
- Be aware of where the first aid kit is.
- Wash hands before meals, when leaving the work area and at the end of the shift. This will prevent accidental ingestion of chemicals or contact with eyes.
- Maintain correct posture when lifting or carrying heavy objects.
- Report all incidences of accidents and sicknesses to the manager as soon as they occur.
- Report any defects or problems with the machinery that might lead to potential accidents.
- For prevention of ergonomic hazards, employees must pay careful attention to their bodies for signs of fatigue, pain, changes in endurance, weakness, and the like. Certain good habits like keeping good posture, taking frequent rest and bathroom breaks and warm up of muscles before work; moving and stretching muscles during breaks will help prevent ergonomic hazards.

Case Study 5: Promoting Occupational Health and Safety in Handloom cluster: A case of Pochampally

Introduction

Pochampally, a natural cluster in Nalgonda district of Andhra Pradesh, is the single largest handloom tie and dye weaving centre famous for "Ikat- Tie and Dye" sarees. The term Ikat has its origin in Malay –Indonesian expression 'Mangikat' meaning to bind, knot or wind around. It is believed that Ikat technique was brought to Pochampally in the early twentieth century during the period of Nawab Salarjung. Pochampally Ikat, the technique of resist - dyeing is mostly done with geometrical designs, and involves the sequence of tying (or wrapping) and dyeing exposed sections of bundled yarn to get a predetermined colour scheme prior to weaving. The patterns formed on the yarn are then configured into the woven fabric.

Pochampally Ikat is the first product from India's traditional craft sector to be awarded a Geographical Indication (GI) status under the Indian Geographical Indications Act, 1999. Geographical Indications (GI), one of the six Trade-Related Intellectual Property Rights (TRIPS) of the World Trade Organisation (WTO), seeks to provide protection to products registered as GI goods.

Pochampally is the single largest handloom tie and dye-weaving cluster with 2000 pitlooms and 5000 artisans. Also, Pochampally Ikat products have good market potential both in the domestic and overseas market. These factors made Pochampally an obvious choice for the Textile Committee's Cluster Development Programme launched on 8 August 2008.

This case study attempts to explore the environmental and occupational health and safety measures taken in the Pochampally Ikat producers' community after GI protection was granted in 2004.

Production and Marketing

The production and marketing of Pochampally Ikat is largely managed by two bodies based in Pochampally: (1) Pochampally Handloom Weavers Co-operative Society Limited, an autonomous society registered under the Society Act, 1860 and (2) Pochampally Tie and Dye Silk Saree Manufacturers Association, an organisation established under the law. As many as 800 looms in the cluster are registered with the Pochampally Handloom Weavers Cooperative Society Limited; but only 15 to 20 percent looms (around 200 looms) are reported to be active today. The remaining looms work under the private sector with the Pochampally Handloom Tie and Dye Silk Sarees Manufacturers Association.

From the point of view of production and marketing, a very recent development in Pochampally Ikat is the Pochampally Handloom Park (PHP), set up under the Public- Private Partnership model which assumes great significance. The park was originally envisaged as providing a boost to the distressed weaver's community. The PHP is located in Kanumukkala village in Nalgonda district, 60 Kms from Hyderabad and 15 Kms from the Pochampally village. The joint collaboration and support of local entrepreneurs namely the Ministry of Textiles, Government of India and Government of Andhra Pradesh led to the creation of this PHP.

The PHP has a 100 KLD CETP which has been installed last year. The park has obtained the certificate to establish as well as operate the CETP. The CETP uses chlorine gas to treat water. Due to the low production levels within the park the CETP is not operational. All the waste water generated is being transported through a kuchha drainage system to the storage tank in the CETP. Currently the water is not being treated as the CETP is not functional.

Environmental Measures

Raw materials used in the preparation of sarees include yarn, colours, zari and other chemical agents (soda, bleaching powder, starch etc). PHP is primarily using fine cotton and mulberry silk yarn for production. The fine cotton is being procured from Tamil Nadu whereas the silk is being purchased from Bengaluru. The major supplier of cotton yarn to PHP is National Handloom Development Corporation Limited (NHDC) whereas majority of silk yarn is procured from the open market. The yarn suppliers claim to use organic cotton or ahimsa silk but there is no method of verifying this. The park requests the client to supply the organic cotton yarn and they weave the cloth in required designs. Since its inception in 2009 the PHP has done a total business of INR 1 lakh in organic cotton as raw material.

Since the park is catering primarily to the export market, it takes special care to use environment friendly dyes. The PHP is using vat, reactive and azo free acid colours. Due to the adverse environmental impacts the park does not use any dye which is naphthol or sodium based as it has been banned by the government. Despite the significant high cost of environment friendly dyes compared to other dyes, the PHP caters to the market demand and legislation and refrains from using cheaper dyes and uses only environment friendly dyes.

For cost effectiveness the PHP initially dyes only 100 grams of material and then undertakes a lab testing to ensure that the shade is exactly the same as required. Only after the lab testing is positive, bulk dying is undertaken, ensuring the adequate use of quantity of dyes.

Occupational Health and Safety

A considerable effort has been put in by the PHP to ensure better occupational health and safety of the weavers and artisans working in the park. The workplace has been designed in such a fashion that the weaver gets plenty of fresh air and natural light. The roof of the indoor sizing hall has been constructed using fiber which ensures cooler temperature inside even during peak summers. For adequate lighting the roof has been left translucent at regular strategic intervals. To ensure proper ventilation, a gap has been left between the ceiling and walls of the hall which further regulates the temperature and keeps the hall fresh.

Similar principles have been used in the weaving area also. A fan has been installed over each loom to ensure higher comfort for the weaver. Modern Jacquard looms[17] are being used in comparison to the pit looms used traditionally in the cluster. To make weaving a stress free experience, the looms are fitted with five gears. Several processes during the pre weaving procedures have been mechanized which reduces drudgery. In this Handloom Park, each process in handloom Ikat weaving has been segregated and decentralized. All the unskilled and semi-skilled pre-weaving processes have been mechanized to ensure that the weaver can maximize his/her time for skilled job i.e. weaving. In terms of occupational safety, all the artisans involved

[17] Jacquard looms simplifies the process of manufacturing textiles with complex patterns such as brocade, damask and matelasse

in degumming and dyeing wear gloves, aprons, caps and boots to protect their skin and body from any side effect as a result of direct contact with dyes and hot water.

The PHP ensures that all the artisans working in the park are linked with several government schemes. All the artisans in the park have medical insurance through ICICI Bank where the annual premium for the insurance is paid by the park. Also high percentages of artisans have been linked with Mahatma Gandhi Bunkar Bima Yojna. The scheme insures the weaver against natural and/or accidental death and also covers total and/or partial disability due to accident.

Conclusion

The Pochampally Handloom Park is a good case portraying an efficient and integrated management of occupational safety and health and environmental responsibility. This case study has shown how health and safety of workers and the environment is closely related to business excellence and profitability. The PHP has catered to the environmental needs and related legislations by usage of environmental friendly dyes and chemicals. Also going by the claim that the PHP workers make, the use of ahimsa silk and organic cotton reflects the effective implementation of environment related legislations and policy.

In terms of Occupational Health and Safety, the PHP has catered to the workers safety and health by giving them protective covering, ensuring ventilation and light in the work area and also catering to the psycho-social issues by reducing repetitive and fast paced work.

Further, the implementation of government schemes ensures social security of the workers, which has resulted in better productivity. All the efforts which the PHP has put in to ensure better occupational safety and health of weavers has ensured attendance due to health reasons. This has made the work at Pochampally Handloom Park more organized and disciplined.

Case Study 6: Promoting Occupational Health and Safety in modern SME textile units: A case of Baramati

About Baramati Hi-Tech Textile Park Ltd. (BHTPL)

The textile park at Baramati was set up in 2008 under the 'Scheme for Integrated Textile Park (SITP)' of Government of India. For this purpose a special purpose vehicle (SPV) called Baramati Hi-Tech Textile Park Ltd. (BHTPL) was set up over 60 acres of land with an investment of 108.52 crores to house small domestic garment manufacturers.

BHTPL is situated in the Maharastra Industrial Development Corporation region of Baramati, which is around 100 kms from Pune. Within this park the BHTPL consists of a comprehensive group of textile oriented units specializing in various functions such as garmenting, apparel printing and packaging, home furnishing, embroidery and technical textile. It also has a series of smaller units available as ancillary support units. The primary aim of the establishment of BHTPL is the economization of the production costs.

The Park provides a Common Effluent Treatment Plant (CETP) to process industrial sewage and also a unit for generating solar electricity. Baramati Hi-Tech Textile Park is recognized as the first textile park in Maharashtra to have a specific focus on garmenting. The textile park has the provision for upgrading the skills of the local work force in the units through its common training facilities. The Common Effluent Treatment Plant (CETP) has not been functional in the park as the units do not produce enough effluents and also the park did not have any dyeing or printing functions or any processing of the cloth for CETP to run in full capacity. In terms of occupational health and safety measure, we explored the functioning of one unit- Peppermint brand that depicts the effective implementation of OHS policy and related legislation.

Peppermint Brand: A unit in the Park promoting occupational health and safety

The Peppermint Brand (established in 1995) is a clothing brand for young girls from 06 months to13 years. They produce fashionable clothes for babies, toddlers, kids and pre-teens. The facility also accommodates an in-house design studio, for designers to create in-house designs. The brand is spread in more than 500 MBOs and large leading brand stores across India. Presently there are 120 women engaged in the unit.

Well-organized and healthy working conditions for women have been guaranteed in this unit. The workspace is not cramped and is provided with adequate lighting. For fresh air and proper ventilation the ceilings have been kept high and exhaust fans have been installed. Proper signages and markings such as toilets, drinking water area, kitchen or mess for the workers, medical room, changing room ensures user friendly and accessible vicinity.

Installation of water coolers and washbasins in the unit provide for availability of clean water for drinking and washing. Maintenance of clean work area is also indicative of a healthy work environment. To ensure worker's safety, lockers are provided separately for men and women.

The unit also tackles the problem of monotony and related stress by providing the workers regular breaks and work intervals. There are three breaks in the whole day (2 tea breaks and one lunch break of half an hour). Involvement of labour in specific tasks in the process of garment making also has reduced the pressure of repetitive and fast paced work. The machines are imported and maintained very well which curtails noise pollution and ensures the health and safety of the workers. The wages provided to the workers falls under the minimum wages act.

Conclusion:

The OHS policy is being effectively implemented in Peppermint Brand unit under the Baramati Hi-Tech Textile Park Ltd. The unit ensures the worker's physical, mental and social wellbeing by minimizing risks of accidents and providing a safe working environment.

This has been observed by exploring the various OHS measures that the unit makes available to its staff like lighting, provision of water, ventilation, signages, security, cleanliness and minimum wages prescribed.

Case Study 7:LOTUS INTEGRATED TEXTILE PARK: A Case of Promoting Best Occupational Practices in a Large Industry

About the Trident Group and the Park

Today, Trident is amongst the top 5 terry towel manufacturing facilities in the world in terms of its capacity and technology. . The new unit has been commissioned under the textile park being developed by Lotus Integrated Textile Park Limited, a special purpose vehicle promoted by Trident Group under the Scheme of Integrated Textile Parks (SITP) of the Central Government. The project cost is Rs. 840 crore and was incorporated into the SITP in November 2006. The park provides employment for around 25,000 persons.

