# RECP Experiences in Pulp & Paper Sector, Gujarat, India

## Achievements at a Glance

Gujarat Cleaner Production Centre (GCPC) is working with Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH – Germany and Gujarat Pollution Control Board on best available techniques implementation in Pulp and Paper in Gujarat. Using the case studies from various Best Available Techniques Reference Documents, Guidance of Sector Specific Experts and Industries, 19 different pilot case studies were identified and implemented. For Pulp and Paper sector the total investment is USD 834375 (One time) and saving was USD 436817.18 (Yearly). Also, the shortest payback period is 10 Days for Pulp and Paper sector. The BAT involves the improvement targeting resource efficiency, process improvement, energy efficiency and reduced environment impacts, by employing appropriate technologies, both environment and economic gain as achieved.

## Overview

The Pulp and paper sector has relevance as is widely known to be an energy and water intensive sector, also having greater implication from the environmental angle. 'Environmental Friendly Technologies/Techniques' could play a significant role in reducing the negative environmental impact provided suitable approach is adopted and right kind of technology is selected by the industries.

Under this, Potential industrial clusters were identified by consultations with the industrial association and industries and volunteering industries were identified for implementation. Total 15 units were selected for pilot scale study and the baseline situation of the selected industry with identification of core environmental issues like resource efficiency inefficient operations, pollution problems etc were documented.

The studies helped to develop Action Plans in these industries for undertaking environmental improvements by making improvements targeting resource efficiency, process improvements, energy efficiency and reduced negative environmental impacts. By employing appropriate technologies, both environmental and economic gains have been achieved. Also, the case studies helped in documentation of possible improvement in the identified industry sectors and dissemination amongst those sectors.

## Benefits

### 1. Acidic Sizing (Alum & Rosin) Replaced by Surface Sizing

### Description:

Sizes are applied to the surface of the paper sheet (surface sizing) to avoid dusting (linting) of the paper in offset printing processes. Surface sizing increases the surface strength of the paper. In surface sizing, the web is passed through the sizing liquor pond. As a result, the paper web absorbs the sizing liquor. This case study describes the economic as well as environmental benefits that could be accrued through replacement of the Acidic Sizing by Surface Sizing techniques replaces the internal acidic sizing and therefore eliminates consumption of chemicals such as Alum and Rosin which are a major cause of TDS formation in process water.

### Implemented technology / technique

**BEFORE:**

- In Kraft board & MG Kraft paper industries, alum & rosin are used for sizing process, which reduces drainability, and supports fiber retention.
- Acidic sizing disables manufacturing of high GSM paper. It also increases total dissolved particles in effluent.
- In chemical chest, alum and rosin were added about 30 Kg/Ton and 8 Kg/Ton respectively as sizing agent.
- Aluminium sulphate (alum) combines with the Sodium rosinate to form Aluminium rosinate (the water-repellent size), along with the ions of sodium sulphate and sulphuric acid.
- The acidic material is responsible for deterioration of cellulose and decreased paper permanence. It is also observed that rosin-sized paper has a lower thermal decomposition temperature and reduced paper strength.
- Due to acidic nature, COD and TSS are also increased in the effluent.

**AFTER:**

- Surface sizing of paper refers to the application of starch by means of a size press or film press which is placed after the M.G. Cylinder and 6 nos. Dryers. This process replaces the acidic sizing to neutral sizing.

- In surface sizing, Retention Aid K-301 150 gm/Ton and PAC (Poly Aluminium Chloride) 15 Kg/Ton are added as sizing agent to both sides of the paper web, as it passes through rollers that press the size on the sheet and remove excess size.
- It Increases internal and surface strength from 16-18 BF (Burst Factor) to 24 BF, improved printing quality and paper stiffness. Surface sizing also affects the printing process by altering paper absorbency, flatness, density, fiber consolidation.

### Economical benefits

The Capital cost invested by the industry was 86,042 USD and a total revenue increase due to product quality improvement was estimated as 56,285.85 USD per annum giving simple payback in 19 months.

## 2. Broke & Trimming Reprocessing Optimization

### Description

The term 'broke' refers to any formed paper from the beginning of the paper making process to the finished product. Broke will exist in many forms and varying quantities and it will always be generated by the paper making process. Depending on the particular case, machine broke will be generated at different locations.

The main goal of a broke system is to return the paper fiber back to the process with no disruption in the uniformity and quality of the stock flowing to the paper machine. The amount of broke produced during papermaking is normally 5 – 20% of the machine capacity.

This case study describes, how in the pilot industry, the paper machine broke and trimmings generated were collected and fed back into the pulper for reprocessing,

### Implemented technology / technique

**BEFORE:**

- During the paper reel production, prior to final packaging of the rolls, the paper is required to pass through the Pop Real & Re-winder process, in which paper broke & trimmings of about 5% (3 Ton/Day) are generated as process waste.
- This waste was collected and recycled by directly feeding into the Hydro Pulper for reprocessing and thereby again undergoing the entire cycle of process steps.
- This reprocessing accounted for additional costs in terms of energy, man power and chemicals consumed, eventually increasing the overall production cost.

- Continuous reprocessing of fiber also degrades the fiber strength and thus affects paper quality.

AFTER:

- With small operational change in the process, the broke & trimmings are now directly fed to the Machine Chest through fan pump in place of Hydro Pulper.
- This change in process circumvents additional reprocessing of material by again undergoing 8 to 9 process steps, and therefore helps in optimizing the costs of power, chemicals, man power etc.
- It directly results in net saving of energy (electrical power used in reprocessing) to the tune of approx. 50 kWh/ton of paper.
- By avoiding reprocessing, the strength of fibers is also found to be improved giving an improved paper quality.

### Economical benefits

- The company implemented change in March 2014 by investing an amount of 159.337 USD.
- The observed savings in the electric cost was 478.69 USD per month, giving simple payback of 10 days.
- The total savings of 5,736.13 USD per annum (only electricity cost) is thus estimated.

## 3. Condensate Recovery

### Description

Paper recycling industry is a water intensive sector and a substantial quantity of water is used for production of steam. Therefore, generation of waste water in any form subsequently increases the hydraulic load on the ETP/CETP.

This case study reflects how recovery and reuse of hot water streams within process not only saves the water for reuse but also conserves valuable thermal energy which in turn reduces the fuel consumption to generate heat. Reduction in steam leakages also improves the overall condensate recovery in the system.

### Implemented technology / technique

BEFORE:

- Transfer of paper pulp from the pressure zone to the drying zone, resulted in removal of moisture, thereby, increasing the pulp consistency from 45%-50% up to 94%. For the purpose, a total 21 units of drying cylinders are installed for removal of moisture. The heating of these dryers was carried out by indirect supply of steam and eventually the steam converts to the condensate.

