NTIEM
Promoting Sustainable Development

A Report on Sustainable Textile Production

Narol Textile Infrastructure and Enviro Management (NTIEM)

February 2024

Team Lead: J K Vyas, CEO

Coordination: Nainish Kapadia, DGM

Report Preparation: Vipul Patel, Manager

Aakanksha Dave, AEE

Contents

Overview

The Indian textile industry is the second largest producer of MMF Fiber after China. India is the 3rd largest exporter of Textiles and apparel in the world. India has a share of 4.6% of the global trade in textiles and apparel. Major textile and apparel export destinations for India are the USA, EU-27, and UK, accounting for approximately 50% of India's textiles and apparel exports.

Cotton is one of the most important cash crops and accounts for around 21% of the total global fiber production. India occupies the first position in the world in cotton acreage with around 119.10 lakh hectares under cotton cultivation which is around 36% of the world's area of 326.36 lakh hectares. Approximately 62% of India's Cotton is produced in rain-fed areas and 38% on irrigated lands.

Gujarat has been an important center of textile production and trade, and is known worldwide as the 'Manchester of the East', 'Textile State of India', and 'Denim Capital of India'. Gujarat occupies the second position in India's total exports in the textile sector. Gujarat alone produces 60 to 70 % of the country's denim fabric, which ranks first in the country and third in the world. The state also produces 37 % cotton, contributing 60 % to exports from the country. Gujarat contributes 5 % to the total man-made cotton fiber production of the country. Gujarat is the highest contributing state with a 30 % share in woven fiber production in synthetic fiber production.

The various processes carried out in the textile industries of Narol, Ahmedabad, members of the NTIEM include bleaching, mercerizing, washing, dyeing, printing, and finishing. These textile units are spread over an area of about 500 hectares in and around the Narol, Shahwadi, Ranipur, Isanpur, and Piplaj areas of Ahmedabad district in the state of Gujarat. These textile processing units together, process about 2,800 million meters of fabric every year, generating total revenues of over INR 25 billion. The exports from this cluster cater to the demand of many global regions/countries such as Europe, the United States of America (USA), the Middle East, China, Thailand, Turkey, Brazil, etc. The textile processing units directly or indirectly employ around 1,40,000 personnel in the region.

Background

A study by the Centre for Science and Environment (CSE) estimated that the water consumption by the Indian textile industry alone is about 200-250 m^3/tonne cotton cloth of water in comparison to the global best of less than 100 m^3/tonne of cotton cloth. Since the textile industry is highly water intensive, and India has been identified as a highly water-scarce region, the long-term viability of the Indian textile industry hinges heavily on sustainable water management in India.

A water conservation program can cut water consumption by up to 30 percent or more, and the cost savings can pay for the required materials in a very short time. Since the average plant has a large number of washers, the savings can add up to thousands of rupees per year. Other reasons for large effluent volume are the choice of inefficient washing equipment, leakages from pipe joints, excessively long washing cycles, and the use of fresh water at all points of water use.

Objectives

The main objectives of water conservation in the textile industry are mentioned below;

1. Water the most important resource in the world covers about 71% of the earth's surface. 97% of the earth's water is found in the oceans (too salty for drinking, growing crops, and most industrial uses except cooling). Only 3% of the earth's water is fresh.
2. Water can dissolve more substances than any other liquid including sulfuric acid.
3. 7% of the fresh water on Earth is trapped in glaciers.
4. 70% of the human brain is water and it makes up about 66 percent of the human body. A person can live about a month without food, but only about a week without water.
5. A leaky tap that drips at the rate of one drip per second can waste more than 3,000 gallons per year.
6. Higher water consumption than the required quantity or the wastage of water leads to higher wastewater generation and subsequent increase in electricity consumption which adversely impacts climate change.
7. Climate change is causing a decline in groundwater levels, necessitating water conservation to mitigate shortages and raise groundwater levels.
8. Increasing population and diminishing water sources highlight the urgency of water conservation for current and future generations to avert water scarcity.
9. The textile industry's significant water consumption underscores the need for wastewater reuse and recycling to reduce reliance on fresh water.
10. In response to Ahmedabad's over-exploited status, CGWA has imposed higher charges and penalties for groundwater extraction, emphasizing the importance of responsible water management.

