

Business Case: Caustic Soda Recovery

Support to Safety Retrofits and Environmental Upgrades in the Bangladeshi Ready-Made Garment (RMG) Sector

It is Worth to Recover Caustic Soda

In order to prepare, clean and dye fabrics, the textile industry uses substantial quantities of chemicals. One of the most commonly used chemicals is caustic soda (NaOH), used to increase the strength and luster of cellulosic material. During the process of mercerising cotton is dipped into concentrated caustic soda solution and other wetting agents under tension at room temperature. At the end of the mercerizing cycle the mercerized fabric is rinsed with water to wash out excess caustic. The rinse water, which is mainly weak caustic, is usually generated in large quantities, which - if discharged without treatment - can result in a substantial loss of caustic soda and lead to a high consumption of acid for neutralization in the Effluent Treatment Plant (ETP),

Advantages of Chemical Recovery and Dosing at a Glance:

- Reduced waste caustic discharge and effluent treatment costs
- Savings from reduced purchases of caustic soda
- Saving in energy cost for heating water

hence generating large volumes of sludge.¹

By installing a Caustic Recovery Plant (CRP) it is possible to recover used caustic from the effluent stream. CRPs concentrate the weak caustic in the effluent streams by passing it through heat exchangers, evaporating excess water from the solution and leaving behind concentrated caustic. To increase the concentration of the recovered caustic soda to the desired level CRPs can have multiple stages.

At the end of the recovery process the generated vapour is condensed with non-contact cooling water, generating hot water, which can be used for other processes units such as bleaching units and boiler feed tanks (See Business Case: "Reuse of Cooling Water"). As textile factories usually need large quantities of hot water, the number of stages of the CRP needs to be adapted to the required amount of hot water. Sometimes a three-stage

evaporation plant can be more economical than a four-stage one.²

Experiences from the Bangladesh textile sector show that a four-stage CPR with a capacity of 38,000 litres per day can recover around 6.5 million litres of caustic soda at a concentration of 28 °Baumé per year. During the recovery process around 28 million litres of hot water are generated as a by-product per year. The expected annual savings from the reduced caustic soda purchase and reduced hot water demand are about BDT 32 crore. As the total investment costs can be expected to be around 19 crore the

Approximate Investment Cost and Annual Savings (BDT)



Case study result from Zaber and Zubair Fabrics LTD

average payback period of CPRs is usually less than one (1) year.

Detailed information about the cost and benefits CPRs can be found on the next page, followed by a case study example on page 3. Technical details on the installation and implementation process as well as legal requirements and possible means of financing can be found on pages 4 to 5.



Caustic Recovery Plant (CRP) at Zaber and Zubair Fabrics LTD

¹Cleaner Production Case Study (n.d.). Caustic Recovery Plant

²Körting Hannover AG (n.d.). Changing mercerising wastewater into money

Save Caustic Soda, Generate Hot Water

Recovering and reusing caustic soda opens significant saving potentials. Potential direct and indirect benefits are shown in the table below:

Direct Benefits:

Reduced purchase of fresh caustic soda	Recovering and reusing caustic soda from rinse water can significantly reduce a factory's demand for fresh caustic soda. A CRP can recover up to 95% of the caustic soda in the lye. In a system which processes 4,000kg of weak lye (at 5.2%) per hour this would result in about 200kg of caustic soda per hour. Going at an average market price for caustic soda of BDT 40 per kg the approximate savings could amount to BDT 7,800 per hour. ³
Reduced hot water demand and fossil fuel consumption	The cooling water used in a CPR has a typical discharge temperature of 45°C to 55°C. This heat can be re-utilized as a source of heating in other processes which require hot water. Calculations show that reusing hot cooling water this way can save up to 0.3% of the overall fuel consumption required.
Reduced water treatment costs	As per environmental norms, wastewater cannot be discharged at high pH-values. To neutralise excess caustic in the wastewater, effluent treatment plants often use sulfuric acid (H ₂ SO ₄). A CRP significantly reduces the amount of caustic in the discharge water. This in turn enables factories to reduce their acid consumption by up to 57%. Given an average market price for sulfuric acid of BDT 17 per kg, a CRP which recovers 200kg/h of caustic soda can save around BDT 4,200/h worth of acid.

Indirect Benefits

Reduced Greenhouse Gas Emissions	Reducing the demand for hot water results in a reduced demand for fossil fuels. This reduction of fuel contributes to a reduction in the amount of GHG emissions. A reduction in fuel demand equivalent to 1m ³ of natural gas, otherwise used for heating water, would translate into reduced total emissions of 1.9 – 2.2 kg CO ₂ eq (ref. 2014 IPCC Guidelines).
Reduced environmental stress	Avoiding high pH-levels of the effluent disposal to nearby water bodies reduces the environmental stress in the respective areas.