- Industry was able to recover only 48% of the condensate out of total steam supplied. The loss of condensate was due to leakages of steam in supply network as well as due to condensate handling losses,
- The plant was losing valuable heat content of the condensate. The maximum feed water temperature achievable at boiler was also only 80 °C.

**AFTER:**

- A thorough inspection of the complete steam distribution system was done to identify the steam leakages.
- The leakages as found in the steam network as well as the condensate return were plugged and rectified.
- The total condensate recovery increased from 48 % to 68 % of the total steam supplied, resulting in an increase of feed water temperature at boiler up to 86.5 °C (Average). This helped in reducing the overall fuel consumption of 681 tons per annum.

### Economical benefits

The capital cost invested by industry was only 318.67 USD with total savings achieved by reducing fuel consumption was 5,736.13 USD per annum with simple payback in 20 days.

## 4. Continuous Operation of Clarifier as "Save All"

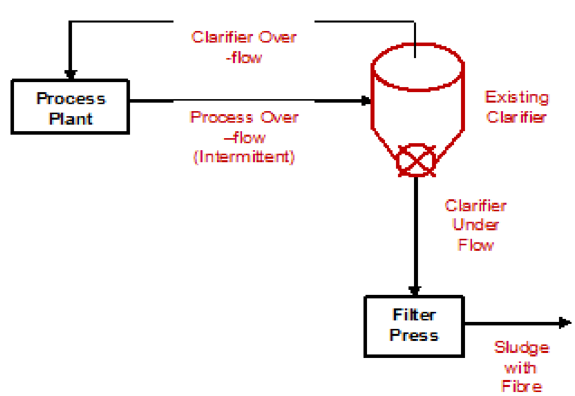
### Description

'Save-all' devices (typically drum or disc filter or dissolved air flotation units etc.) that separate solids (fibers and filler) from the process water. An efficient save-all system that produces clarified water with a low suspended solid content is essential to use process water instead of fresh water for select applications. This case study addresses how an efficient 'Save All' makes good environmental sense in the paper production process.

### Implemented technology / technique

**BEFORE:**

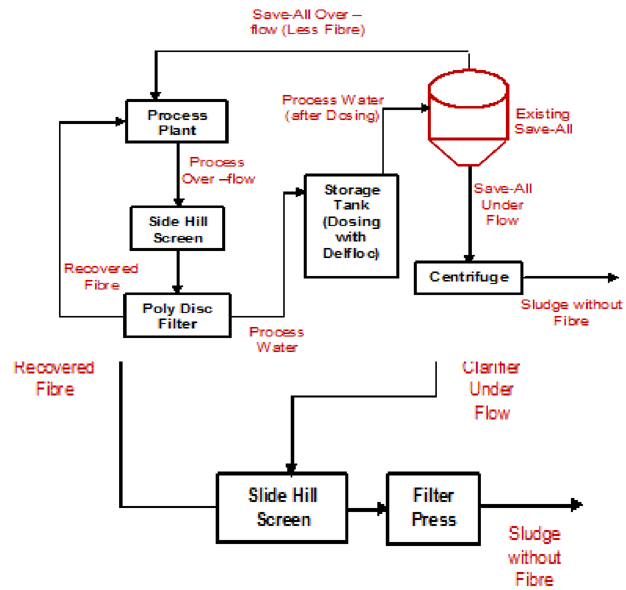
- The surplus flow from different storage / holding systems was going to ETP and was intermittent, thus the clarifier operation was not continuous.
- The recirculating water quality from ETP to process was very poor due to



stagnation of organics resulting in bio-fouling.

- There was hardly any recovery of fiber, which in turn increased solid sludge generation at sludge dewatering system.

AFTER:




- The existing clarifier was made into continuous operation as “save all” since March 2014, due to which recirculating water quality is improved from overflow of clarifier. The clarified water is now recirculated to process.
- Underflow of clarifier is now passing through Sliding Screen for recovery of fiber which is reused into the system.
- This reduces the TSS up to 40% in non-recoverable impurities which were earlier going directly to the filter press and finally as sludge.
- The problem of high sludge generation and its eventual disposal is also resolved. The actual savings are not yet accounted.
- The recirculating water quality from ETP to process was very poor due to stagnation of organics resulting in bio-fouling.
- There was hardly any recovery of fiber, which in turn increased solid sludge generation at sludge dewatering system.

## Environmental benefits

The capital cost invested was negligible, since the TSS level has been reduced by 40 %; the value of recovered fiber is significant.

## 5. Efficient Fiber Recovery through Poly Disc Filter & Quality Process Water for Recirculation

## Description

The process water from paper machine, passing through the poly disc filter via side hill screen, results in recovery of valuable fibers to be reused. This case study depicts how treating of overflow with coagulating chemicals such as Delfloc-5310 (Polyelectrolyte Polymer) reduces the TSS, results in improved recirculation of water.

## Implemented technology / technique

**BEFORE:**

- The surplus process water flow mainly from machine area was directly fed to the "Save All" via Side hill screen. The side hill screen generates high levels of residual fiber content as the fiber recovery is not efficient.
- The under flow from Save-All was diverted to 'Sludge Holding Tank" contained for post dewatering in centrifuge, while the overflow with high TSS (>400 mg/lit) was recycled back to process for reprocessing of fiber (internally and via "Save All" system) to various production steps. This leads to the reduction in strength of the fiber as well as increased reprocessing cost.
- The presence of fiber in recirculating streams also results in problem of biofouling and unnecessary increase TSS in the filtrate.
- The quality of recirculation water was checked for COD and if it exceeded 5000 mg/liter, then certain quantity was purged to downstream biological treatment system, to avoid potential effect on product quality.

**AFTER:**

- Under this intervention it was decided to pass the surplus process water from the machine area through a "Poly Disc Filter"the after side hill screen, in the process flow. This is expected to recover about 0.5% fiber (based on 160 TPD capacity) from water process stream and reuse it into the process.
- The filtrate from poly disc filters to be stored in a new tank with a capacity 100 $m^3$ per day. Where Delfloc 5310 is introduced as a "Coagulant" through an online dosing system.
- The dosed water is transferred to the existing Save-All where the coagulant will absorb the remaining fibers & fines (TSS) from the water, the flocs generated settles at the bottom of the Save-All. The overflow from Save-All (TSS<100 mg/liter) is recirculated to the process plant which will also eliminate the biofouling within process water and the underflow goes to the sludge dewatering system through centrifuge.

### Economical benefits

The capital cost incurred in the process was USD 239005 and the estimated savings was of USD 57361 per annum giving a payback period of in 4 years.