Effluent characteristics from the Textile Industry:

Process	Composition	Nature
Sizing	starch, waxes, carboxymethyl cellulose, polyvinyl alcohol	high in BOD and COD
Desizing	starch, glucose, carboxymethyl cellulose, polyvinyl alcohol, fats and waxes	high BOD, COD, suspended solids, dissolved solids
Scouring	caustic soda, waxes, grease, soda ash, sodium silicate, fibers, surfactants, sodium phosphate	dark colored, high pH, high COD, dissolved solids
Bleaching	hypochlorite, chlorine, caustic soda, hydrogen peroxide, acids, surfactants, sodium silicate, sodium phosphate	alkaline, suspended solids
Mercerising	caustic soda	high pH, low COD, high dissolved solids
Dyeing	various dyes, mordants, reducing agents, acetic acid, soap	strongly colored, high COD, dissolved solids, low suspended solids, heavy metals
Printing	pastes, starch, gums, oil, mordants, acids, soaps	highly-colored, high COD, oily appearance, suspended solids
Finishing	inorganic salts, toxic compounds	slightly alkaline, low BOD

Preliminary measures of Water conservation:

- Use of pressure taps in place of conventional taps

- Use of atomizing nozzles in taps and other openings

- Use of automatic shut-off valves

  An automatic shut-off valve set to time, level, or temperature controls the flow of water into a process unit. One plant estimated that a reduction in water use of up to 20 percent could be achieved with thermally controlled shut-off valves

- Use of pipes having less diameter wherever possible
- Use of low-pressure jet wherever possible in place of high-pressure jet for cleaning floors, vessels, screens, etc.
- Create awareness and motivate the employees about water conservation and fix the accountabilities
- Encourage/reward the good practices

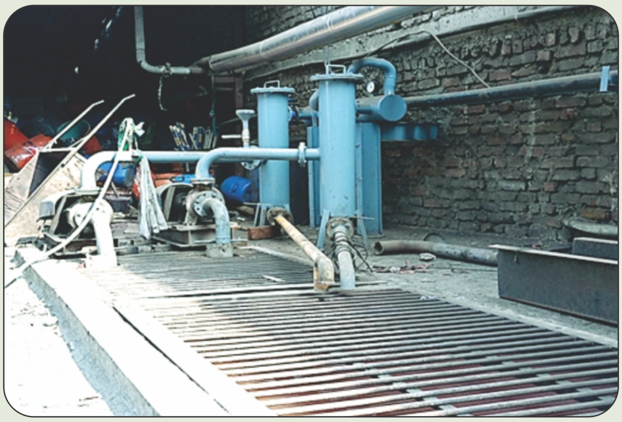
Water conservation and cost-saving options in Dyeing and Printing: (case study in Surat region)

In Dyeing department	In Printing department
Install PLC System in Drum M/C Example: 400kg Drum M/C I) Without PLC System Water Consumption is 45,000L/d ii) With a PLC System Water Consumption is 35,000 to 36,000L/d iii) Minimum Water savings: 22.22%	**Orifice (Reducer) in Ptg. Blanket Wash Line** I) Without Orifice Water Consumptions In One Ptg. M/C. 3000 to 5000 L/h (Line Size 18 to 50 mm) ii) With Orifice Water Consumptions in One Ptg. M/C. 1500 Ltr/Hour (Line Size 6 to 10 mm) iii) Minimum Water savings: 50%
Install Control Valve in Jet M/C Example: 200kg Jet M/C I) Without Control Valve Water Consumption 40,000 L/d ii) With Control Valve Water Consumption 22,000 to 24,000 L/d iii) Minimum Water savings: 45%	**Install Control Valve in Ptg. Blanket Wash Line** I) Without Control Valve Ptg. M/C Running 24 h ii) With Control Valve Ptg. M/C Running 16 to 18 h
Install PLC System in Jet M/C Example: 200kg Jet M/C I) Without a PLC System Water Consumption is 40,000 L/d ii) With PLC System Water Consumption 16,000 to 17,000 L/d iii) Minimum Water savings: 60%	**Overall Reduction by adopting both of the above:** Example- Suppose the number of Printing M/C -7 I) Existing water system: 3000 Lit/Hrs. X 24 Hrs. X 7 Ptg. = 504000 Lit/Day. Which can be difficult to recycle ii) Reducing water System and Control valve system 1500 Lit/Hrs. X 16 Hrs. X Ptg. = 168000 Lit/Day. Which can be easily recyclable