The plant is spread across approximately 300 acres of land with state-of-the-art technology. The plant facility comprises of mainly- yarn processing, weaving preparatory, weaving, process house, finishing house, final inspection office and fully equipped research laboratory. The complete process - from yarn manufacturing, to weaving, dyeing and final packing - is done in house. It is a vertically integrated set-up with stringent quality controls at all levels.

Trident was ranked 45th in 'Great Place to Work Survey' out of 471 participating companies. The factors that have contributed to this achievement are namely – the social initiatives, initiatives towards employees/ workers and initiatives towards environment. By catering to the needs from micro to macro level the textile park has been able to achieve greater productivity and better results.

The Initiatives by the Trident Group

Employee:

To sustain the business growth, the company values its employees and recognises that human resource is a key factor to sustain business growth. It undertakes various initiatives to enhance employee welfare through following activities:

- Creating a harmonious working environment
- Establishing an open forum for exchange of ideas and suggestions
- Extending social security through medical and life coverage
- Focusing on training by both in-house and external faculty
- Engaging members to participate in sports, recreation, special occasions and festivals
- Strengthening the company through the extensive involvement of members and their families
- Discussing major issues through large scale interactive process (LSIP)
- Providing residential colonies at plant sites
- Inculcating employee safety standards
- Introducing reward and recognition schemes as well as performance-linked incentives.
- Formulation of ASMITA (Women Empowerment Cell) to particularly address concerns of the Company's female employees.

Environmental:

The Company has formed a safety, health and environment committee and indulges in the following activities and follows these principles:

- Environment friendly product development (paper with ECF technology)
- Practice 3R (reduce, reuse, recycle) and waste management
- Conserve energy by installing power saving technology and procurement of energy efficient equipment
- Recycle and reuse treated effluents for plantation activities
- Implement rainwater harvesting to recharge aquifers
- Continuous investment in zero effluent discharge manufacturing facilities
- Commission a water treatment plant resulting in surface water use substituting groundwater
- Proper water sewerage treatment through a sewage treatment plant; use of treated water for plantation
- Produce organic yarn (environmental-friendly with zero pesticide)
- Adopt cost-effective clean technology
- Certify manufacturing facilities in line with ISO: 14001
- Undertake process alterations, resulting in low water consumption and effective odour control
- Conducting Green Manufacturing Audit by an external agency and addressing the concerns/gaps by a dedicated team to make Trident Green.
- Irrigation to prevent water loss due to evaporation.
- All the above efforts of the company are aimed to make the planet safe and green, while conserving finite resources.

- Reducing waste and making the system cleaner
- Increasing recycled content
- New products and approaches
- Reformulation of existing products
- Eco-friendly products
- Healthy environment for future generations

Social:

Some key initiatives undertaken comprise of:-

- Around 200 villages with 12,000 farmers were adopted by providing them with full support and partnership from sowing to harvesting of cotton. Farmer awareness sessions and trainings are imparted in a friendly environment to facilitate a better cotton crop, thus extending societal, civic and economic benefits.
- Continuous participation in the development of Sacred Heart School at Barnala.
- Free medical and outreach programmes providing free medical check-up camps to address issues like general healthcare, gynaecological problems, orthopaedic issues and other health concerns.
- Capability and competence enhancement of local technical institutes around plants using Takshashila infrastructure and capability.
- Disaster management initiatives for the areas surrounding the Company's premises in coordination with civil authorities.
- Organising of blood donation camps on a regular basis.
- Large scale funding of the rural economy, and outsourcing a majority of raw material from adjacent areas and villages. This consumption of agro-residue provides a ready and assured market to farmers, resulting in economic prosperity and poverty alleviation.
- Imparting education to females of the adjoining villages on various social issues.
- Providing regular sponsorships to aspiring professionals within the industry.

Conclusion

Trident, the parent company of the Lotus Integrated Textile Park portrays an efficient and integrated management of occupational safety and health and environmental responsibility leading to business excellence and profitability. The textile park is expected to benefit all employees and their employers, and also the wider society, by reducing the burden on healthcare systems and implementing environmental safety measures.

The management of the Park has been successful in developing a protocol through which it implements the OHS policies and laws and also meets the requirements of the buyers, thus showing social and environmental responsibility and creating a healthy working culture.

Learnings (Section 5): the reader should be able to answer the following questions after reading the above section

Q1. What is OHS and why is there a need for it?

Q2. What are the benefits of occupational health and safety in an enterprise?

Q3. List the possible hazards and risks involved in a textile industry.

Q4. What are the measures that can be taken to reduce the risks and hazards? List the minimum health and safety protocol that your enterprise needs to implement.

Q5. How will you develop a policy for OHS and what are the various steps that your need to follow in this regard?

Q6. What is the role and responsibility of the management in taking OHS measures?

Q7. What are the learnings that you gather out of the case studies of:-a) Pochampally b) Baramati and c) Trident Group and Park

Q8. Make an assessment of the OHS measures that you are following in your organization presently and list the various steps you need to take to modify and improve them.

Section 6: Sustainable Raw Materials

Organic Cotton

What is Organic Cotton?

Organic cotton is grown using methods and materials that have considerably lower impact on the environment as compared to conventional systems of production. Organic production systems replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilizers and build biologically diverse agriculture.

Internationally, cotton produced according to the internationally recognized organic farming standards of the EU regulation 834/2007 of the USA National Organic Program (NOP), the Indian National Program for Organic Production (NPOP) or the Japanese Agricultural Standard (JAS) is recognized as organic cotton.[18]

Why Focus on 'Sustainable' Textiles?

- Textile waste occupies nearly five percent of all landfill space.
- One million tonne of textiles ends up in landfills every year.
- 20 percent of industrial fresh water pollution comes from textile treatment and dyeing.
- In 2009, the world used three trillion gallons of fresh water to produce 60 billion kilograms of fabric.
- It takes 700 gallons of fresh water to make one cotton T-shirt.
- One trillion kilowatt hours are used every year by the global textile industry, which equates to 10 percent of global carbon impact.

Source: Global Market Report on Sustainable Textiles 2010

[18] http://www.organiccotton.org/oc/Organic-cotton/Organic-cotton.php

Third-party certification organizations verify that organic producers use only methods and materials stipulated in organic production. In addition, international regulations prohibit the use of genetically engineered seed for organic farming. All cotton sold as organic must meet these strict regulations covering how the cotton is grown.

In India, some of the key certifying agencies (GOTS) are CERES India, ECOCERT INDIA Pt Ltd, ETKO India, IMO Control Private Limited, Bangalore and One Cert Asia Private Limited.

What is the Business and Social Case for Organic Cotton?

Organic cotton is now a preferred source for almost all leading brands, especially those from USA and Europe. Apart from having relatively better score on ecological sustainability, it is also considered to be socially sustainable since it provides better prospects for producers and retailers.

Organic cotton fibre is particularly preferred in personal care items (sanitary products, make-up removal pads, cotton puffs and ear swabs), home furnishings (towels, bathrobes, sheets, blankets, bedding), children's products (toys, diapers), clothes of all kinds and styles (whether for lounging, sports or the workplace) and even stationery and note cards.

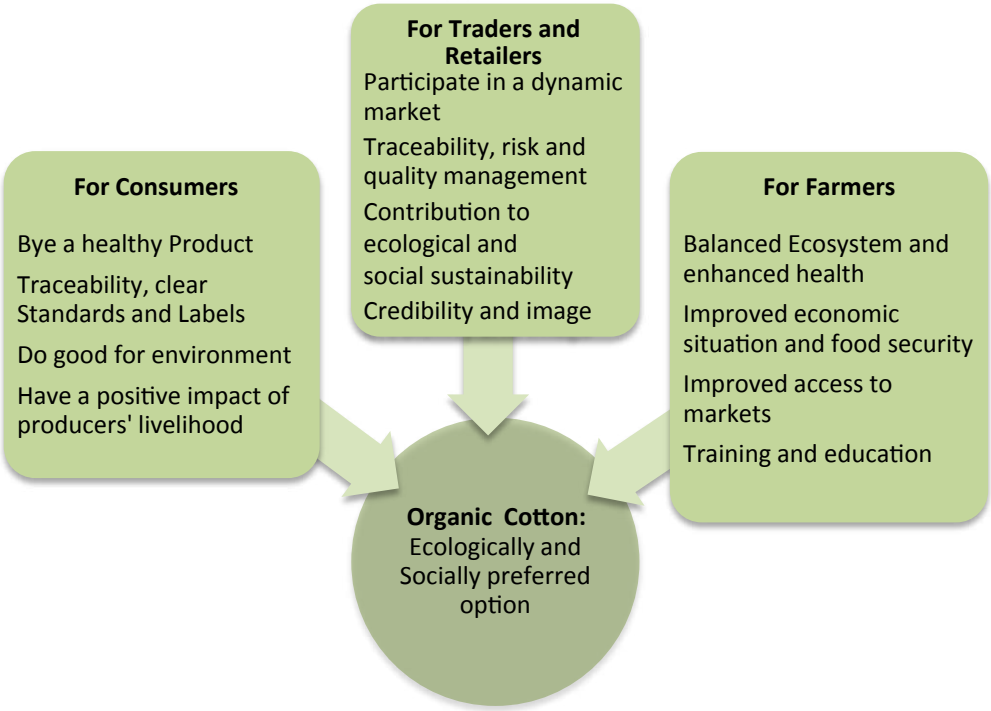


Figure: Benefits of Organic Cotton at various levels of the value chain

As per the Global Market Report on Sustainable Textile 2010, the market for sustainable textiles which includes organic and recycled fibres, is positively growing. The global retail sales of products from organic cotton saw an increase of over 20% between 2009 and 2010 and this rate is likely to continue in near future despite economic recession. All leading brands such as H&M, Nike, Inc., Zara, Adidas, Greensource, Anvil Knitwear, Target, Disney Consumer Products, Otto Group were found to be competing for greater use of organic cotton.

The report says that 'neither recessions nor unstable economies seem to have put a dampener on the fast-growing organic and sustainable textiles industry whether looking at the past few years or into the future. The focus on producing textiles in a more sustainable manner continues to increase, mostly as a result of ingenuity and commitment on the part of caring innovators around the world and in every textile sector and the thirst for 'all things green' on part of even cash-strapped consumers.'

The point is that the demand of organic cotton is increasing globally and that there is a greater emphasis worldwide on ecologically and socially sustainable practices in the textile business. Of course, there is a parallel phenomenon of consumers demanding 'green textiles' and greater awareness on standards and labels.

Fairtrade Cotton

Fairtrade is primarily a social label and focuses on improving the working and living conditions of smallholder farmers in the South. However, Fairtrade standards also include environmental criteria. Organic is explicitly linked to environmentally friendly agriculture. It is not just the environment that benefits from its ban on the use of chemical fertilizers and pesticides; farmers' health is all the better for it too.

The buyer pays the premium for each purchase directly onto a separate premium account held by the respective producer organization. Smallholder farmers and workers decide independently and democratically, as to which projects they want to carry out with this premium.

What is the Domestic Market Scenario of Organic Cotton?

Supply Sources

The bulk of organic cotton production in India occurs in the states of Gujarat, Madhya Pradesh, Maharashtra, Orissa, and Andhra Pradesh. Tamil Nadu leads the supply of organic cotton, due to presence of a huge textile cluster in Tirupur. A number of suppliers also have their corporate or marketing offices in NCR. As per an earlier study by AIACA and KAARAK, a majority (67%) of suppliers are also manufacturers. Currently, organic cotton is used mostly for export market due to its increasing demand by leading international brands.