## 6. Efficient Fiber Processing by Recovery through Rotary Screen-1

### Description

Removal of contaminants and recovery of fibers and fines from process water including centri-cleaner & pressure screen rejects is necessary for cleaning process water. This case study describes how use of Special Rotary Screen helps to maximize the process of recycling as well as recovery of fiber.

### Implemented technology / technique

**BEFORE:**

- The Centri-cleaner reject and Pressure Screen reject containing fiber (0.5% of total production 160 TPD) were under constant re-circulation in paper machine process water which reduced the quality of water as well as that of product due to reduction in strength of the fiber and TDS built-up within process water.

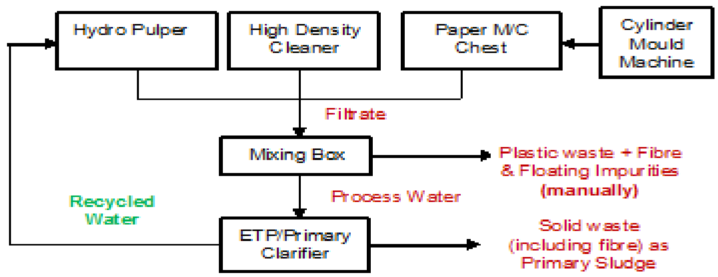
**AFTER:**

- The Centri-cleaner & Pressure screen rejects are isolated from paper machine circulating system and subjected to a dedicated rotary screening system to recover fiber and water.
- Installation of a 0.5 mm slot Rotary Screen system is done for the isolated stream.

### Economical benefits

The capital cost incurred in the process was 239,005 USD and the estimated savings was of 57,361.37 USD per annum giving a payback period of in 4 years.

## 7. Efficient Fiber Processing by Recovery through Rotary Screen-2a




### Description

Removal of contaminants and recovery of fibers and fines from process water including cylinder mould filtrate is necessary for cleaning process water. Use of Special Rotary Screen helps to maximize the process of recycling as well as recovery of fiber. This case study describes how the above could be effectively achieved by using a Special Rotary Screen.

### Implemented technology / technique

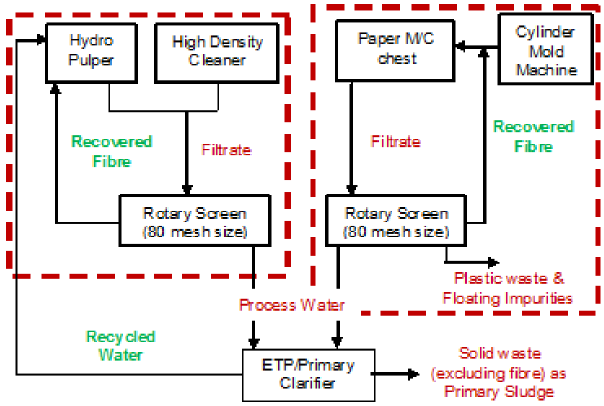
**BEFORE:**

- Filtrate from Hydro Pulper (intermittent) and High Density Cleaner (intermittent) with filtrate from Cylinder Mould combined with Paper machine chest (continuous) are mixed in mixing box where floating impurity removal was practiced through manual operation, the filtrate of which is sent to ETP after removal of floating impurities. Thus resulting in low removal efficiency of fiber and fines.
- The practice increased SS (suspended solids) and TDS (Total Dissolved Solids) in filtrate water being sent to ETP from Mixing Box. This increased solid waste from primary clarifier in form of sludge and was required to be disposed to TSDF site.
- Since the filtration/scr. is not done and the streams are mixed, the valuable fiber leads to the sludge with fines & contaminants through ETP.

**AFTER:**

The stream lines for Hydro Pulper (intermittent) and High Density Cleaner (intermittent) made first loop and segregated from the stream from Cylinder Mould combined with Paper machine chest, which made the second loop.

- The Rotary Screen (B2 Thickener, 80 mesh sizes) is installed; it recovers the fibers by screening the filtrate of both the loops separately as per availability of filtrate. The improved filtration / screening improved the process water quality which can be recirculated in the process loop. At the same time, the fiber recovery was improved which can be recycled in the process loop.




. The rotary screen was installed prior to clarifier, which recovers 50%-60% of total fiber which was earlier going into the sludge (0.103 Ton/day).

## Economical benefits

Capital investment of 28,680.68 USD and with minimum operating cost, industry saves 7,170.172 USD (Fiber recovery cost only) giving a payback period of 4 years.

## 8. Efficient Plastic Waste Handling

### Description

In a waste paper based paper mill, plastic waste (about 3% per ton of paper) in is generated loose forms. This case study depicts how handling of compacted bailed plastic waste imparts more efficiency in terms of storage, manpower & transport.

### Implemented technology / technique

**BEFORE:**

- After screening, plastic waste was manually collected onsite and then transferred to another plant located within Vapi for making plastic roof sheets.
- Plastic waste generated from the process is being stored onsite in loose condition and thus requires significant space, additional manpower to handle & transport the plastic waste from generation to storage area.
- Because of very high calorific value of plastic waste, this waste has potential to be used as fuel but due to Regulatory restrictions and consideration as Hazardous waste, industry has to incur significant cost for handling & disposal. Also, this plastic waste (non-PVC) from paper industry

has good potential to be co-processed in cement industries, for which, it is essential to have viable storage and transportation costs.

**AFTER:**

- Industry has installed an onsite “Bailing Machine”, which compresses the loose plastic waste into bails of proper dimensions with increased density as per requirement of cement industries for ease of handling & reduced transportation cost (high density bails).
- Gujarat Paper Mill Association (GPMA) in Vapi has started co-processing of plastic waste by sending it to cement industries located in Gujarat and nearby states with the help of Gujarat Pollution Control Board (GPCB) for incineration purpose.
- It also reduced labor cost of about 7.97 USD (Rs. 500) per Ton of plastic waste.
- The capital cost invested by industry is 7,966.85 USD (Rs. 5, 00,000,) with operating cost in terms of electricity consumption of bailing machine and operator cost.
- Since, there is no direct monitory benefit but it gives indirect benefits in terms of saving space, environment friendly disposal (co-processing in cement industries) in place of incineration.
- The rotary screen was installed prior to clarifier, which recovers 50%-60% of total fiber which was earlier going into the sludge (0.103 Ton/day).