Calculating the Cost of a Caustic Recovery Plant (CRP)

The specific cost of a CRP heavily depends on the size of system and the quality the recovered caustic soda. Experiences show that the average investment for a four-stage CRP with a recovery capacity of 6.5 million litres of caustic per year is around BDT 19 crore.

³ RAFAE Engineering (n.d.) Case Study: Caustic Recovery Plant at AL-KARAM TEXTILE MILLS(Private) Ltd.

All system components such as tanks and pumps can be maintained by trained internal staff. Average annual maintenance cost can be expected to be less than 3% of the initial investment.

The following table shows possible investments for the installation of a CRP on the example of a medium sized RGM factory in Bangladesh:

Possible investments for selected components of Caustic Recovery Systems:

Type of Investment	Average Cost (BDT)
Pipes (2"-4" x 200 m lengths)	25 lakhs
Pumps	
Strong Lye Tank(100 cu. m cap)	100 lakhs
Weak Lye Tank(100 cu. m cap)	80 lakhs
Valves	30 lakhs
Industrial chemical heater	80 lakhs
Pre-heater	50 lakhs
Filter	40 lakhs
Capacitor	
Control Board	30 lakhs
Total Costs	BDT 19 crore
Average amortization/payback period	< 1 Year



Refining Tanks of Caustic Recovery Plant (CRP) at Zaber & Zubair Ltd.



Setting Tank

Case Study Spotlight: Zaber and Zubair Fabrics Ltd, Dhaka, Bangladesh

Description of the Factory

Zaber & Zubair Fabrics was founded in 1997 and started producing textiles and garments for the export market in March 2000. The manufacturing processes of Zaber & Zubair are vertically integrated, including spinning, weaving, printing, dyeing, singeing, desizing. The company also operates a continuous bleaching plant as well as a stitching unit. The textile mill is located in Tongji, close to Dhaka. It has a daily production capacity of about 230,000 meters of finished fabrics or 46,000 sets of various home textile products, including bed linens, window furnishings, and table and kitchen linen.

Implemented Measures

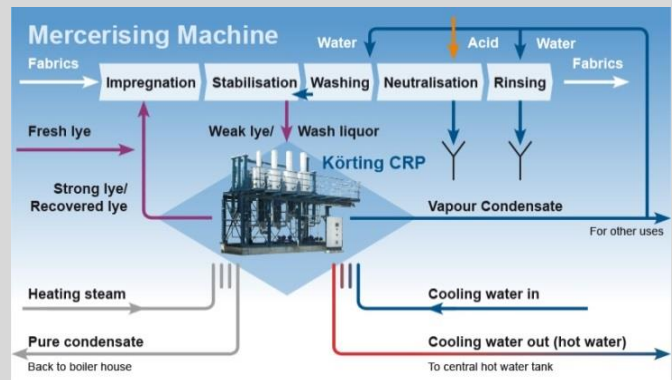
Mercerization is a process necessary in the production of textiles and garments to increase the fabric's luster and strength. This process involves treating the fabric with caustic soda (NaOH) and other wetting agents. To remove the excess caustic the fabric is rinsed at the end of the process producing large quantities of weak lye. If the rinsing water is discharged without treatment this not only results in a substantial loss of caustic soda, but also leads to a high consumption of acid necessary for the neutralization in the ETP to avoid tremendous adverse impact on environmental impact or nature.

Zaber & Zubair Fabrics Ltd used to drain the rinsing water from its six mercerizing units to its in-house effluent treatment plant without recovering caustic soda. The rinsing water used during the mercerizing process was high in salinity (Total Dissolved Solids, TDS) and alkalinity. Thus, Zaber & Zubair Fabrics required large volumes of sulfuric acid (H_2SO_4) during their effluent treatment process to neutralize the excess alkalinity. Due to the high volume of sulfuric acid consumed during this process, the management decided to search for possibilities to reduce costs by minimising the volume of chemicals required for the mercerisation process. During their research, they became aware of the possibility to install Caustic Recovery Plants (CRPs), which separate the weak lye (washing liquid) into strong lye and vapour condensate. The strong lye, which is recovered during the process, can be reused at the mercerizing machine. As the CRP can turn a large proportion of the weak lye into reusable concentrated caustic soda (strong lye), the need to purchase additional chemicals is reduced drastically.