PLC System in Drum

Control Valve in Jigger Machine

Recycle Tank & Pump



8mm Orifice (Reducer) Install in Ptg. Blanket Wash Line

Printing Blanket Wash Control Valve and orifice

Images of Y-Valve

Different measures of water conservation in the Textile industry: (case study in Surat region)

Measure 1: Recycle/ Reuse of Cooling water and Condensate water as boiler-feed water

Problem	In the knitting industry, for example, the amount of cooling water utilized in the process is equivalent to 13% of total fill and rinse water.	
Measure	Cooling and condensate water recovered from jet dyeing machines and reused as boiler feed water or as process hot wash water on soft flow dyeing machines, RFD (Ready For Dyeing) machines, etc.	
Benefits	• The total boiler feed water is being now catered by recovered condensate & and cooling water amounting to 50 KL per day • Boiler feed water consumption reduction: 100% • Recovery of energy in the form of heat from hot water: 15% • Reduction in boiler emissions • Reduction in wastewater generation (quality & quantity)	
Approximate Cost	Capital costs	Rs. 3 lakh
	Operating costs include the pump operation of 10 HP	Rs. 3.13 per annum
	Savings	Rs. 33 lakh per annum
	Payback Period	3 months

Measure 2: Reuse of Treated water for washing at Printing machine

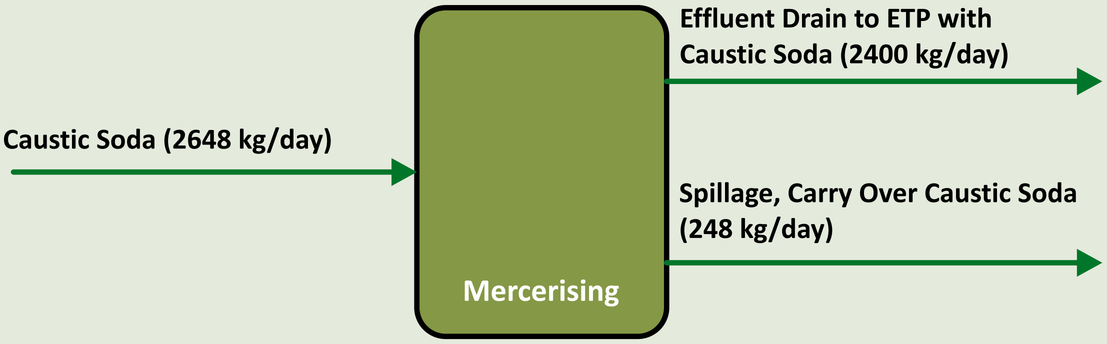
Problem	One Printing machine requires 1500 lit/hr for continuous cleaning of the blanket and screens, therefore it requires 150KL of water per day.		
Measure	In-house piping arrangements were made to divert the ETP-treated water for cleaning at printing machines through an overhead tank.		
Benefits		**Pumps of 6 HP**	**Pumps of 7.5 HP**
	Capital cost investment	Rs. 1 lakh	Rs. 3 lakh
	Operating cost per annum	Rs 1.69 lakh	Rs 86 thousand
	Savings per annum	Rs 3.46 lakh	Rs 2.58 lakh
	Payback period	10 months	21 months