### Economical benefits

Waste is being used as fuel for cement industries with state of the art pollution prevention equipments ensuring reduced emissions (quantification in progress)

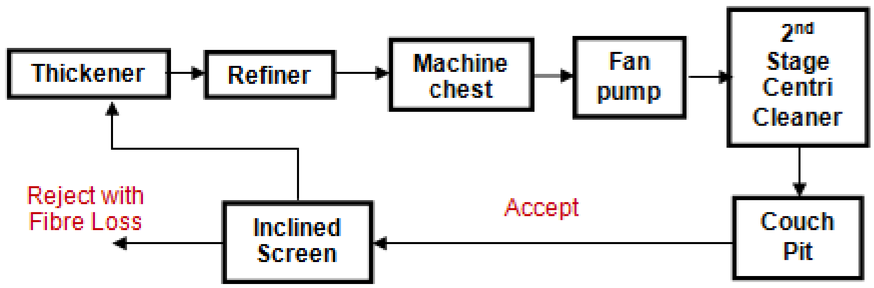
## 9. Process Modification - Recovery of Fiber from Couch Pit and 2nd Stage Centri-cleaner

### Description

This case study describes how reprocessing of fiber as Couch pit and 2nd Stage Centri-cleaner accept could be reduced by modifying the route of pulp and efficient fiber recovery.

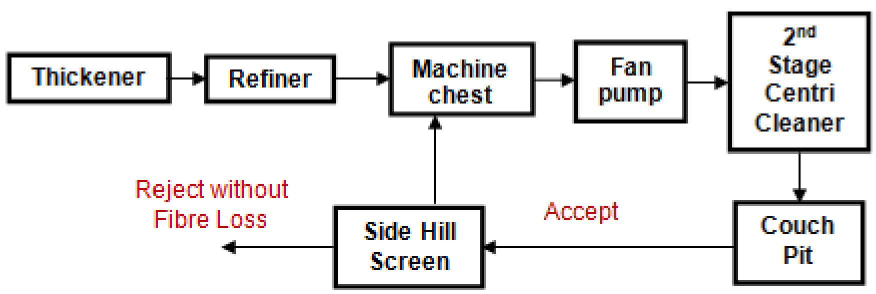
### Implemented technology / technique

**BEFORE:**




- During Kraft paper manufacturing process, accept of 2nd Stage Centri-cleaner collected in Couch pit was reprocessed after screening through inclined screen and sent to the thickener.
- The inclined screen was found to be non-efficient and there was a loss of about 5% (based on 70 TPD productions) fiber with the rejects.

**AFTER:**




- Additional side Hill screen is placed in process, after the couch pit, to reduce continuous recirculation of pulp with direct supply to mixing (machine) chest after screening and fiber recovery with by-passing thickener and refiner.

## Economical benefits

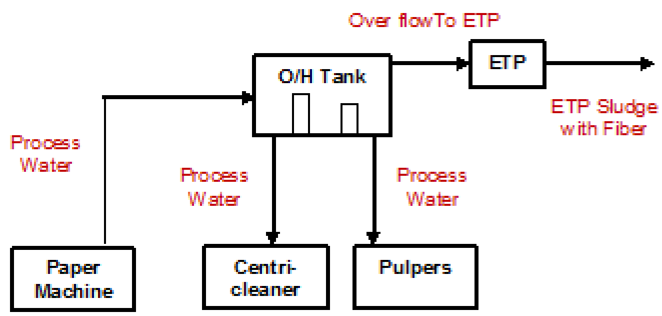
Total capital cost invested by industry was 2,708.73 USD with total saving of 23,430.53 USD per annum giving a simple payback in 2 months.

## 10. Installation of "Mark save All" System for Efficient Fiber Recovery & Better Process Water Quality

## Description

This case study describes how used water from the paper machine can be treated by the 'Save-all' device that separates solids (fibers and filler) from the process water. It usually operates on a filtration, sedimentation, flocculation, or flotation principle (typically drum or disc filter or dissolved air flotation units etc.).

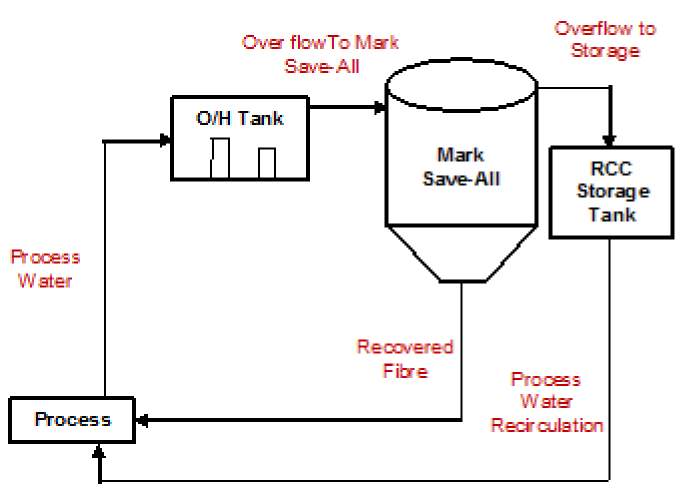
## Implemented technology / technique




**BEFORE:**

- The paper production process involves the recirculation of process water in order to keep fresh water consumption as low as possible. The past practice adopted by industry included, supply of back water from paper machine directly to the overhead (O/H) tank, through which some portion of water was supplied to the centri-cleaner and hydro-pulper for dilution purpose, while the overflow of overhead tank was sent to ETP for treatment.
- The overflow from overhead tank containing fibers was lost through treatment process where after the decantation; the fibers resulted in sludge formation. The non-recovered fiber through decanter also resulted in increased TSS in effluent.

**AFTER:**



- A "Mark Save-All" system is being introduced by the industry, which works as a system for efficient recovery of fibers and generating better quality process water for recirculation.
- The process water from paper machine goes to the Mark Save-All which is a conical tank in which the solid contents are settled at the bottom by gravity and then it can be recovered (400 kg per day) and are fed to the paper machine through a Fan pump. The clear water as overflow is sent to a RCC storage tank through which it will be recirculated to different process like Thickener shower, Turbo dilution, Johnson Screen and chemical preparation for pulping.

### Economical benefits

The capital cost invested by the industry was 39,834.28 USD with a total savings of 41,873.8 USD per annum giving simple payback in 11 months.

### Environmental benefits

This system is also expected to reduce 25-30 $m^3$ per day fresh water consumption by recovering the clear water.

## 11. Installation of Poire for Fibre Recovery from Coarse Rejects (Plastic Waste)

### Description

This case study describes how poire system is used to remove the plastic waste from pulp slurry that comes from the Hydro Pulper and through which fiber loss due to mixing with plastic waste can be avoided.

### Implemented technology / technique

**BEFORE:**

- Pulp slurry containing plastic waste was collected in a tank and then coarse rejects (plastic) were removed manually onsite.
- Fibers loss with plastic waste was estimated to be around 0.5% (based on 160 TPD productions). This plastic waste along with fibers was sent to a Cement factory for co-processing as waste from Paper industry.

AFTER:

- Industry planned to install a batch processing Poire system for efficient defibering of the pulp and reduction in the fiber loss while removing the contaminants from the pulp. Thus, the loss of fiber to the cement industries as waste for co-processing can be avoided.