Based on a cost-benefit analysis, Zaber & Zubair Fabrics management decided to install two four-stage Caustic Recovery Plants (CRPs) that run at a combined capacity of 76,800 litres per day. The CRPs concentrate diluted spent caustic soda (at 6%-7% NaOH) into concentrated caustic soda (22% NaOH), which can be reused in the mercerizing processes. The system was installed on a turn-key basis by Koerting Hannover Ltd. (Germany) and Bengal Technology and Engineering Associates (Bangladesh).

Investments and Savings

Integrating the CRP to recover reusable concentrated caustic soda (strong lye) proved to be highly effective and cost-efficient for Zaber & Zubair Fabrics Ltd. In total, the company invested BDT 19 crore to set up the CRPs and which helped to minimise cost by reducing the need to purchase extra caustic soda as well as sulfuric acid for the treatment of the wastewater. Moreover, the investment contributed to reducing energy costs by utilising



hot cooling water for the other process.

In total this resulted in savings of BDT 32 crore per year, and a payback period of less than one year for the investment.

Key Performance Measures

On average, each CRP recovers 6.5 million litres of caustic soda per year at a concentration of 28 °Baumé and generates around 28 million litres of hot water per year as a by-product.

Prior to installing the CRPs, Zaber & Zubair's ETP consumed 700 tonnes of H_2SO_4 every month to neutralize its wastewater. The installation of the CRPs reduced the acid (H_2SO_4) consumption by 57% to 300 tonnes per month.



Weak Lye Tanks of CRP at Zaber & Zubair Fabrics Ltd.

References for Caustic Recovery in Bangladesh

Although there are no direct regulations regarding the recovery of chemicals in Bangladesh yet, there are guidelines which address the permissible maximum pH-levels of industrial discharge water.

In accordance to the guideline for assessment of effluent treatment plants published by Bangladesh Department of Environment (DEO) and the national standards for waste discharge quality at discharge point for Industrial Units and projects the maximum pH-level at discharge point has to be in the range of 6 to 9.⁴

Besides the national legislation in Bangladesh, leading brands in the textile industry have also recognised the need to limit hazardous wastewater discharges from textile manufacturing processes. This has been driven both by heightened public scrutiny and the desire by industry leaders to be good stewards of the planet's resources. As a result, several multi brand consortia such as the American Apparel and Footwear Association (AAFA), the Business for Social Responsibility (BSR) or the Sweden Textile Water Initiative (STWI) as well as most of the major textile brands (e.g. H&M, C&A, Levi Strauss & Co, etc.) have published wastewater guidelines. The majority of these guidelines also require a pH-level of 6-9 for wastewater discharge.⁵

Key Steps Required for Implementation

As per experience, the installation of a CRP will approximately take between 1 and 2 months (excluding planning and structural preparations).

The following factors can help you to determine your factories saving potential:

- Determine the weak lye generation rate of your mercerising processes. An online calculation tool is offered for instance by Koerting Hannover AG, Germany.⁶
- Determine the concentration of weak lye and mercerising solution
- Determine the amount of hot water needed for pre-treatment in your factory
- Determine the required temperature for hot water and the cooling water inlet temperature

Availability of Materials in Bangladesh

The required materials can be sourced via local and international traders and manufacturers. You may contact Zaber & Zubair

⁴ Bangladesh Department of Environment (2008). Guide for Assessment of Effluent Treatment Plants

⁵ ZDHC (2015). Textile Industry Wastewater Discharge Quality Standards

⁶ Estimation of weak lye generation. Available at: <https://service.koerting.de/en/calculations/calculations/-estimation-of-weak-lye-generation>

Fabrics for their recommendations regarding possible suppliers. For further information see Case Study on page 3.

Nature of Services Required to Support the Implementation

- Installation services for CRPs will have to be conducted by third party specialists
- Maintenance services for the system can be carried out by trained internal staff

Possible Sources for Financing

SREUP credit line could be a good source of financing for such an investment.

Main Feature of SREUP Credit Line	
Loan Type	Normally Term Loan
Discount	Provision and possibility of 20% discount from loaned amount
Loan Tenure	3-5 years in general and in special case up to 7 years
Loan Limit	Normally up to 1 Million Euro and can be increased up to 3 Million Euro in special cases
Interest Rate	7% p.a. (maximum)
Grace period. Debt : Equity Ratio. Repayment	All issues are subject to agreement between borrower and lender



Refinery Tank of Caustic Soda Recovery (CRP) at Zaber & Zubair Fabrics Ltd.



Recovered Liquid Caustic Soda