Pricing

The price of organic cotton in comparison to conventional cotton keeps fluctuating. Recent trends suggest that the premium on organic cotton has seen a decline indicating greater production. However, the demand supply mismatch is still high. The products using organic cotton are often priced about 1.5 times higher than those using conventional cotton.

The main price determining factors for organic cotton fabric are:

- ***Yarn (Hand-spun, Machine-spun) -*** Yarn is transacted at various stages. Greige yarn has wax on it and it cannot absorb water. Scoured yarn is unbleached and without wax. Scoured and bleached yarn is the next stage before the end product of dyed yarn.
- ***Weaving technique (handloom, power-loom) -*** It refers to the arrangement of warp and weft in the fabric.
- ***Quality of raw cotton -*** Raw cotton undergoes various kinds of processes before yarn is made. The larger the magnitude of processing, the costlier the cotton.
- ***Weight (per metre square) -*** It is the weight of the yarn per square-metre in the woven fabric, which is the sum of the weight of the warp and weight of the weft. Weight of the warp is calculated as per square-metre.
- ***Width -*** The width depends on whether the fabric is shrunk or not. The market width is either around 63 inches or 120 inches.
- ***Density -*** Using pick glass is generally used to determine the thread density. Ends per Inch (EPI) and Picks per Inch (PPI) affect the compactness of the fabric. It is also known as thread count or cloth count. Thread counts range from as low as 20 threads per inch, as used in tobacco cloth, to as high as 350 threads per inch, found in type writer ribbon fabrics. Normally (EPI) and (PPI) of a fabric are described as EPI×PPI. Thus a fabric of 74×66 means 74 EPI×66 PPI. A fabric is said to be well balanced if the number of warp yarns and weft yarns per inch are almost equal.

- ***Crimp -*** It refers to the amount of bending that is done by thread as it interlaces with the threads that are lying in the opposite direction of the fabric. Crimp is defined as the ratio of difference of length of yarn (Ly) taken from length of fabric (Lf) to the length of fabric (Lf) (Crimp = (Ly-Lf)/Lf). A crimp usually gives values ranging from 0.01 to 0.14 i.e. (1% to 14%). Crimp is related to many aspects of the fabric. It affects the cover, thickness, softness and hand of the fabric. When it is not balanced, it also affects the wear behaviour and balance of the fabric because the exposed portions tend to wear at a more rapid rate than the fabric. The crimp balance is affected by the tensions in the fabric during and after weaving. If the weft is kept at low tension while the tension in warp directions is high, then there will be considerable crimp in the weft and very little in the warp.

Table 11: Specification required by Suppliers

		For Woven Fabric	**For knitted Fabric**
1	Warp	Yarn Count in warp	Count
2	Weft	Yarn Count in weft	Fabric
3	EPI	Ends per Inch	Knitting Diameter
4	PPI	Picks per Inch	Finishing Diameter
5	Greige width	Width of the fabric before dying/bleaching	Stretch length
6	Greige GSM	Weight of the fabric before dying/bleaching	Greige GSM
7	Dyed width	Width of dyed Fibre	Finishing GSM
8	Dyed GSM	Weight of dyed Fibre	
9	Weave	Style: Plain, satin, dobby, twill etc	

Lead Time and Quotations

Knitted fabric is sold both by Kilogram or Metre. Lead-time depends on the size of a supplier. A bigger player will have a shorter lead time and vice versa. Similarly, the small players will have lower maximum and minimum quantity. Suppliers of woven fabric take 25 days to 10 weeks as delivery time. Some suppliers prefer to have part payment (up to 50%) in advance.

NATURAL DYES

Natural dyes are not a new discovery. Until the advent of chemical dyes in the 19th century, the Indian textile industry extensively used natural dyes from a variety of sources. Since chemical dyes became easily available and at a lower cost the practice of using natural dyes diminished over time.

However, the traditional knowledge still exists and the use of natural dyes is in practice, although limited. Use of natural dyes, however, does not mean that effluent treatment is not required.

How dyes are regulated?

The health and environmental hazards of chemical dyes, led to resistance from various quarters forcing regulatory authorities to take decisive measures. Germany, for instance, amended its Consumer Protection Act in 1994, making use of azo-dyes a criminal offence.

The ban on Azo dyes by Germany triggered similar bans by other countries as well. Azo dyes are believed to contain cancer causing aromatic amines. The Health Committee of the European Union has also identified such amines and called for banning them along with banning pigments based on these amines. In fact, a new law 'Registration, Evaluation, Authorization and Restriction of Chemical Substances (REACH)' was enforced in 2007 and since 2011, producers and exporters are required to notify European Chemicals Agency (ECHA) if their goods contain hazardous properties of a substance (including dyes and pigments) as per the REACH list.

In India, the Ministry of Environment and Forests has officially banned 70 Azo dyes and 42 benzedine based dyes that are considered capable of releasing harmful amines. The prohibition is applicable to almost the entire process i.e. manufacturing, processing, treatment, package storage, transportation, use, collection, destruction, conversion, offering of sale and transfer.

How Natural Dyes are a part of textile markets?

The health and environmental friendliness of natural dyes over chemical dyes is uncontested. However, the market share of natural dyes is very small as compared to the chemical dyes. An earlier study on eco-friendly textiles (Sustainable Textile for Sustainable Development by AIACA and KAARAK) showed that the use of natural dyes is very limited and is confined to very sophisticated process of cloth production, which is often quite expensive.

Consumers who are aware of the health and environmental hazards prefer textiles using natural dyes. In times to come, the segment of such consumer is likely to increase since the study also shows that younger generation form a greater proportion of such consumers.

The dyes to be used in textiles have therefore to be carefully chosen, as they not only impact the health and environment but also the markets for textile products.

What are different types of Natural Dyes?

Natural dyes as the name suggests, are extracted from natural sources. The most common sources are plants (such as turmeric for yellow) and minerals (such as iron from black). There are only three basic natural dyes: Red, Yellow and Indigo. Other colours are prepared by a combination of these basic colours or by using varied mordants. Less common forms of natural dyeing include rust dyeing, dye painting with earth oxides and mud dyeing.

There are three major types of natural dyes –

- ***Substantive/Direct Dyes***

Substantive dyes are used by simply combining the dyestuff with the fibre (or fabric) and simmering for an extended period of time. Usually the quantity of dye is equal to or twice that of the weight of the fibre. An example is turmeric, an Indian spice, which works on cotton as well as on wool; others include onion skins, walnut husks and tea.

- ***Vat Dyes***

The vat dyes work the same way on protein and cellulose, by being introduced into the surface of the fibre while in soluble form and then converted into an insoluble form. The vat dyes include many synthetic dyes, but also the natural dye indigo and the ancient tyrian purple dye extracted from shellfish. They are complex to use, requiring the establishment of anaerobic (oxygen-free) fermentation.

- ***Mordant Dyes***

Most natural dyeing is done with the use of mordants. The mordant allows many natural dyes to attain acceptable wash fastness, which would otherwise just wash out. A mordant remains in the fibre permanently, holding the dye. Mordants are usually heavy metal ions and sometimes tannins. Tannins are particularly important in dyeing cotton and other cellulosic fibres. Different metals, when used as mordants, produce a different range of colours for each dye.

Suppliers of natural dyes usually prefer:

- A minimum order which may vary from 500 gm to 10 kg.
- Having an advance part payment
- Buffer time for delivery (7 days to couple of months depending on the order/availability)

How are Natural Dyes Priced?

Price of a dye is dependent upon cost of raw material, which in turn, depends upon its availability. For example, if a dye is made from a bark of a tree which is scarcely available then the price would be higher. Similarly, turmeric which is used to make yellow colour, has a higher market price. The price also depends on the kind of processing needed for making a dye. Mostly dyes are available in solid form and are sold as per weight measured in grams or kilograms.

Among the commonly used natural dyes for cotton are annato, cutch, logwood, madder, and indigo; of which all of these except indigo require mordants, while indigo requires a special type of dye vat.

Case 8: Sustaining the use of Natural Dyes: Example from Ajrakhpur

Introduction: Ajarakh, a name of the magnificent fabric of Sindh and Kutch came to be known so depending on which story one would like to believe- that of the King calling his beautiful bed spread 'aaj rakh' or derived from the Sanskrit word 'a-jharat'-which means something that doesn't fade.

The printing process: The process of printing Ajrakh has remained unchanged over centuries where the fabric is first treated with Harada, which helps in fixing the color, and then is printed with lime or gum, where the color is not required and added with black for outlines. After printing, the fabric is dyed in indigo, then washed to remove the resist material and dyed in the mordant. Depending on the mordant, the print areas get their color, like alizarine gives red, henna gives green and rhubarb gives brown. Printing and dyeing is repeated till all the colors get their full strength in the material. Ingredients like camel dung, castor oil, resin of the babool tree, wheat flour, gram flour, flour of jowar, bajri, kachika, roots of the majathia plant, pomegranate rind, turmeric, iron oxide, catechu and tamarind are used in making these dyes.

The story of 'Ajrakh': The massive earthquake in Gujarat on 26th January 2001 not only caused immense damage to lives and property, but also caused changes in the environment. This led to increase in the iron content of Saran River making it unsuitable for Ajrakh printing. Also, for relocating quake-affected villages (along the road linking Bhachau and Bhuj through Dudhai), the Babool shrubs were cut to clear the land. This deprived the artisans of a valuable vegetable dye acquired from the *'Prosopis juliflora'* or the babool. The construction of new villages from Padhhar to Bhachau has also affected rural culture. For instance the once flourishing business of the Khatri community known for their intricate Ajrakh work declined in the aftermath of the earthquake.

After the earthquake, half the craftsmen of Dhamadka village stayed back while the rest moved on to a new place and built a village named "Ajrakhpur". Over sixty families, mostly from the minority community are into this craft today. The village, which is still developing is trying to utilize sustainable methods of growth. The craftsmen understand the value of water for the craft and have built a water-harvesting plant in the village in collaboration with the government thereby setting an example for others to follow. After ten years of the earthquake, now the business is picking up again, primarily with the aid of international and Indian companies like Anokhi and Fabindia. They always use natural dyes based on popularity and high demand in the international market. Today, traditional Ajrakh is selling well and new designs have also been introduced.

Learnings (Section 6): the reader should be able to answer the following questions after reading the above section

Q1. Why is there a need to use sustainable raw materials?

Q2. What is organic cotton and what are its benefits?

Q3. List the various sources to obtain organic cotton.

Q4. How is organic cotton priced in comparison to conventional cotton and what are the factors that determine its price?

Q5. What are natural dyes and why do you need to use them?

Q6. What are the different types of natural dyes?

Q7. How are the natural dyes priced?

Q8. What are the learnings from the case study of Ajrakhpur?

Section 7: A Case Study of Jaipur Integrated Texcraft Park Private Ltd.

About JITPPL PARK

Jaipur Integrated Texcraft Park Private Ltd. or JITPPL is a model eco friendly park, with a wide variety of infrastructural facilities for effluent treatment, rain water harvesting, water recycling and conservation, and energy conservation. The park is located at Bagru, near Jaipur, which is known all over the world for its traditional textiles, various styles of hand block printing and related skills. The land for the park was acquired in June 2008, which also marked the start of the construction of the park. The JITPPL is registered as for profit company under the Company Act 1956. JITPPL is one of the project partners of the SWITCH Asia Project – SUSTEX funded by European Commission. JITPPL aims to establish itself as a model of environment friendly sustainable textile businesses. This is the first park to cater to the niche segment of hand block printing; renowned worldwide, and equipped with state of the art technology to conserve and preserve water.