### Economical benefits

The capital cost to be invested by industry is about 127,469.72 USD with estimated savings through fiber recovery will be 57,361.37 USD per annum i.e. with a payback in 26 months.

## 12. Product Change – Natural Shade Paper Production

### Description

This case study depicts how recycled paper production can be made more environments friendly by use of natural shade of raw material as final product shade that eliminates the use of synthetic dyes and pigments in paper making. The potential environmental impact of dyeing is mainly the releases to water.

### Implemented technology / technique

BEFORE:

- The recycled Kraft paper produced by the industry was produced in brown shade for which approximately 600Kg/month dyes were consumed.
- Due to the addition of dyes, organic load in the effluent (COD and TDS) was high, resulting in poor process water quality due to continuous recirculation and adds to the water treatment cost at ETP.

AFTER:

- Use of dyes was eliminated and production of paper in natural shade is now practiced.
- Company also convinced its customers for the use of natural shade paper instead of colored paper as an individual responsibility to the environment.

### Economical benefits

There is no capital cost invested by the industry and compared to the previous situation, the company has obtained saving of USD 11,472

(Dye Cost) per annum through reduction in ETP load and improving recirculation water quality.

## 13. Optimization of Heat Losses in Paper Dryers

### Description


Normally, in a paper dryer, the steam cylinders are about 4- 5 feet in diameter. A typical paper machine has 40 to over 100 steam cylinders, requiring 1,275 to 1,575 BTUs steam input per pound of water dried from the sheet. This case study reflects how insulation of the side plates of these cylinders, non-covered surfaces and non-insulated piping would prevent the heat emission to the surrounding area, resulting in significant saving of energy.

### Implemented technology / technique

**BEFORE:**

- Transfer of paper pulp from the pressure zone to the drying zone, resulted in removal of moisture, thereby, increasing the pulp consistency from 45%-50% up to 94%. For the purpose, a total of 21 drying cylinders are installed for removal of moisture.
- It was identified that the side plates of the cylindrical dryers were not insulated. With an open installation of a cylinder dryer, continuous thermal energy was lost due to radiation and convection. The side plates of cylinders and non-insulated pipings emit heat to the surrounding area. Additionally, removal of great quantities of ambient air from the area resulted into even higher loss of energy by convection.

**AFTER:**

All the cylinder dryers were insulated at side plates with Rock Wool supported by aluminium cladding (specifically designed for motion at fixed RPM), the insulation provided is having following properties:

- The density varies according to the operation needs, $60kg/m^3$ to $160kg/m^3$.
- The moisture absorbency is very less.
- Very light and easy to apply.
- Can be tailored to any requirement, set by the customer.
- Has a thermal conductivity ranging from 0.07 W/mK to 0.21 W/mK. This depends on the product and the boundary conditions of the system.

- It's very resistant to most alkalis. And the leachable chloride content is less than 5ppm, thus not propagating corrosion.

The modification was done in-house by the industry in December, 2013 with the help of local contractor.

### Economical benefits

Capital cost incurred by industry for insulation was7,966.85 USD with no operational cost giving a total savings of 40,965.58 USD per annum giving return of investment in just 2 months.

### Environmental benefits

By insulating the side plates of cylinder, the dryer reduced average steam consumption up to 75 kg per ton of paper and average fuel consumption up to 29 kg per ton of paper production.

## 14. Pressure Regulating Device on Filter Press for Efficient Moisture Removal

### Description

This case study describes how to improve the solid content in sludge through pressure regulating valve (as automation is an option) to in turn enhance the filter press efficiency

### Implemented technology / technique

**BEFORE:**

- Filter press was used to remove the moisture content from the final effluent and recover the solid mass as sludge for further disposal as required.
- The output of sludge cake from filter press consisted of solids up to 30% (approx. 4500 Kg/batch) and moisture up to 70% (10500 Kg/batch), the batch of 15 m3 effluent took about 48 hours' time for dewatering at filter press. Thus the high moisture content required additional drying before disposal and requires additional space, as well.

**AFTER:**

- A pressure regulating device has been introduced which supplies the compressed air intermittently to maintain the required pressure between the plates of the filter press, so as to

- achieve the solid contents in final sludge cake more than 45% (6750 Kg/batch) with reduction in moisture content up to 15% (2250 Kg/batch).
- The pressure regulating system was installed along with a dedicated air compressor of 15 HP for compressed air supply.

### Economical benefits

Capital cost invested by industry is 4,780.1 USD with operating cost of compressed air, although the savings in terms of improved water recovery (not accounted). Additionally the space required and time for drying before disposal has reduced.

## 15. Reduction in the "Edge Cutter" Waste by Adjustment of "Deckle Guard"-1

### Description

When the paper moves from Head box to wire section, generally, the required width of paper on Pop Reel and Rewinder is 106 inches (269.24 cm). This case study depicts how adjustment of "Deckle Guard" would result in reduction of the "Edge Cutter" (edge trim) waste.

### Implemented technology / technique

**BEFORE:**

- When the paper is passed through the wire section for dewatering, total width of wire section is more than required width of the paper, thus, "Deckle Guard" is adjusted to 5.5 inch width from both ends of the wire.
- Due to this adjustment, when the paper is cut through the "Edge Cutter" for getting the desired width (106 inches or 269.24 cm), wet broke is generated which is required to be reprocessed through the drum thickener via Couch Pit. This reprocessing increases production cost and resource consumption.

**AFTER:**

- Industry after evaluation, readjusted the "Deckle Guard" by reducing the width from 5.5 inches to 3 inches at both the ends of wire section.
- The waste from the "Edge Cutter" was reduced to about 2.5%-3%. Which in turn reduced the reprocessing cost i.e., about 0.143 USD (9 Rs. /kg).

### Economical benefits

With no capital cost investment the industry saved 8,130.97 USD per annum in the reprocessing of broke.

## 16. Reduction in the "Edge Cutter" Waste by Adjustment of "Deckle Guard"-2

### Description

When the paper moves from Head box to wire section, generally, the required width of paper on Pop Reel and Rewinder is 102 inches (259.08 cm). This case study depicts how adjustment of "Deckle Guard" would result in reduction of the "Edge Cutter" (edge trim) waste.

### Implemented technology / technique

**BEFORE:**

- When the paper is passed through the wire section for dewatering, total width of wire section is more than required width of the paper, thus, "Deckle Guard" is adjusted to get a final width of 102 inches
- Due to this adjustment, when the paper is cut through the "Edge Cutter" for getting the desired width, there is generation of wet broke which is required to be reprocessed through the drum thickener via Couch Pit. This reprocessing increases production cost and resource consumption.