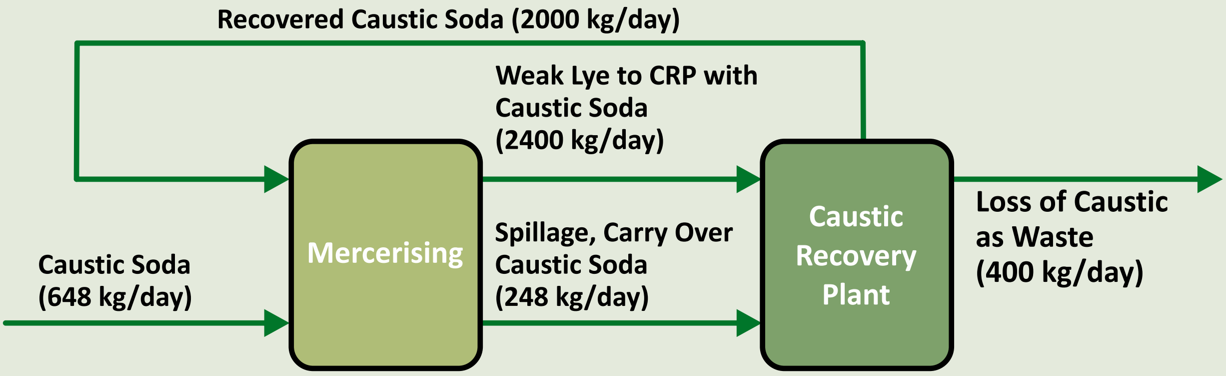
Measure 3: Water consumption optimization at the Jigger machine

Problem	Higher water consumption as well as wastewater generation in the Jigger machine	
Measure	To reduce water consumption and effluent generation two separate water lines for jigger machines are to be provided, one for water filling and one for carrying overflow from the jigger machine so that the water can get more retention time in the jigger machine to reduce the water requirement.	
Benefits	Capital Cost	Rs. 2 lakh per jigger machine
	water saving	360 KL/year per jigger machine

Measure 4: Caustic Soda recovery and reuse system

Problem	After treatment, the fabric is washed with water and starch to remove unreacted caustic soda (98 to 99 % of unreacted caustic) from the fabric. This wash water contains a substantial amount of caustic soda which is not only a resource loss but also it generates pollution in the wastewater (higher COD, TDS, TSS, alkalinity etc.)	
Measure	The condensate can be used for pre-washing and the caustic soda can be reused in the mercerizing process.	
Benefits	Chemical (Caustic) consumption	Reduction by 75%
	Total savings	Rs. 1.42 CR
	payback period	12 months (Operational data)





Measure 5: Batch washing in place of continuous washing in jet dyeing machine

Problem	During continuous washing 5 KL/ batch of water is consumed	
Measure	Batch / Intermittent washing is applied with fresh water intake of three cycles in a batch manner instead of a continuous flow of water.	
Benefits	Water consumption	3.5 KL/ batch of water
	Water consumption reduction per annum for 11 machines	39600 KL
	Capital Cost	0
	Operating Cost	0
	Savings per annum	Rs. 3.05 lakh
	Payback period	Immediate returns

Measure 6: Replacement of alkaline scouring with Bio-scouring enzyme for enzymatic scouring