JITPPL, a Special Purpose Vehicle (SPV), has been created by its stakeholders to undertake strategic planning for forward and backward linkages and has been created as per the guidelines of a major national scheme, Scheme for Integrated Textile Park (SITP) in India. The park is expected to employ 1000 to 1500 workers. The expected turnover of the operational park was of Rs. 94.2 crores, which has been revised to Rs.90.15 crores recently. The JITPPL Park is established on a vast area of about 24 acres allotted by RIICO. The total cost incurred for the construction of the park is Rs. 53.53 crores, which is Rs. 8.25 crore higher from the

initial budget due to delays in the construction of the park and also due to the addition of other facilities like rainwater harvesting, solar panels etc.

The Government of India under the scheme has provided the grant of Rs. 21.41 crores which formed about 36 percent of the total cost. The promoter's contribution to the park was 20.71 percent while the remaining amount of nearly Rs 25 crore was covered under the term loan payable by the promoters.

The park consists of 22 units, with the size of each unit ranging between 665 m^2 to 8000 m^2. More than 50 percent of the units are for hand block printing, while the rest is for screen printing, dyeing, and as warehouses. During the course of construction, the JITPPL members made several additions to the initial design which included common facilities for rain water harvesting and solar panels.

The park comprises of the following facilities:

Table: Common facilities in the Park

Common Facilities	**Size/Capacity**
Common Effluent Treatment Plant (CETP)	0.5 MLD capacity
RO water system	0.8 MLD capacity
Big pond for water harvesting	1KLD capacity
Two common processing units	2440 and 1950 sq metre or 0.6 and 0.48 acres
Multipurpose hall	2950 sq metre or 0.73 acres
Service providers and exposition	1200 sq metre or 0.3 acres
Retail	1500 sq metre or 0.37 acres
Administration and first aid centre	1058 sq metre or 0.26 acres
Overhead tank	
Solar Panels	55 kWp
Individual rain water harvesting tanks	Average 160 KL

Profile of the JITPPL members

The members are MSME owners and most of them are young and first generation entrepreneurs. Around 21 units are functioning in JITPPL with products ranging from garment fabric to printed fabrics to embroidered products.

The dyeing and printing functions are performed on different fabrics like Cotton, Silk, Khadi and quilted fabrics. The estimated production ranges from 2500 pieces per month to 50000 pieces per month. For details of members please see Annexure 3.

Formation and Genesis of JITPPL

As a response to the local printers challenge of staying in a competitive market due to globalization, a consortium called COTEX or Consortium of Textile Exporters was formed in 1998. This consortium brought together the local printers (mostly first generation entrepreneurs) to reap benefits of joint actions and at the same time kept them independent in terms of their operations.

COTEX was an outcome of UNIDO facilitated Cluster Development Program (CDP) which was initiated with 6 exporters. It was a non-profit entity registered under the Societies Registration Act 1860 of Rajasthan. The main aim of the group was to enhance the exports of textiles and create new market avenues for local printers. Though the consortium evolved in the late 1990s and early 2000s, its membership has substantially increased from 6 exporters to 26 exporters, taking joint actions on the principle of cooperation. The immediate benefits of the consortium were perceived in the terms of exposure to different fairs and exhibitions and the subsidised participation fees. The main reason for cooperation can be attributed to specialization and uniqueness of different products of the firms while operating in the same market segment.

In 2003, the court issued an order to close down printing in the areas of Sanganer in Jaipur to reduce the environmental pollution being caused by the textile industries due to the discharge of effluents in the water bodies. This resulted in a threat of relocation or shut down of these printing units. Some of the members of the COTEX were part of the group which approached the Hon'ble Supreme Court and got a stay for a period of 2 years on the same, to request for an additional time to shift or relocate to other areas. They put forward a proposal of Texcraft Park under the scheme of Ministry of Textiles and a new group called Jaipur Integrated Textile Park Private Limited or JITPPL was formed. After facing a lot of challenges and with the help of state and local government, COTEX acquired the land from Rajasthan State Industrial Development and Investment Cooperation (RIICO) at Bagru on a subsidized rate. This marked the beginning of the JITPPL. Presently, out of the 20 members, 11-12 are from COTEX group and others are the new entrants. Some of the JITPPL members visited parks in Pochampally in Andhra Pradesh and Tirupur in Tamil Nadu to get a fair understanding about the park and the CETP unit.

Operating Structure of the Park

Presently, the members of JITPPL select the CEO of the company from among themselves. The CEO takes the decision for the company and is supported by professional staff. The first CEO of the JITPPL group was Mr. Rahul Duggal. He was succeeded by Mr. Vishal Choudhary. Ms. Suvira Sheoran heads the group currently. As per the latest operational norms, the CEO rotates every two years.

All the members in JITPPL are the board members. There is an Executive Committee which meets regularly to take regular management decisions. Apart from this, JITPPL has also formed a separate Building Committee which looks at different aspects of the construction phase.

After the park becomes operational, the management will be transferred to a professional team comprising of CEO, two support staff and a chartered accountant. The CEO will look into the day to day business/services; all of the members will be reporting to him.

The Current Status of the Park

The initial target completion date of the JITPPL was in 2010, i.e the constructed units were to be handed over to their owners. However, the project is now delayed by more than two years and the current expected deadline for the completion of the park has been extended to December 2012.

At the time of writing case study, two units (namely Ojjas and Rangotri) have temporarily shifted to the park. The installation of the CETP and the recycling unit is almost complete. The construction of the large overhead tank is also complete. Work on Solar Panels and Rain water storage pond is in progress. The construction of some of the units is still to be completed and the work is in progress.

Technical Processes at JITPPL:

JITPPL uses GETZ prescribed methodology for treating effluents generated by the textile units and water purification process. The technical processes involved include the following:

1. Filtration
2. Pre treatment of water
3. RO or Reverse Osmosis

Filtration

Filtration is the final stage in clarification process of CETP. The water is passed through the valves (from the top to the bottom), and this water is passed through the layers of sand where the filtration takes place. All the dust and suspended particles are filtered in the top layer of the sand. These dust particles are cleaned by passing water in the opposite direction (bottom to top) which is called 'Backwash' once in a shift. Generally backwash is done 8 hours for about 10 minutes. During backwash, water will flow through the drain. During 'Rinse' position the water is sent in the opposite direction (top to bottom) to check the quality of water. Generally rinse is done for about 5 minutes after backwash.

Reverse Osmosis

The process of Reverse Osmosis (RO) is used commonly for water purification after the CETP process at JITPPL.

Reverse osmosis is a separation process that uses pressure to force a solution through a membrane that retains the solute on one side and allows the pure water to pass to the other side. It is the process of forcing a solution from a region of high solute concentration through a membrane to a region of low solute concentration by applying a pressure in excess of the osmotic pressure. This is the reverse of the normal osmosis process, which is the natural movement of solution from an area of low solute concentration, through a membrane, to an area of high solute concentration when no external pressure is applied. The membrane here is semi-permeable, meaning it allows the passage of solvent but not of solute. The membranes used for reverse osmosis have a dense barrier layer in the polymer matrix where most separation occurs.

Pre-Treatment

Before feeding the water in the RO system, the impure water is conditioned to prevent fouling of the membranes by fine particle or biological growth, and to reduce the risk of damage to high pressure pump components.

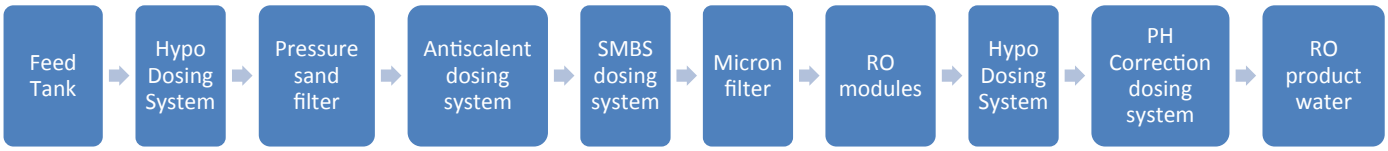
The pre treatment scheme includes the following

- Hypo dosing system used for killing micro organization and disinfection of feed water
- Pressure sand filter to remove the suspended solids
- Antiscalant dosing system to prevent the fouling of the membranes
- SMBS dosing system- used for reduce the free residual chlorine
- Micron cartridge filtration - To remove particles of 500 Angstrom

After the pre-treatment process, the water is fed into membranes under high pressure by means of a high pressure pump. ORP controller with necessary interlock at the upstream of micron filter has also been considered at the unit. In case of any oxidizing agent like chlorine is detected, the ORP meter would sense the same and activate the interlock, thus enabling the high-pressure pump to trip.

Membranes are cleaned in place by chemical cleaning system, which includes a chemical cleaning pump and chemical cleaning tank. Here a 2-stage RO is considered to attain maximum recovery. The permeate will be collected in the permeate tank. The reject from the RO stage-II will be collected in the reject water tank.

Figure 1:The process adopted by JITPPL as prescribed by GETZ



Project Delay and its Factors

It is understood that despite the best efforts of JITPPL to maintain timeliness, the project got delayed by more than two years. The members who are closely engaged with the process believe that there are multiple factors for this delay in which the tendering system to select the contractors for construction is the major one. As per the tendering norms, the company with the lowest bid got the tender for civil construction work. The contractors were unaware of the labour groups in and around the park and found it challenging to arrange for labourers for a very long time, there by delaying the whole process. As it turned out to be, the construction cost was under-estimated and ultimately the contractor surrendered the work. Consequently, a new tender was floated and a local contractor was given the tender. The work did pick up some pace but due to the unavailability of the necessary equipment, the construction work got obstructed and was further delayed. The present contractor is however doing an efficient job with regard to the completion of the project.

The unfamiliarity of JITPPL members with the tendering process along with the entire process of infrastructure development is also believed to one of the main reasons to have delayed the process. It is also believed that the financial crunch faced by some of the promoters and also the laid back attitude of the some of the promoters in the initial stages of the project contributed to this delay. The time consuming process of acquiring the NOCs from the Pollution Control Board and installation of electricity connection are also considered to be other factors. Some of the members also believe that the Project Management Consultant could have worked better to ensure timely completion, however, the key stakeholders overall seem to be highly satisfied with them. Due to this time gap, the requirements of the many of the units changed, with most of them wanting to enhance their capacities. This led to a revision in the design of the CETP unit and addition of new facilities. This required more time to accommodate those revisions and changes.

The experience of the JITPPL is an important one especially from the perspective of a genuine group of small businesses, willing to undertake special initiative for sustainable production. The key learning emerged from this process are being briefed below for the benefit of larger audience.

Key Learnings

Trust among the members - It has been observed that earlier association of members with each other through COTEX has helped in building high level of trust and understanding amongst the members. For instance, even during the absence of some members during the regular meetings, the important decisions or discussions gets conveyed to the absentees. Members claim to have full faith and confidence in the functioning of the Executive Committee, CEO and other staff members. The high trust level has ensured that despite all the difficulties and delay, the group has stuck together and is working towards completion of the Park in a mission mode. This also highlights the need for trust building amongst stakeholders of the other parks in the country.