**AFTER:**

- Industry after evaluation, readjusted the "Deckle Guard" by reducing the total width from 105 inches to 102 inches.
- The waste from the "Edge Cutter" was reduced to about 2%-2.4%. Which in turn reduced the reprocessing cost i.e., about 0.1195 USD /Kg).

### Economical benefits

With no capital cost investment the industry saved 39,435.94 USD per annum in the reprocessing of broke.

## 17. Reduction in Fiber Loss at Drum Thickener

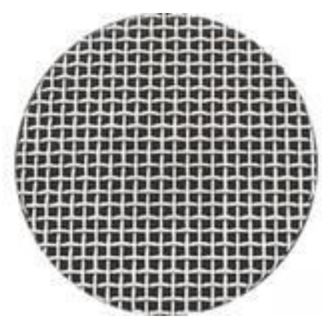
### Description

This case study depicts how the optimized size of screening mesh as per process and quality improves the efficiency of the screening system and reduction in fiber losses.

### Implemented technology / technique

**BEFORE:**

- In the previous process, at thickener, the pulp slurry is adjusted for the consistency before processing to next step.
- The accept from the thickener proceeds to thickener chest while the reject is passed through the screen with 40 mesh size, due to large mesh size a significant amount of fiber with fines also passes through the screen and reaches to pulper and results in reprocessing of fiber to various production steps leading to the reduction in strength of the fiber as well as increasing reprocessing cost.
- The presence of fiber in recirculating streams also results in problem of biofouling and unnecessary TSS increase in the filtrate.



**AFTER:**

- Industry has installed the screen with 60 mesh size, because of which the fibers leading to pulper has been reduced significantly (the actual quantity is not accounted).
- It reduces recirculation and increase in fiber strength by avoiding continuous reprocessing of the fiber thus results in improved paper quality.

### Economical benefits

The fiber recovery and utilization in paper making results in reduction in production cost (quantification is in progress).

## 18. Secondary Treatment at ETP for Meeting Discharge Norms

### Description

This case study describes how a proper secondary treatment facility helps the source industry that generates the pollutants in achieving the discharge norms (COD & TSS) of the CETP.

## Implemented technology / technique

**BEFORE:**

- The industry was running an ETP plant only with primary treatment for the treatment of waste water generated.
- The average discharge from industry after primary treatment was 3000 mg/liter COD & 300 mg/liter TSS. While the discharge norms prescribed by the CETP are 1000 mg/liter COD & 100 mg/liter TSS.
- Regular discharge of effluent not meeting prescribed norms for about 40 $m^3$ waste water per day was observed and the industry had to pay the penalty against discharge to CETP operating company.
- The treated water was reused as process water of about 150 $m^3$ per day with high SS, thus the quality of product was also affected.

**AFTER:**

- Industry has upgraded the ETP by installing secondary (Activated sludge and diffused Aeration system) treatment. The treated water quality has improved with final discharge parameters of COD 800 mg/liter and TSS less than 100 mg/liter, which are well within the prescribed discharge norms by CETP.
- Industry continues to reuse about 150 $m^3$ of treated water per day as process water with better quality than in past, resulting in improved paper quality.
- The investment made is not for economic gains but with an objective to preserve environment and complying with norms.

## Economical benefits

The capital investment done by the industry was 47,801.14 USD, however was making significant amount savings by way of avoiding penalty cost from CETP company.

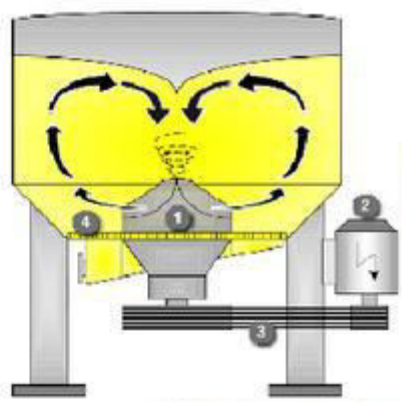
## Environmental benefits

Industry could comply with the CETP discharge norms which in turn had minimum negative impacts on final receiving media.

## 19. Variable Frequency Drive on Major Electrical Motors

### Description

The AC induction motor typically operates at 80% efficiency when under full load, but the efficiency drops dramatically at lower loads. Applications like Pulper, Turbo, Paper machine main drive etc. are having constant variation of load. The power consumption by these equipment motors must be optimized to have cost effective and environment friendly operations. The task of a variable speed electrical drive is to convert the electrical power supplied by the mains into mechanical power with a minimum loss. This case study describes how variable frequency drive helps conserving energy.



### Implemented technology / technique

**BEFORE:**

- The waste paper on the conveyor is added to the pulper along with water. The role of the pulper is to break apart the paper sheets into individual pulp fibers while leaving the contaminants as large as possible. The process conditions in the pulper are characterized by strong pressure shocks from falling bales, vortex formation from fast rotating agitators as well as heavy abrasion from foreign substances such as wires, glass, stones, etc. thus the load on the motor of 200 HP varies continuously.
- Turbo Separator is functional in separating unwanted material from pulp like metal pieces and heavy water resistant particle pins, this machine is efficient and reliable. Besides, it also acts as a plastic catcher in some plants and thus it is exposed to varying loading at motor of 120 HP.
- In paper machine, the paper produced varies in terms of Length, Grade, Fiber Concentration, Quality variation which in turn affects the loading on the motor which is of fixed 200 HP capacity.
- When the motor is operating at light load for extended periods, the motor's efficiency falls due to the over-fluxing of the windings for the particular torque required to drive the load. At a constant terminal voltage this flux, often referred to as magnetizing current, is fixed and accounts for around 30-50% of the motor’s total losses.

**AFTER:**

By installing VFD, when the frequency applied to an induction motor is reduced, the applied voltage must also be reduced to limit the current drawn by the motor at reduced frequencies. Apart from energy saving, VFD provides following benefits:

- Motor is driven only as fast as needed in order to get the right speed and process control required
- Soft start/stop means less wear on couplings, belts and motors. Controls prompts the operator as and when system needs attention
- Industry continues to reuse about 150 m3 of treated water per day as process water with better quality than in past, resulting in improved paper quality.

The VFDs on the major motor were installed by the industry.