INITIAL PROCESSING COST OF FABRIC WAS RS. 5.51 PER KG

WATER CONSUMPTION REDUCTION: 45.45%

CHEMICAL CONSUMPTION REDUCTION: 8.65%

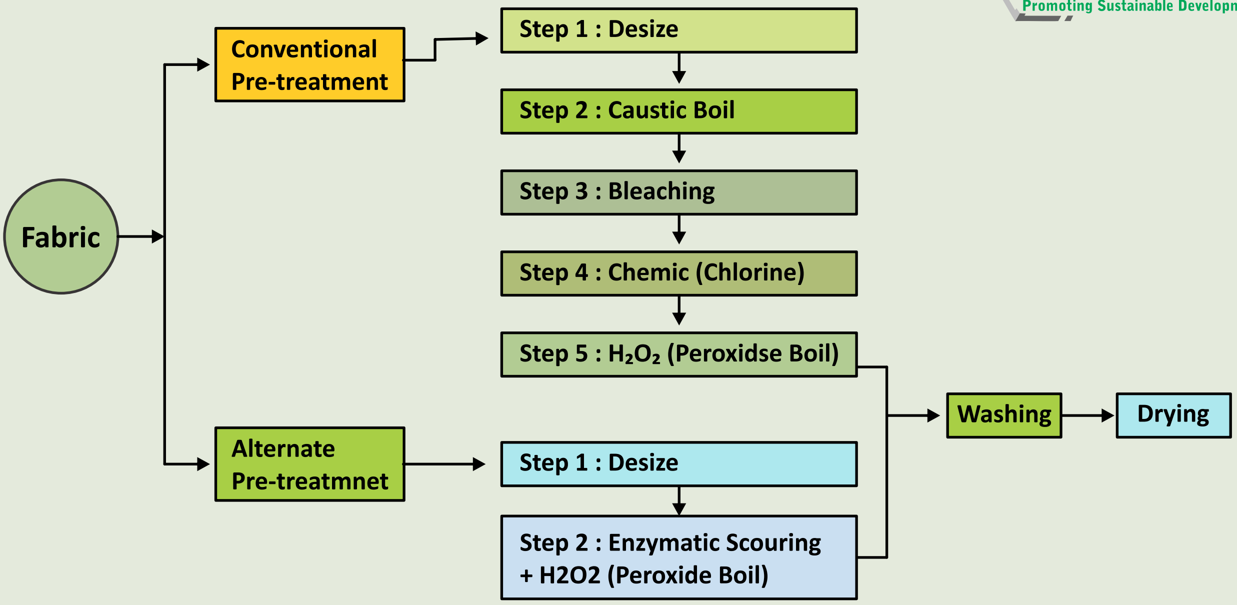
ELECTRICAL POWER CONSUMPTION REDUCTION: 37.04%

FUEL (COAL) CONSUMPTION REDUCTION: 24.55%

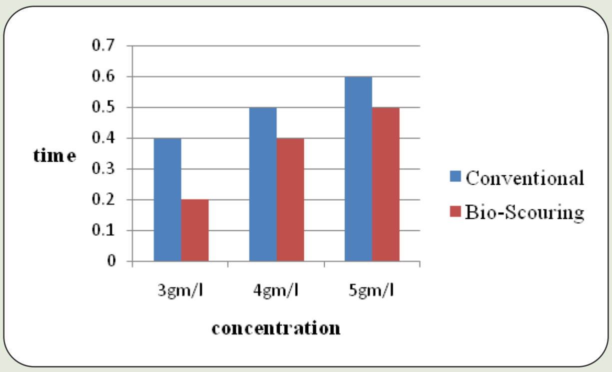
THE PROCESSING COST OF FABRIC REDUCED TO RS. 3.91 PER KG OF FABRIC.

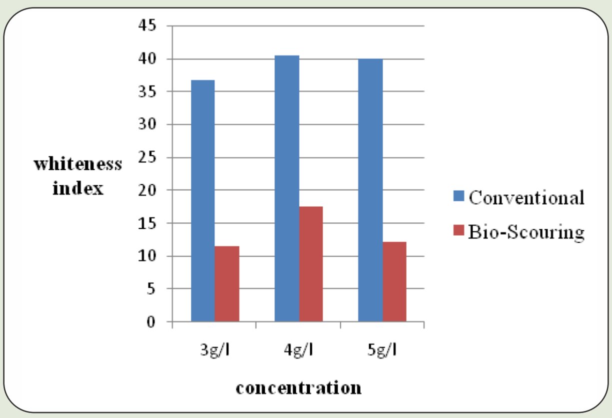
10% ADDITIONAL COST COMPARED TO EXISTING CHEMICALS

THE TOTAL SAVINGS ACHIEVED WAS RS. 50, 22,000 PER ANNUM.



It can be observed that enzymatic scouring involves a smaller number of steps, consumes less time, power, and fuel, and reduces the overall cost.