Forecasting - The construction of the park started in 2006, where each unit member was asked to present his/her expected turnover and production capacity in order to construct the unit according to the promoters` requirement. It is observed that the future projection made by the company was not adequate, as most of the units understated their production capacities. Some units have grown upto 16 times from the predicted production capacity and are finding the units in the park small for their production; while some are planning to shift only a part of their business. There is a provision for extension of units in the specified areas which is a possibility in future. Therefore, as an important learning, one should look at creating infrastructure which can meets their demands at least in the coming 5 to 6 years. This does have increased risks for small businesses, however, the JITPPL experience shows that a minimum time of 5 to 8 years should be kept in mind while estimating the growth.

Delay leads to increased project cost - The delay has led to increase in the cost of construction of the park, the rate of interest, financing charges, operative expenses etc. Some of the members have purchased machinery for their units in the park for the last one year which is lying idle, and they are paying interest for the same, without earning revenue from it. The EMIs of all the members have started already from the month of April on the loan taken for construction of their unit, which is a huge overhead cost for a member. This directly hits any business and accordingly the delay and its implication should be considered right at the beginning and all precautionary measures must be taken.

Tendering process - As an important learning, the sub-contracting of work leads to poor quality as well as direct impact on adherence to timelines. It is important that all the stakeholders in the park should familiarize themselves with the tendering process in order to take right decisions.

As it was commonly felt, the time and technical expertise required to undertake tendering process are very important considerations during the planning phase. The rendering process based on selection of lowest bidder went against the JITPPL and as a result it is important that the park stakeholders should know about different options within the tendering system to select the best contactor while ensuring cost effectiveness.

Engagement with Project Management Consultants - IL&FS were the PMCs for the JITPPL project and their role was of a mediator or an agent between the members and the government or the contractor. They were responsible for managing all the work in the park, from documentation to coordination with the sub contractors.

Most of the park members commonly felt that the role of PMC was an integral one and any other group should definitely engage a PMC to undertake such infrastructure development work. However, it was also realized that the park stakeholders also need to familiarize themselves with the technical details in order to ensure high performance of the PMCs.

Technical knowledge to the members - Observations showed that the knowledge on CETP and other equipments was inadequate among the members of the JITPPL, more so in the initial stages of the project. Since they are decision makers, it is important that their technical capacities are enhanced for effective oversight and smooth decision making. The capacity building can happen through seminars, conference or workshops to impart technical knowledge on operating, costing and functioning of the facilities being planned or created.

Challenges

Disbursement of loan: The government under the SITP gave a grant to the JITPPL Park, but disbursal of loan was delayed leading to a further delay.

Management of ETPs: This park was started to preserve and conserve hand block printing, howeverthe screen printing units have also been set up inside this park. Some of the screen printing units and large units have planned to install their individual ETPs, however, the huge difference in the volume of effluents discharged makes the management even more challenging especially due to fact that the fixed costs are based on unit of land occupied in the park.

Labour and Buyer accountability: The competitive atmosphere in the park may lead to changes in the compensation paid to the labours and the selling price of the products. Commonly, the labour keeps shifting between the units based on the attractive salary and the buyer keeps changing the purchase unit based on the purchasing price. This questions the trust, accountability and ethics of the park. It is therefore a challenge

for the units to keep their prices low and their salaries high, to stay in this competitive market. A need for prescribed rules and guidelines on labour and buyer policy by JITPPL is thus observed.

Availability of Skilled Labour: Some of the members believe that transfer of labour from existing units to the park may cause a lot of difficulty with regards to the availability of skilled labour. The units therefore seek skilled labour near Bagru and train them. It is not only a challenge to find skilled labour in Bagru but also a challenge to sustain them after training.

Government approvals: In the JITPPL park, each unit will have to get separate certificate from electricity board and pollution control board to start their operations. Some members who had applied for such certificates haven't been able to get even one after 4 months of operations. The process of acquiring various approvals from the various ministries like State Pollution Control Board, Electricity Board are other big challenges for the units.

Cost of production: The biggest challenge in front of the units is the sudden increase in the cost of production after entering the park. An increase in estimated cost of around 20-25 percent in observed in these units. Resources that were available for free as an independent unit, required to be paid for after entering the park. For instance water which was available free of cost outside the park is chargeable inside the park. The units thus face a challenge of adopting sustainable ways of production and at the same time to increase the volume of production, sales and increase the outreach to cover the costs incurred. However, most of the members were confident that increase in cost of production may not be a huge issue.

Best Practices:

The aim of the case study is to present the best practices that have been observed in the process and functioning of JITPPL members. The following are the best practices observed:

1. ***CETP and RO water system -*** The JITPPL park aims to reduce the contamination of the local environment and water resources caused by the textile manufacturing units. To help the industries in controlling pollution and promoting a cleaner environment, the Common Effluent Treatment Plant (CETP) and STP has been installed in the park.

   RO system for fresh water supply and HPS for recycled water supply has also been installed. The textile units discharge various effluents during production and the technique for effluent treatment used by each unit is dependent of the type and amount of discharge.

   This sustainable and effective methodology entailed huge investments. The initial cost of the CETP was Rs. 282.44 lacs, which increased to Rs. 739.26 lacs after the setting up of RO system, STP and HPS. The CETP installed by GETZ water solution, and had an initial capacity was 1KLD, but now increased to 5KLD by importing the equipment from Bangkok. The RO system installed in the park has a capacity of 4 KLD.

   The Special Purpose Vehicle has received the environmental clearance for the project Zero Liquid Discharge (ZLD) CETP. Each unit will have different billing meters for their effluent discharges. JITPPL members pay Rs. 42 per Sq. metre of the land they owned as the fixed charge for maintenance plus Rs. 132 m^3 on the amount of effluent discharge. Some units like Suprint textiles, Goodwill textiles are also installing their individual CETP units in addition to the common CETP, because they are anticipating higher effluent discharge.

2. ***Rain water harvesting -*** The JITPPL plans to recycle around 30000 ltrs of water per day in the manufacturing of textiles, which otherwise would lead to a huge depletion in ground water. Keeping this in view a rainwater collection pond having a capacity of 200 lakh litres has been built in the park. An amount of Rs. 150 lakhs was spent by the JITPPL for this purpose, after receiving various approvals/compliances. Besides the rainwater harvesting pond, a rainwater harvesting tank has also been installed in each unit having the capacity of 1.6 lakh liters. A big overhead tank with the capacity of 1 lakh litres has also been also installed to meet any emergency situations.

3. ***Solar Panels for common areas -*** The Park has installed Solar photovoltaic (PV) based power generation plant of 55 kWp (2x15Kwp and 1x20 kWp) as one of the initiatives to promote sustainable practices. These solar panels will contribute to 3.66 percent of the total electricity requirement.

   These panels will mainly be used in providing electricity to street lights and the administrative block. The installation of this plant was also done through tendering process, where bids were called for. TATA solar power got the tender. The process of installation is in its last stages and the Solar PV has costed them Rs. 100.47 lakhs in total.

4. ***Occupational Health and Safety -*** Occupational Health and Safety policy is being followed individually by the textile units in the park. Some units are providing gratuity fund, insurance or medical facilities to the workers. The members also have plans to open dispensaries in the park premises and also install first aid kits, fire extinguishers and other safety equipments.

5. ***Natural Dyes/Organic Cotton -*** It has been observed that one or two units use natural dyes for manufacturing textiles. Most of the units use Azo free chemical dyes. For example, they use Indigo which includes crystallized component imported from Germany. The units are reluctant to use natural dyes because it is a tedious process to extract these dyes from the vegetables and because of its low colour quality.

There are very few suppliers of natural dyes and the owners are vary of the ones available easily in the market. Most units in JITPPL use balanced dyes from production. In case of organic cotton, though it is used by many units yet it forms to a very small portion of their total production.

6. ***Transparency -*** There is some level of transparency maintained by the JITPPL group in the park as most members come from the COTEX group. All the decisions are made unanimously by taking the opinion of all the members. The decision on new membership is also made by the members. It is a democratic process where each member is free to help the other without expecting returns.

Learnings (Section 7): The reader should be able to answer the following questions after reading the above section

Q1. Give a brief understanding of JITPPL case study and its formation.

Q2. State the challenges involved from setting up JITPPL to its functioning.

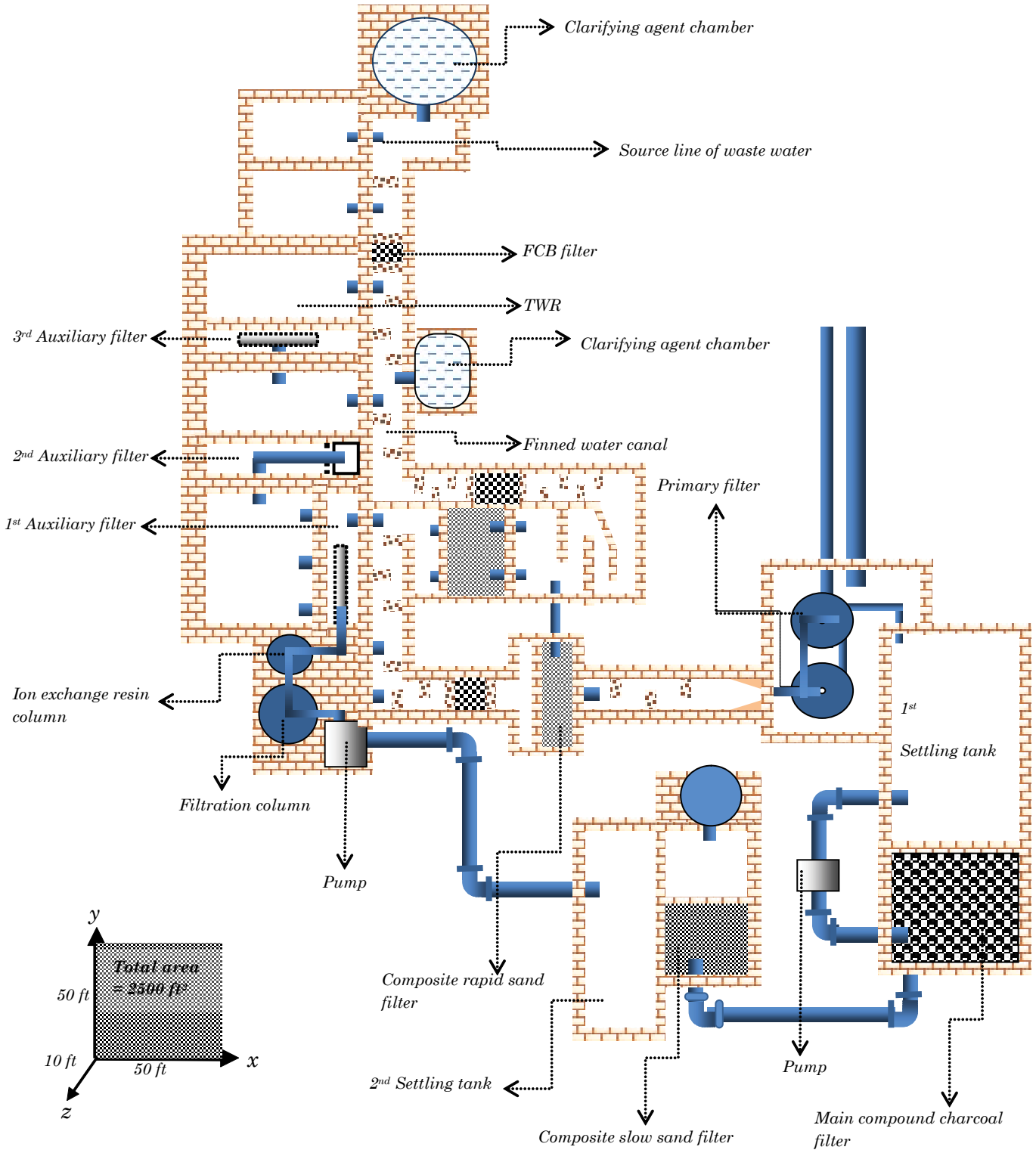
Q3. Give a brief understanding of the ETP technology adopted by JITPPL.