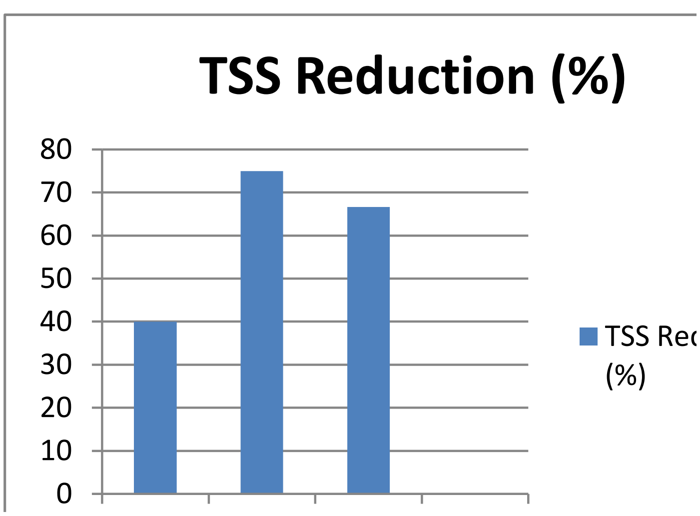
### Economical benefits

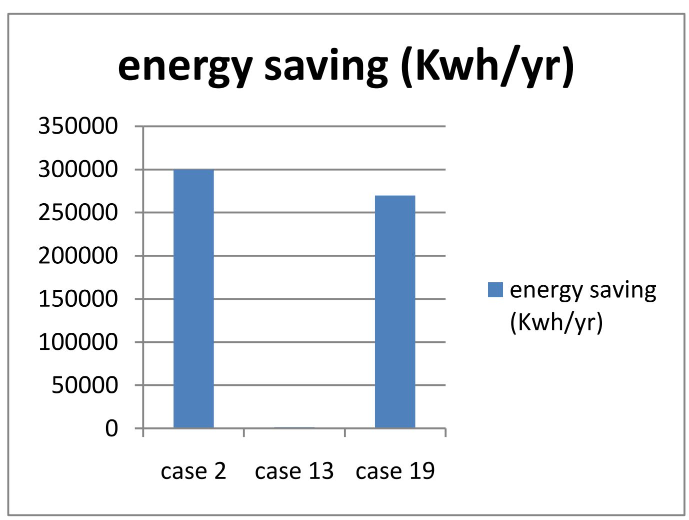
Capital investment to install the VFDs was 27,087.31 USD and with minimum maintenance cost total savings of 33,126.19 USD per annum was accrued giving return on investment in just 10 months.

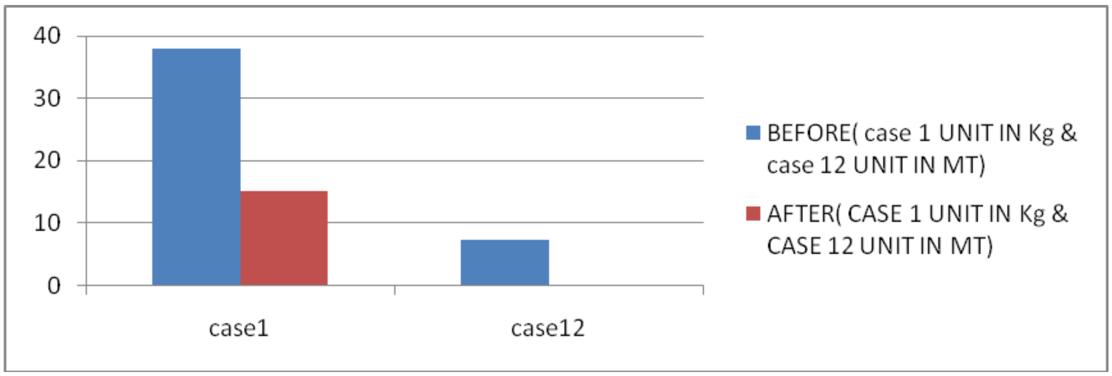
### Environmental benefits

The total electrical power consumption has reduced from 265 kWh per Ton of paper to 250 kWh per ton of paper.

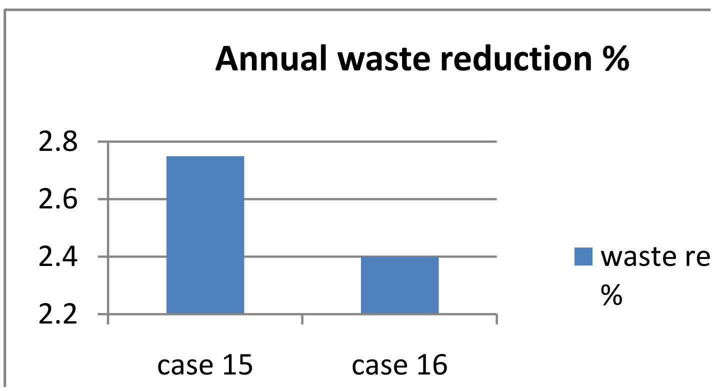
### Table 1: Results at a glance

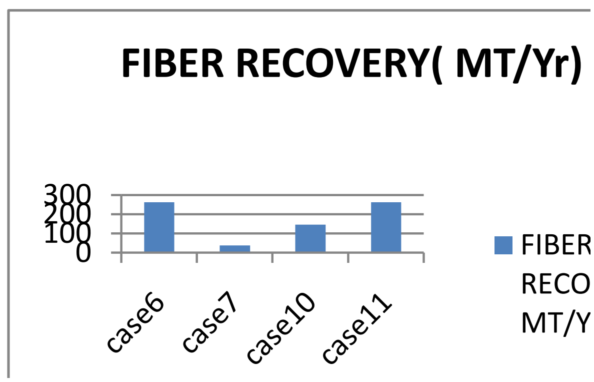





Reduction in Chemical Consumption (case1 in Kg & case 12 in MT)




## Success Areas

The results were achieved through the implementation of the following measures:

- By Surface sizing,  the chemical demands decreases which intern improve the quality of paper.
- By improving broke trimming process, large amount of energy consumption was reduced.
- By condensate recovery measures, there is a reduction in fuel consumption.
- Efficient fibre recovery
- Efficient fibre processing techniques
- Efficient plastic waste handling techniques
- Reduction in dye usage to make natural shades of paper
- Reduction in edge cutting waste.
- Reduction in fibre loss
- Reduction of load on secondary treatment

## Resource Efficient and Cleaner Production (RECP)

**Resource Efficient and Cleaner Production (RECP)** entails the continuous application of preventive environmental strategies to processes, products and services to increase efficiency and reduce risks to humans and the environment.