Reference:
Taken from : Journal of **Textile Engineering & Fashion Technology eISSN: 2574-8114**
Research article volume 5 issue I - **A Sustainable process by bio- scouring for cotton knitted fabric suitable for next generation**
Writers : Ummelewara Bristi, Ashikul Kabir Pias, Fedous Hossain Lavlu Apparel Manufacturing Technology ATM BGMEA University of Fashion Technology BUFT Bangladesh

Measure 7: Efficient Boiler operation

Problem	Boiler efficiencies will vary over a wide range, depending on various factors and conditions. The highest efficiencies that have been secured with coal are in the range of 50-82%. It is being observed that the combustion efficiency of the boiler is lower than the current standard boilers delivering, the combustion efficiency of the boiler was found to be only 80 % while the combustion efficiency of efficient boilers is more than 90 %. The reasons for low combustion efficiency are: • The heat transfer is poor due to the low heat transfer area and short contact time between the flue gas and the water. • The fuel charging door remains more or less open during the entire operation due to various reasons, mostly human errors • There is no control over fuel firing in the combustion chamber
Measures	After a detailed investigation industry has decided to replace the existing boiler which is not efficient with the efficient 6 TPH capacity boiler with an ESP system to take care of the air emissions as well. The performance of the existing boiler was evaluated and a comparison with the efficient boiler for the same amount of steam generation was carried out, based on calculations industry placed the order for a new boiler.
Benefits	Reduction in coal consumption: 10-30% • Reduction in boiler emissions. • Pay Back Period: 21 months

Measure 8: Optimization of Heat energy in Jigger machine

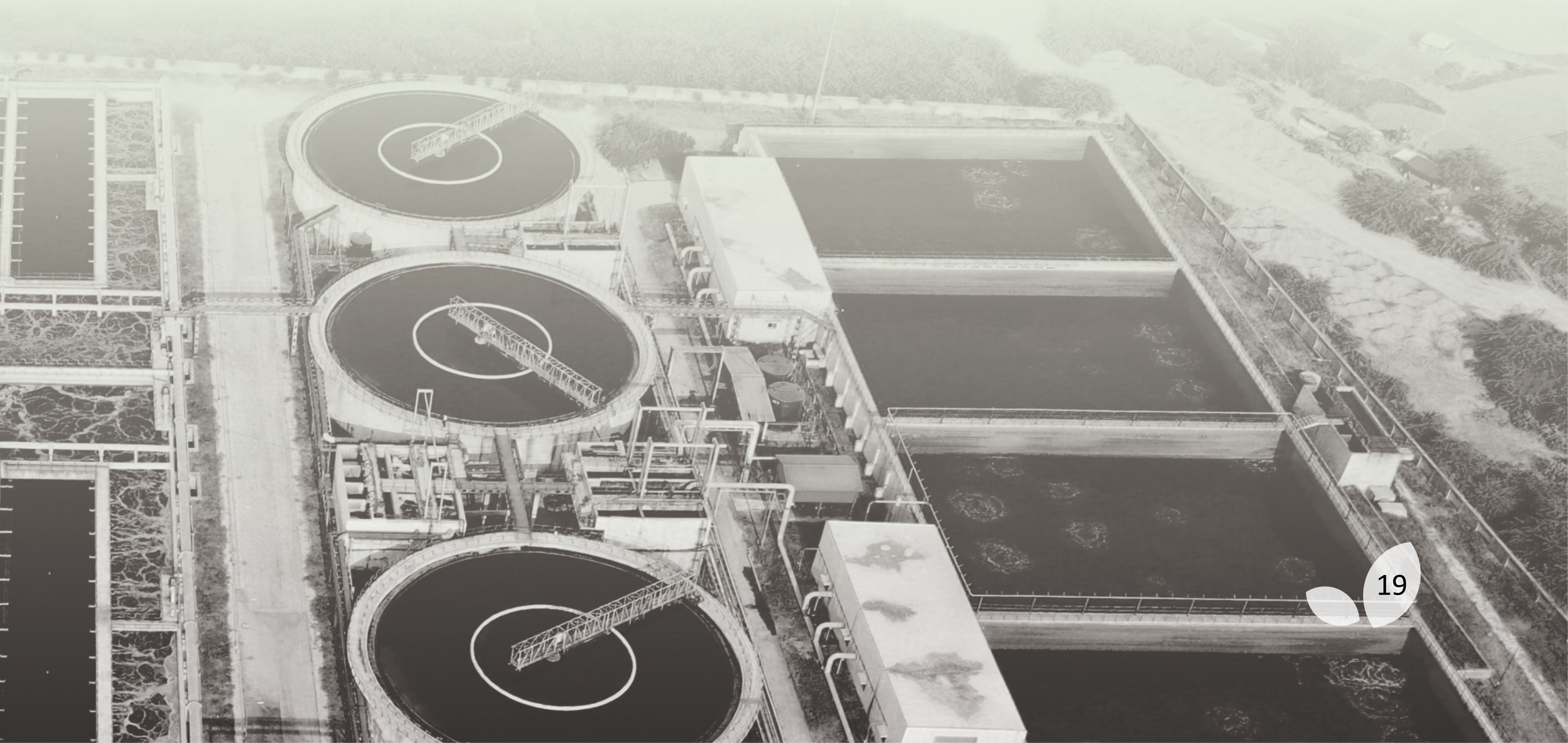
Problem	Hot water is crucial for various processes like Dye application, Dye fixation, and soap in a Jigger Dyeing Machine, which is essential for dyeing cotton fabric. The water temperature, ranging from 80°C to 96°C, depends on the dye type. Steam from a boiler, injected directly into the jigger machine at approximately 3 kg/cm2g, is used to heat the water. However, this method results in significant heat and steam consumption, with an average specific steam consumption at the jigger machine being 1.5 to 2 kg per kg of fabric.
Measure	The water supplied to the jigger is from condenser cooling water (soft water) of the caustic recovery plant at 50°C, thus the water is preheated and will need steam only to raise the temperature from 50°C to an average of 85°C. This hot water is further heated in the closed tank with direct steam injection at 1 kg/cm2 g pressure only to utilize the full heat content of the steam. The machines are supplied with hot water directly instead of heating water at the machines. To maintain the required temperature during the process there are seamless SS coils at the bottom of the jigger machines to provide indirect heating through thermic oil available.
Benefits	• Reduction in coal consumption by 102 tons per year. • Reduction in freshwater consumption of 30000 KL per year • Reduction of CETP charges in the future for the volume of wastewater reduced • Reduced emissions from boiler • Pay Back Period: 21 months