Q4. What are the learnings that you gather out of the case study ?

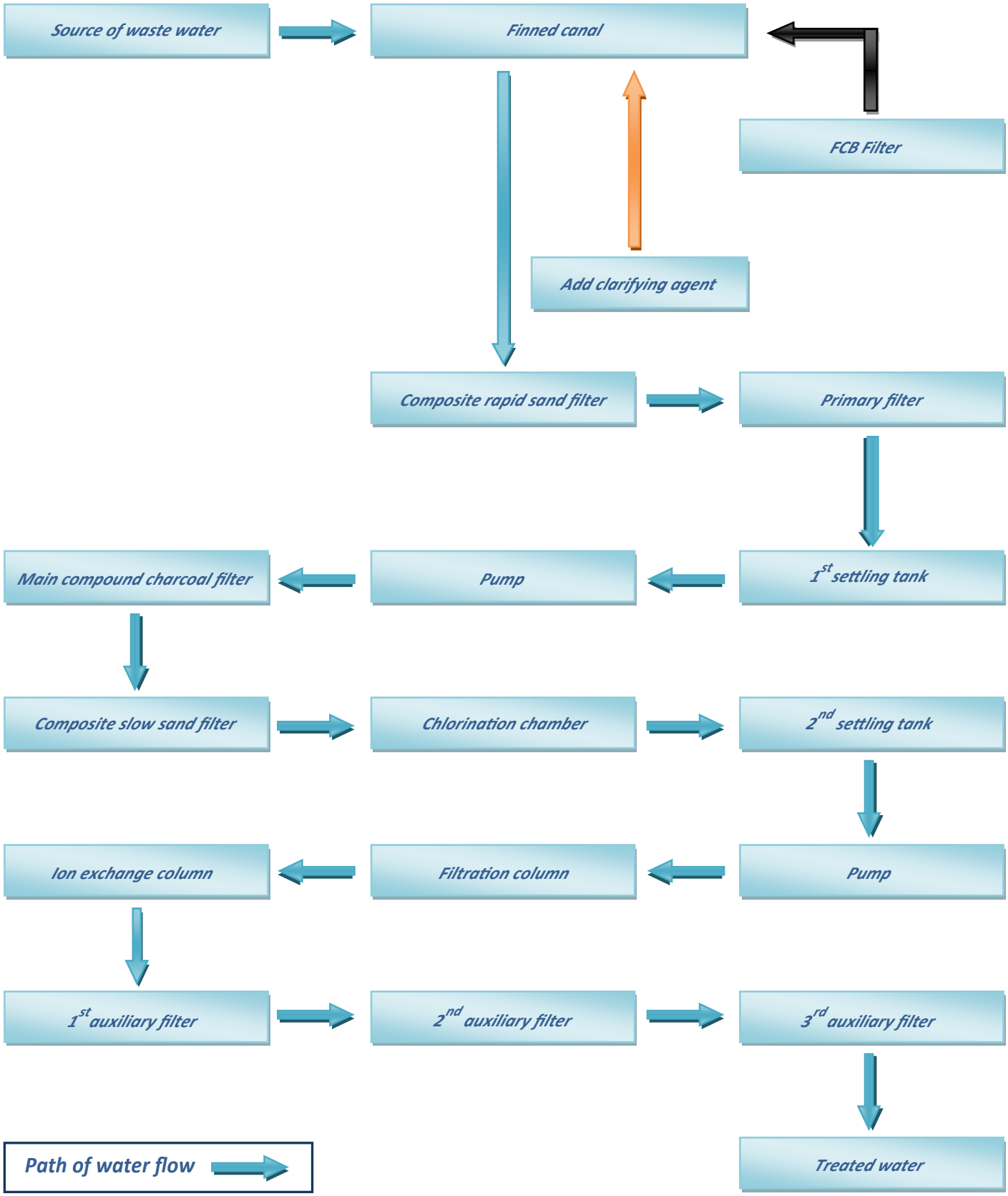
Q5. What are the similarities and difference between your enterprise and JITPPL?

Annexure 1

Operations and Planning KHAMIR

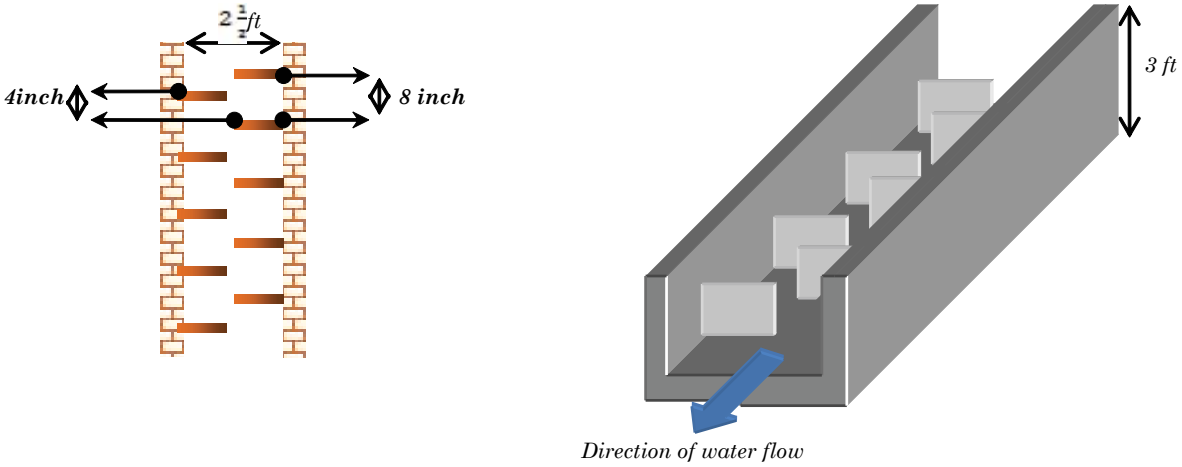


Schematic diagram of Compound Water Filtration System



Functional analysis of Compound Water Filtration System:

1. Finned Water Canal:



Structural Definition:

Finned canal is a simple water canal with vertical fins. Distance between two fins (same sided) 8 inch and distance between two fins (opposite sided) 4 inch. Height of the canal wall is 1.5 ft. Width of the finned canal is 1.5 ft

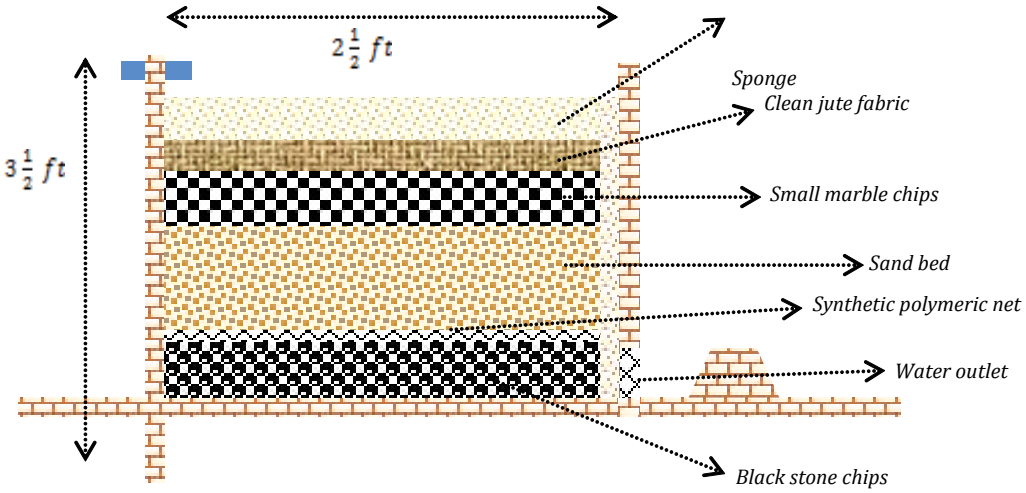
Function of Finned Canal:

- Definition of fin: A fin is a surface used for thrust or to steer while traveling in water, air, or other fluid media, (in other words, a foil (fluid mechanics).
- Function: To prepare a mixture of $KAl(SO_4)_2.12H_2O$ (solution) and waste water we need the lectric motor stirrer. It applies the principle of turbulent flow (fluid dynamics) to reduce the cost of water treatment mechanism. Finned canal creates a turbulent flow of $KAl(SO_4)_2.12H_2O$ (solution) and waste water which enables their efficient mixing.

Maintenance:

- Clean the finned canal after every 10 days.

2. FCB Filter [Finned Canal Block filter]:



Function of FCB Filter:

- FCB filter is an additional filtration system, which helps to remove bigger size suspended particles and partially coloring materials from waste water.

Maintenance:

- Clean the sponge bed after every 15 days and change the sand bed after every 30-45 days.

3. Clarifying Agent:

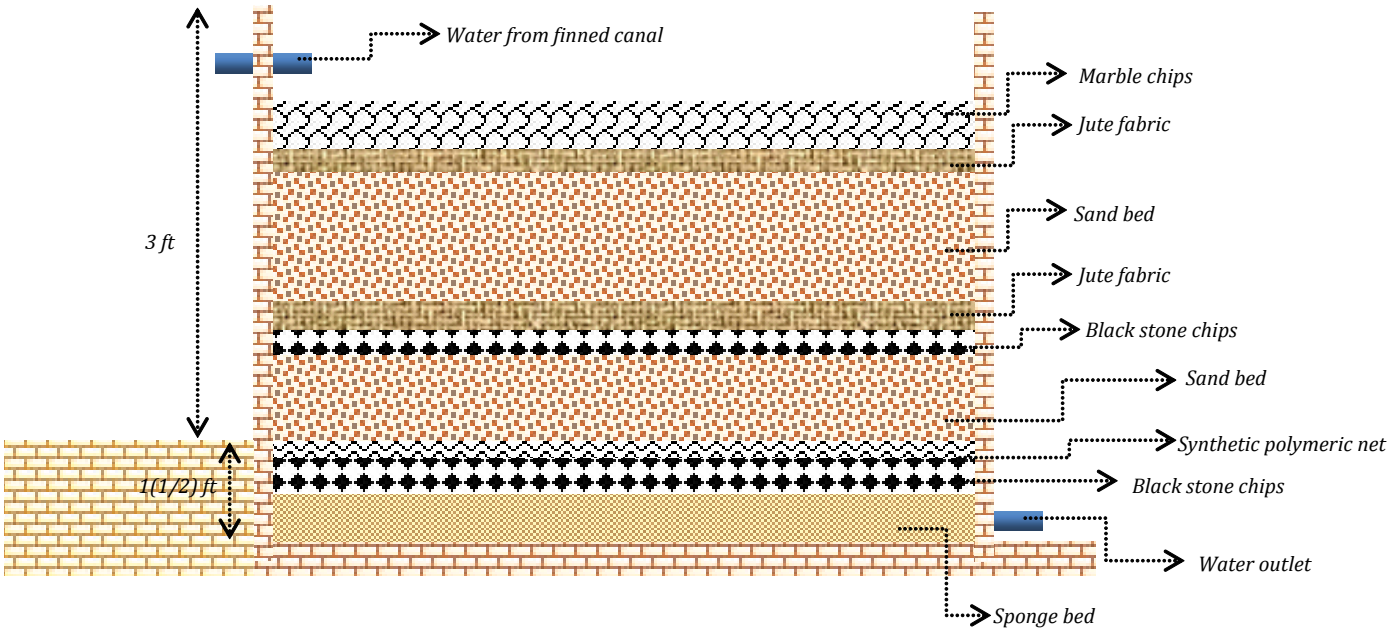
Function of the Clarifying Agent:

- Clarifying agents are used to remove suspended solids from liquids during flocculation. Particles finer than 0.1 µm (10-7m) in water remain continuously in motion due to electrostatic charge (often negative) which causes them to repel each other. Once their electrostatic charge is neutralized by the use of coagulant chemical, the finer particles start to collide and agglomerate (combine together) under the influence of Van der Waal's forces. These larger and heavier particles are called flocs.