RECP addresses three sustainability dimensions individually and synergistically:

- *Production efficiency*
  > Through improved productive use of natural resources by enterprises

- *Environmental management*
  > Through minimization of the impact on nature by enterprises

*Human development*
  > Through reduction of risks to people and communities from enterprises and supporting their development


### Table 2: Options implemented

| S.NO | Techniques | Benefits | | | |
|---|---|---|---|---|---|
| | | Economics | | Resource Use | Pollution Generated |
| | | Investment (USD) | Annual saving (USD/Yr) | Reduction in energy use, water use and/or material use (per annum) | Reduction in waste water, air emission and /or water generation (per annum) |
| 1. | Acidic Sizing (Alum & Rosin) Replaced by Surface Sizing | 86,042 USD | 56,285.85 USD | Chemical reduction before : 30kg/ MT - alum & 8 kg/ MT – Rosin after : 150 gm/MT - K301 15 Kg/MT – PAC(Poly Aluminium Choloride) | |
| 2. | Broke & Trimming Reprocessing Optimization | 159.33 USD | 5,736.13 USD | Energy Saving :50 kWh/MT Energy saving / year : 300000 kWh/yr | |
| 3. | Condensate Recovery | 318.67 USD | 5,736.13 USD | Reduction of fuel consumption : 681 MT/Yr | |
| 4. | Continuous | Negligible | Total | | TSS level has |

| | | | | | |
|---|---|---|---|---|---|
| | Operation of Clarifier as "Save All" | | suspended solid (TSS) level reduced by 40% | | been reduced by 40 % |
| 5. | Efficient Fiber Recovery through Poly Disc Filter & Quality Process Water for Recirculation | 239,005.73 USD | 57,361.37 USD | | Reduce TSS to 75% |
| 6. | Efficient Fiber Processing by Recovery through Rotary Screen-1 | 239,005.73 USD | 57,361.37 USD | Recover around 90% fiber which is around - 262.8 MT/Yr | |
| 7. | Efficient Fiber Processing by Recovery through Rotary Screen-2a | 28,680.68 USD | 7,170.172 USD | rotary screen-2a recovers 50%-60% of total fiber = 37.59 MT/ Yr | |
| 8. | Efficient Plastic Waste Handling | Waste is being used as fuel in cement industries | Reduced emission | | 657 MT/Yr of plastic waste is been bailed and send to cement industry reduction pollution load |
| 9. | Process Modification - Recovery of Fiber from Couch Pit and 2nd Stage Centri-cleaner | 2,708.73 USD | 23,430.53 USD | Looping reduce the energy consumption and and increase the fiber strength | |
| 10 | Installation of "Mark save All" System for Efficient Fiber Recovery & | 39,834.28 USD | 41,873.80 USD | Recover fiber =146 MT/Yr<br>reduce fresh water requirement = 9125 m3/Yr | |

| | | | | | |
|---|---|---|---|---|---|
| | Better Process Water Quality | | | | |
| 11 | Installation of Poire for Fiber Recovery from Coarse Rejects (Plastic Waste) | 127,469.72 USD | 57,361.37 USD | Poir efficiency is around 90% which means 262.8MT/Yr of pulp recovered | |
| 12 | Product Change – Natural Shade Paper Production | No investment | 11,472.27 USD | 7.2 MT/Yr dyes were eliminated | Reduce load on ETP , COD and BOD decreases automatically |
| 13 | Optimization of Heat Losses in Paper Dryers | 7,966.85 USD | 40,965.58 USD | 1642.5 MT/Yr steam saved<br>635.1 MT/Yr fuel saved | |
| 14 | Pressure Regulating Device on Filter Press for Efficient Moisture Removal | 4,780.11 USD | Improved water quality | Amount of solid increased is 6022.5 MT/Yr by applying pressure regulators. | |
| 15 | Reduction in the “Edge Cutter” Waste by Adjustment of “Deckle Guard”-1 | No investment | 8,130.97 USD | | waste from the “Edge Cutter” was reduced to about 2.5%-3% |
| 16 | Reduction in the “Edge Cutter” Waste by Adjustment of “Deckle Guard”-2 | No investment | 39,435.94 USD | | waste from the “Edge Cutter” was reduced to about 2%-2.4% |

| | | | | | |
|---|---|---|---|---|---|
| 17 | Reduction in Fiber Loss at Drum Thickener | Fiber recovery and utilization in paper making | Reduction in production cost | | Remove biofouling and unnecessary TSS increase in the filtrate. |
| 18 | Secondary Treatment at ETP for Meeting Discharge Norms | 47,801.14 USD | Amount of saving by way of avoiding penalty cost from CETP company | Reuse of 54750 m3 /Yr water for system use after treatment | Reduce load on CETP.<br>FROM: 3000 mg/liter COD & 300 mg/liter TSS<br>TO: 1000 mg/liter COD & 100 mg/liter TSS. |
| 19 | Variable Frequency Drive on Major Electrical Motors | 27,087.31 USD | 33,126.19 USD | Energy saved :2700000 kWh/ Yr | |

## Approach taken

The overall objective of the programme is to facilitate promotion of Best Available Techniques (BAT) without entailing excessive cost in various industry sectors in Pulp and Paper Sector in Gujarat so as to strengthen environmental management and pollution control in the industries in these sectors. The following actions were designed:

1. Capacities of identified stakeholders are strengthened in terms of knowledge and skills of the involved staff that are mandated with facilitating environmental improvements in industries.
2. Knowledgebase strengthened in India by using BREF documents as well as exchange of knowledge and experiences from Germany.
3. Customized reference documents developed for Gujarat for identified industry sectors.
4. Pilot measures demonstrated in identified industries/sectors.
5. Dialogue promoted among various stakeholders and voluntary commitments are promoted.
6. Increased knowledge of industry, regulatory authorities and other stakeholders on BAT for facilitating improvements in industries.

## Business case

Best available techniques means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and where that is not practicable, to reduce emissions and the impact on the environment as a whole.

| Testimony Box |
|---|
| **Gujarat Cleaner Production Centre (GCPC)** |
| The Gujarat Cleaner Production Centre (GCPC) has been established by Industries & Mines Department, Govt. of Gujarat under Gujarat Industrial Development Corporation (GIDC) in the year 1998 with technical guidance of UNIDO and since then the centre is actively engaged in the promotion of Cleaner Production (CP)/Clean Technology (CT) through its various activities such as orientation/awareness programmes, CP and CT Assessment Projects etc.<br><br>Contributions of GCPC over the years towards promotion of Cleaner Production in the state of Gujarat to improve the productivity and the environmental problems faced by SMEs have been significant. GCPC had also played active role in framing Industrial Policy 2003, 2004, 2009 and 2015, also supported in developing many financial assistance schemes pertaining to CP/CT. GCPC is also member of RECP of UNIDO and Climate Technology Centre and Network (CTCN), a working arm of UNFCCC.<br><br>GCPC have so far conducted more than **200 Orientation Programmes** in different colleges, organizations and industries associations. The centre has successfully completed more than **100 CP Demonstration Projects** in various sectors like Textile, Dairy, Pulp & Paper, Chemical, Petrochemical, Pharmaceutical, Fish Processing, Ceramic etc. |
| **Contact Details** |
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| **English Abstract (where applicable)** |
| N/A |