Measure 9: Low liquor ratio in Jet dyeing machine

Problem	The jet dyeing machine dyes the cloth by forcibly contacting the jet flow of the dyestuff solution. It executes efficient dyeing in such a manner that the tension on the cloth is decreased as much as possible, and that the cloth dyes evenly with a relatively small amount of dyestuff. Current Jet dyeing machines operate at a liquor ratio of 10:1, thus resulting in excess water consumption and in turn excess wastewater generation. One factor limiting implementation is the high cost of the new machines, which Favors uses at new facilities rather than as replacements for older machines.
Implemented Measure	Machines of newer designs operate at a liquor ratio of 7:1. These machines usually incorporate low-friction Teflon internal coatings and advanced spray systems to speed rinsing.
Benefits	• Reduced water consumption: 30% • Reduced electrical power consumption: 20% • Reduced fuel (coal) consumption: 30% • Reduced consumption of chemicals and auxiliaries.

Measure 10: Modification in ETP design to reduce the raw water consumption

Problem	One of the well-known Textile industries is situated in backward areas in Ahmedabad. The total area covered is 420 acres, with different capacities for various fabric projects and a co-generation power plant generating 35 MW. This complex generates 10,500 m3/day of effluent. However, the region faces water scarcity and lacks proper effluent discharge points. To address this, the complex was established in 1997 with a focus on minimizing water consumption through effluent recycling, pioneering the concept in the industry.
Implemented Measure:	The industry prioritized obtaining top-notch technology to meet objectives. This included importing key equipment such as a Desalination Plant from Aqua-Chem USA and Reverse Osmosis membranes from Fluid Systems USA. The treated effluent undergoes Reverse Osmosis with pretreatment, yielding over 95% high-quality water utilized in the process house. The remaining 5% is processed through a Desalination Plant, where over 98% of the reject is recovered as pure water. This distilled water is used for power generation and boiler steam after passing through a mixed ion exchange resin Bed. Achieving Zero Liquid Discharge, over 98% of the effluent is recycled, while waste in the form of sludge and salt is disposed of at a TSDF approved by the Gujarat Pollution Control Board.