Name of the clarifying agent (Alum): $KAl_2(SO_4)_3.12H_2O$

- Use only Alum solution to add with waste water, do not use solid Alum.
- Concentration of the alum solution: 3% [mass-volume %]

4. Composite Rapid Sand Filter or CRS Filter:



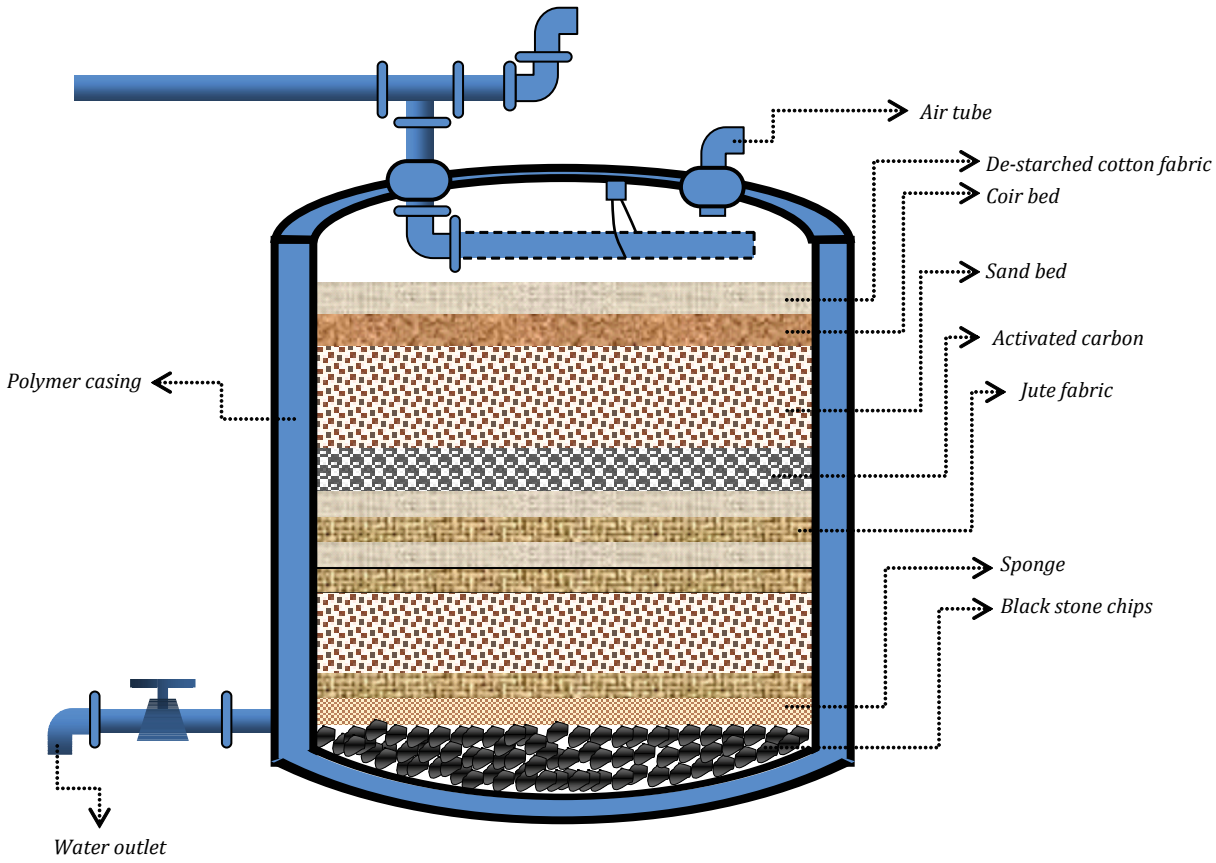
Function of CRS Filter:

- CRS filtration is an additional filtration system which is connected with finned canal line. CRS filter support to remove the suspended materials and coloring materials from waste water.

Maintenance:

- After every 20 days clean and dry the jute fabric and after 60 days change the jute fabric. Change the sand bed after every 70 days.

5. Primary Filter:



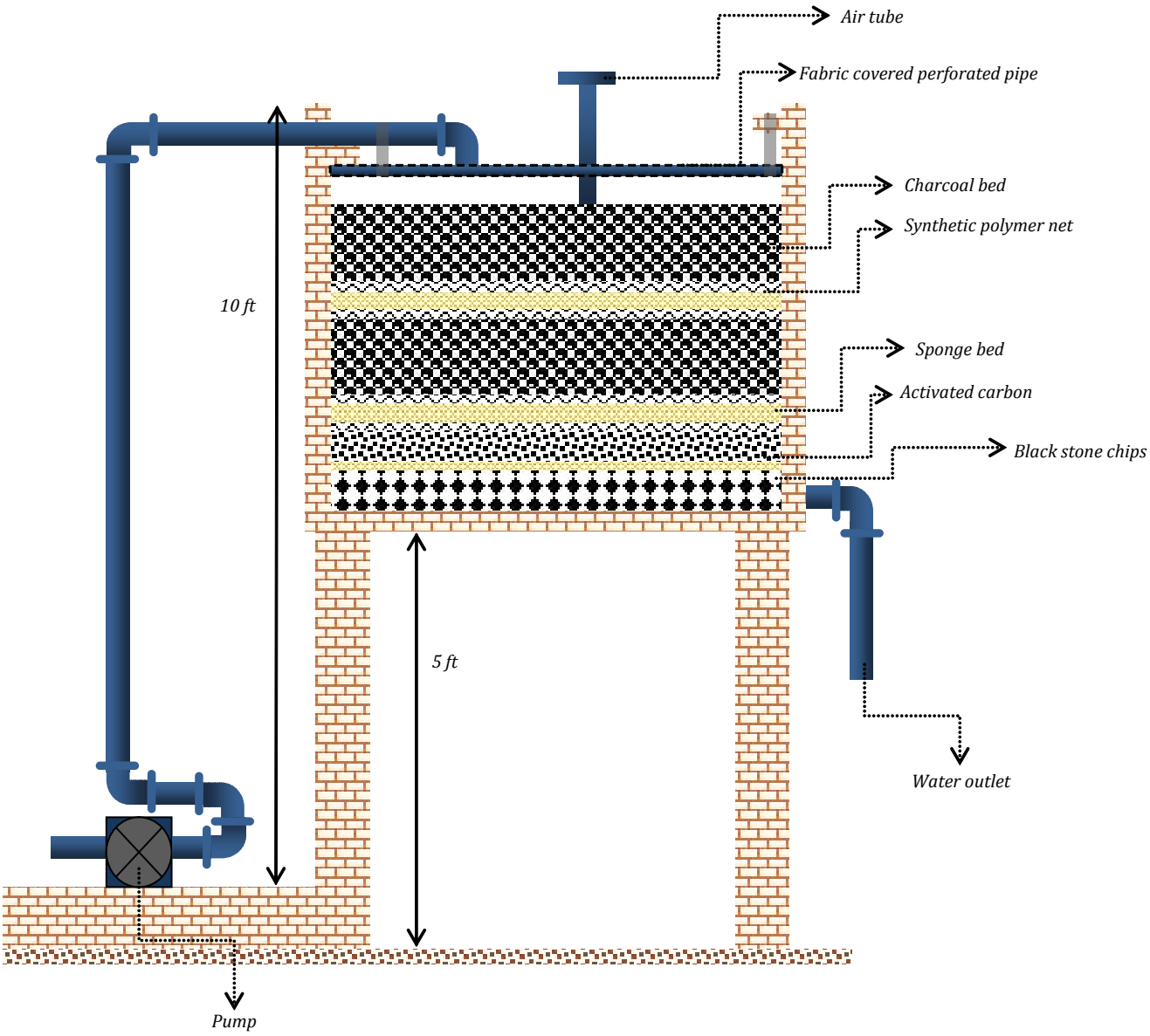
Function of Primary Filter: Primary filters are parts of the main filtration system. Main functions of primary filters are as follows:

- Removal of coloring materials
- Removal of suspended small particles
- Partial hardness removal
- Adsorption of organic compounds

Maintenance:

- After every 35 days clean and dry the cotton fabric, jute fabric and coir bed. Change the sand bed after 45-50 days.

6. Main Compound Charcoal Filter [MCC Filter]:



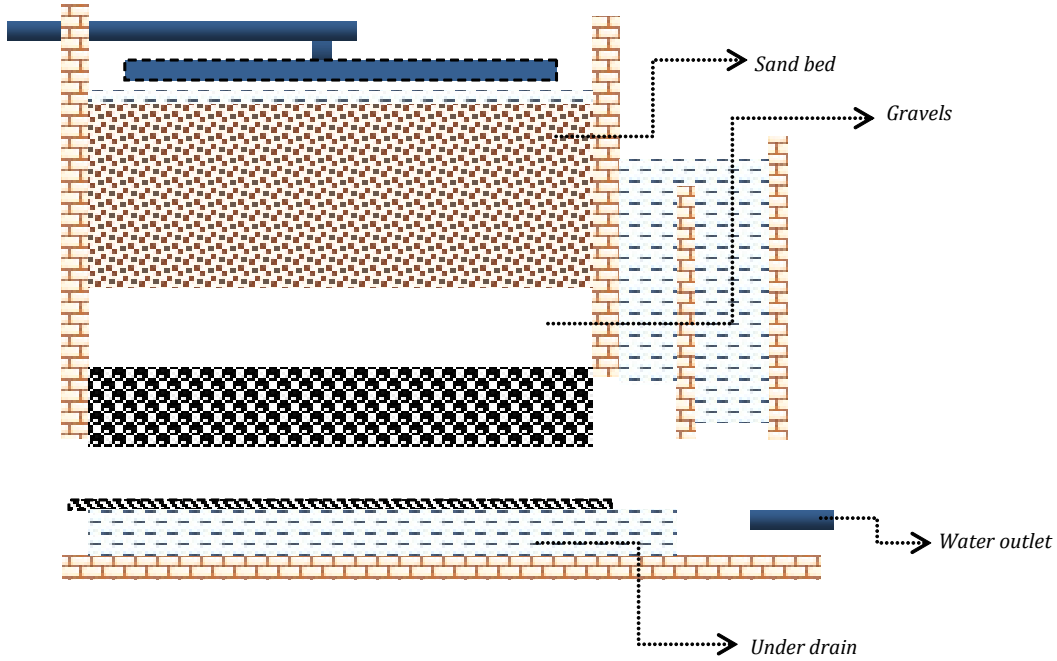
Function of the MCC Filter:

- Hardness removal from waste water
- Filtration

Maintenance:

- After every 6 – 7 month change the charcoal and clean the sponge bed.