Cleaner production practices

Cylinder Drying Range

Precautions on a Cylinder Drying Range to run it efficiently are:

- No steam leakages in the pipeline.
- Good functional stream traps properly maintained, preferably independent steam traps for each cylinder.
- Recovery of condensate for Boiler feed.
- Proper tension in the fabric to have intimate contact between fabric and cylinder. Uneven tension will form creases as well as reduce drying efficiency.
- Maintain clean surface of cylinders – Teflon-coated cylinders are recommended.

Stenter

Precautions on a Stenter to run it efficiently are:

- Sealing of chambers with proper asbestos rope packing and tightening top, bottom, and door panels is a must. Leakages of fresh air into the machine through circulating Blower fans can increase the energy consumption by more than 30%.
- Exhaust Blower and exhaust damper control is meaningful only when the chamber is properly sealed, otherwise the leakage into the chambers will be much more than the exhaust capacity. This is the main reason for fumes leaking out from the feeding and delivery openings of the chambers. If chamber sealing is proper exhaust Blower of 5 HP capacity for a 5 Chamber Stenter is more than sufficient to keep fumes leaking out. Controlling of Damper or Exhaust Blower RPM will then be useful for energy saving.
- During the Finishing process on Stenter, technicians prefer to keep the actual speed about 10% lower than what it should be. This is mainly to keep a safe margin due to overshooting and shooting at a chamber temperature of as much as 100 degrees Celsius. The main cause of temperature fluctuations is the poor quality of the control valves used. Here the investment in a good quality motorised valve and proportionate temperature controller will pay back in just a few months due to higher production.
- Technicians also tend to run the stenter at a safer speed during the finishing process, as it is impractical to adjust the speed with changes in fabric color and weave in the same batch. It

would be worthwhile to install a device that will measure and control fabric temperature at the beginning of the last chamber. If the fabric temperature is more than the desired temperature, the controller will switch the blower fans to a lower speed in the last chamber, thereby saving substantial power. Rs. 50/hr. Alternatively, machine speed can be automatically increased.

Inventors (Variable Frequency Drives)

Invertors for Stenter

In a stenter invertors can be used for the Main Drive, Mangle Drive, over-feed system, blower motors, and exhaust blower motors. Of the total power consumed by 140 Amps in 5 chamber stenters, 110 Amps is taken up by blower motors and the remaining drives consume 30 Amps. Of this, Main Drive and Overfeed Drive together do not consume more than 20 Amps. By using Invertors one can at the most save 10% power compared to DC drives.

Invertors for jet/ soft flow/ Dyeing machines

Most of the jet/ soft flow/ Dyeing machines have pumps of larger capacity than the actual requirement. Here it will be worthwhile to use invertors for the main pump and remove the pressure control valve for the nozzle. The savings could be up to 30%.

Invertors for Hydraulic Jiggers

For the large size (960 kg capacity) the main pump motor consumes 15 HP throughout the operation. In actual practice, though the machine is designed to operate at 150 m/min speed, it is usually run at 100-120 m/min. It would be worthwhile to use an inventor to replace the flow control valve. Savings could be up to 30%.

Moisture control in Exhaust for Stenter/ Dryers

This instrument is useful only for 100% cotton/ viscose/ wool fabric and its use is recommended, as it is affordable. With the desired moisture in the dried fabric either the machine speed can be automatically varied to get optimum speeds or the blower of the last chamber can be switched to high or low to save energy.

References:

Website: https://cmogujarat.gov.in/en/latest-news/new-era-development-gujarats-textile-sector-honble-cm#:~:text=the%20textile%20sector.-, Gujarat%20alone%20produces%2060%20to%2070%20%25%20of%20the%20country's%20denim,fiber%20production%20of%20the%20country.

GPCB Manual:

1.Environmental Management Guidelines & Cleaner Production Practices

2.4Rs Reduce, Recover, Reuse and Recycle – a way to sustainability

NTIEM
Promoting Sustainable Development

CETP: 34-Part, Nr. Animal Foundation,
Gyaspur, Ahmedabad, Gujarat 382405

Office: ATPA Earth, 170 Part, Pirana Rd,
Piplaj, Ahmedabad, Gujarat 382405

contact@ntiem.com

91 79 29708230

www.ntiem.com