7. Composite Slow Sand Filter [CSS Filter]



Function of CSS Filter:

- Main function of CSS filter is removal of all types of coloring materials and smaller particles. CSS filter is an important part of total filtration system.

Maintenance:

- Change the sand after every 8-11 months.

Annexure 2:

Occupational Health and Safety- A Checklist of hazards in textiles

Part of the filtration system	Frequency of the maintenance	Type of the maintenance
Finned water canal	10 – 15 days	Clean the finned canal especially corners of fins
FCB filter	Clean the sponge bed after every 15 days and change the sand bed after every 30-45 days.	Wash the sponge and dry it Change the sand bed and use new sand
CRS filter	After every 20 days clean and dry the jute fabric and after 60 days change the jute fabric. Change the sand bed after every 70 days.	Wash the jute fabric and dry it in direct sun ray Change the sand bed and use new sand
Primary filter	After every 35 days clean and dry the cotton fabric, jute fabric and coir bed. Change the sand bed after 45-50 days.	Use de-starched cotton fabric Wash the cotton fabric with water and dry it in direct sun ray Wash and dry the coir bed in sun ray Change the sand bed and use new sand
Column filter	Clean the column filter every 4-6 days	Reveres flow cleaning
Ion exchanging column	Clean the column after 2-3 days Recharge the column after 15-20 days	Reveres flow cleaning NaCl recharge

OHS: Checklist of hazards in textiles		
Mechanical hazards	**Yes**	**No**
Is work equipment and machinery regularly checked to ensure that it works properly and that the guards and other protective measures are in good condition and operating correctly?		
Are there machines with unprotected or unguarded moving parts?		
Are the emergency stops on the work equipment and machinery accessible and working?		
Are there machines where an unprotected or unintentional start-up is possible?		
Noise and vibration		
Are there workers exposed to noise which is so loud that they have to shout to communicate with a person standing 0.5-1 metre away?		
Are there any noise sources which are not dampened, enclosed effectively or placed in a separate room?		
Is there a lack of noise screens between sources of noise and work areas?		
Are there workers who do not use ear-protectors, even when the noise level is high?		
Are workers carrying out tasks that expose them to vibration - either of their hands and arms, or their whole body?		
Do pregnant women use vibrating tools or machines; for example, during cutting or sewing?		
Does the employer purchase the lowest-noise machines available?		
Does the employer purchase the lowest-vibration machinery available?		
Chemical hazards		
Do workers use hazardous chemicals; for example, those classified as toxic, harmful, corrosive, irritant, sensitising, carcinogenic, mutagenic, or toxic to reproduction?		

Do workers use hazardous chemicals if material safety data sheets are not supplied?		
Do workers work with hazardous chemicals even if a set of safety instructions for use has not been drawn up?		
Can hazardous chemicals be substituted for ones less hazardous?		
Are new workers told of the risks from the dangerous substances in the workplace?		
Are workers aware of the dangers posed by the chemicals they are using?		
Do employees work with carcinogenic or mutagenic substances?		
Do pregnant or breastfeeding women work with carcinogenic or mutagenic substances; for example, arsenic compounds, dimethyl sulphate, carbon disulphide, ethylene oxide, epichlorhydrine or formaldehyde?		
Are workers exposed to organic dusts; for example wool, cotton or yarns?		
Are there workstations without appropriate collective preventive equipment, such as local exhaust ventilation?		
Are there workers who do not use personal protective equipment, such as gloves, goggles, face shields or respirators, even if this is required?		
Are there workers using hazardous chemicals who have not been trained in their use and handling?		
Fire hazards		
Are fire precautions in place, operational, and accessible?		
Do workers use oxidising, or flammable materials, such as sometimes found in paints, adhesives and solvents?		
Are oxidising or flammable substances or preparations stored in unventilated rooms?		
Are there any sources of ignition; for example, open fire, electrical equipment, electrostatic charges or high temperature?		
Do explosive mixtures arise in work processes; for example, air and gases such as hydrogen or methane, air and vapour of benzene or acetone?		
Are there any areas where there is a risk of explosion; for example, rooms in which paints or solvents, flammable liquids or gases are stored?		
Are there any areas with a risk of explosion as a result of contamination by stored flammable substances, increased storage temperatures or excessive quantities of products?		
Are there any fire/high temperature/electrostatic field sources in explosive areas?		
Manual handling of loads and prevention of musculoskeletal disorders		
Are loads lifted in awkward working positions; for example, far from the body, above shoulder-height or below knee-height?		
Are heavy objects or loads lifted manually; for example, boxes containing reels of yam, rollers or rolls of cloth?		
Are trolleys or other equipment for moving loads kept in good condition?		
Do workers have to carry out repetitive tasks, and cannot dictate their pace of work?		
Do workers stand or walk for a long period of time?		
Does considerable force need to be used to push or pull equipment such as trolleys?		
Is the floor uneven, sloping, or in other ways likely to make the movement of goods more difficult?		
Are there areas where the pushing or pulling of loads has to be carried out in cramped conditions?		
Do people work in uncomfortable or awkward postures and positions?		
Do workers have to make repetitive movements?		
Psychosocial and other issues		

Are there high levels of absenteeism and staff turnover that may suggest that work-related stress is present in the workplace?		
Is it often necessary for employees to work overtime?		
Are workers showing abnormal behaviour such as drug and alcohol abuse, lack of ability to concentrate, irritability, and depression that may indicate an issue with work-related stress?		
Are women discriminated against in relation to their gender?		
Are women working under the threat of physical violence?		

Annexure 3:

Profile of JITPPL Members

Name of the Unit	Promoters Name	Background of the Promoter	Details of the product*	Export/ domestic	Block printing/ Screen printing	Estimated production quantities*	Rain water storage capacity (KL)**	Size of the unit(sq metre)**
Cotton Curio	Mr. Mukesh Aggarwal		a. Types: garment fabrics and textile made-ups. b. Functions: Dyeing and Printing c. Categories: Textile d. Materials: Grey Cloth, Packing Material, Stitching Material	Two buyer from Australia. Very low exports mostly domestic		150000 mts/ months	140	1333
Desert artisans	Mr. Jagat Bartwal		a. Types: Printed fabric, Stitched garments, wooden items and ceramics items b. Functions: Personal and home use. c. Categories: Women India, Women Western, Mens, Kids, Home furnishings. d. Materials: Cotton fabric, Leater, wood, Clay Items, Hemp, Moonj			20000 pcs/ monthly	150	1333
Exotic	Mr. Atul Poddar		a. Types: embroidery, prints and hand stitch. b. Functions: Stitching , printing and embroidery. c. Categories: All types of home furnishing. d. Materials: cotton, polyester, silk, polydupion etc.			20 ft. container per month		667

Gangaur	Mr. Harsh Madhok		a. Types : Garments and Textile made-ups b. Functions: Dyeing, Printing, Garmenting. c. Categories : Textile d. Materials : Fabrics mainly Cotton, Linen, Silk			100,000 m Dyeing per annum 100,000 m Printing per annum	440	8000
Gitto	Mr. Amitab Patni	His sister was a teacher in NID, Ahmedabad	a. Types: Table and Bed-Linen, Ladies' garments b. Functions: Printing and sewing c. Categories: d. Materials: Cotton, Silk, Cotton+Silk (Chanderi)			We have a range of products varying from simple products like napkins to complex ladies' garments and it is difficult to give an estimate on the capacity.	170	1667
Goodwill textile	Mr. Vimal Shah/Aditya Shah	MBA from US	N.A	Export oriented company mainly Japan and Europe				2800
Gulab	Mr. Suresh Tak	85 year old company	N.A	Domestic market				
Hot Pink			a. Types: b. Functions: c. Categories: Home Furnishings andIndividual Apparels. d. Materials: Cotton/ Chanderi/Silk/ Raw Silk/Khadi /Cashmere/ Wool.				140	2670

Kuber	Mr. Anil Dadhich		a. Types: Salwar Suits and Sarees b. Functions: Printing, Dyeing, Finishing and Packaging c. Categories: Textiles d. Materials: Fabric, Dyes and Chemical			Salwar Suits – 10000 per month Dress Material - 100000 mtr. Per month	100	670
Marudhara Dyetech	Mr. Sushil Mehta Mr. Rakesh Doshi			Exports in US, Europe mostly every where in the world		One of units 60 KLD capacity and second unit of 110 KLD capacity		Two units of 1250 sq metre each
Mewar Texcrafts	Mr. Dhanajai Singh							
Nayika	Ms. Meenu Tholia	Qualified textile designer	a. Types: Dresses, Blouse, Pant, Skirt, Indo Western, Jacket, Coats And All Made -ups. b. Functions: c. Categories: Quilted, Gudri And Hand Emb, Machine Emb, Fine Hand Quilting d. Materials: Silk, Cotton, Khadi, Tussar.	80% exports and 20% domestic		2500-3000 Pcs Per Month (Pcs Include, Garment, Made-Ups, Accessories And The Whole	130	2660
Nirmal	Mr. Narender Kumar verma		a. Types: Salwar Suits and Sarees b. Functions: Printing, Dyeing, Finishing and Packaging c. Categories: Textiles d. Materials: Fabric, Dyes and Colors	Domestic market mainly supply to small scale industries		10000 - Suits pieces. per month or 75000 Mtr. Running Fabric per month	80	667

Parampara	Mr. Vishal Choudhary	Science graduate, MBA	a. Types: Decorations b. Functions: Aesthetics and Festivity c. Categories: Christmas d. Materials: 100% wool hand made felt	Export		50000 pcs per month	90	1340
Rangai			a.Types: Dress Material / Garments b. Functions: Printing, Dyeing, Stitching, Finishing and Packaging c. Categories: Textiles d. Materials: Fabric, Threads, Decorative Material, Dyes etc.			3000 Pcs. Of Salwar Suits - Unstitched		
Rangotri	Mr. Vikram Joshi	Textile technologist started in 1984	a. Types: Cloth b. Functions: Home Decoration. c. Categories: Block Printing. d. Materials: Silk, Cotton, and Linen			Approx. 400mt./ per day.	95	1338
Rasa	Mr. Manish Tibrewala	NIFT graduate started 13 years ago	a. Types: Textile made ups and garments b. Functions: Dyeing, Printing, Stitching, Finishing, Packing c. Categories: Textile d. Materials: Fabrics, dyes and chemicals, stitching and packing materials and accessories	Mostly exports and relaun-ched domes-tically		75000 units	220	2075

RD Tradelink			a. Types: Apparels Functions: Stitching/ Embroidery Categories: Ladies b. Materials: Cotton Printed			20000 PCS/ MONTH		667
Sampada	Madhu Raoayde Sanjay Raoayde							
Soma	Suresh Nair		a. Types: Woven b. Functions: Block printing c. Categories: Madeups/ Garments/ Handicrafts d. Materials: Cotton/ Silk				250	5410
Suprint	Mr. Tejinder Sodhi	Experience of 30years	a. Types: Textile made-ups b. Functions: Dyeing and Printing c. Categories : Textile d. Materials: Grey Cloth, Packing Material, Stitching Material	Both domestic and export. Companies like Wal-Mart, reliance, shoppers stop		600000 Units	330	4010

aiaca
All India Artisans and Craftworkers Welfare Association

All India Artisans and Craftworkers Welfare Association (AIACA)
Switch Asia Project Implementing Partner - India

18, Community Centre, 3rd Floor, East of Kailash, New Delhi- 110065
Tel: +91.11.26416492/93/94 | Fax: +91.11.26416491
www.aiacaonline.org | mailto:contact@aiacaonline.org