



Conference Article

# Caustic Recovery Unit Design for Mercerization Machines

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## Abstract

*The products of the textile industry are very important in our lives, but the textile industry comes to the fore with its impact on the environment, excessive water consumption and waste production. In this study; Existing techniques based on less waste production in the textile industry were examined. With the textile finishing processes applied today, it is possible to give cotton fiber a structure similar to that of synthetic fibers. The most important finishing process that changes the physical and characteristic properties of cotton fiber is mercerization. Mercerization is a pre-treatment process applied to cotton fibers. The weak caustic, which is the output of the mercerizing processes, is discharged into the channel from the stabilization unit. The caustic recovery system designed by our company uses gradual evaporation and condensation principles to evaporate water from waste weak caustic and obtain strong recycled caustic. Recovered strong caustic is used repeatedly in mercerizing processes. In order to serve the fabric quality expectation, recycled caustic can be cleaned using hydrogen peroxide if desired. This study aims to recycle the caustic used in the mercerizing machine. A new process will be developed with a pre-causticizing system. By reducing caustic consumption with the package type caustic recovery unit to be designed, by eliminating the alkaline waste water problem in the mercerizing machine, by reducing the use of chemicals required for neutralization, pollution of nature will be largely prevented and energy savings will be achieved with the heat recovery unit to be designed. It has been determined that the recovery of caustic in textile facilities that use high amounts of caustic, such as the mercerization process, is both economically and environmentally beneficial.*



Keywords: Mercerization, Caustic Recovery, Pre-treatment

## 1. Introduction

The products of the textile industry have a very important place in our lives, but the textile industry comes to the fore with its negative impact on the environment, high amounts of water consumption and waste production. One of the common processes in the textile industry is mercerization, which was discovered by John Mercer in 1844 to increase the brightness, strength and dye ability of the fabric. The principles of mercerization were discovered by two Englishmen named John Mercer and Horace Lowe. Mercer first examined the swelling and shrinking effects of lye on cotton in 1844 and noticed that after the removal of alkali, the fabric gained a tighter and fuller structure, showing its tensile properties, and its dye absorption capacity increased. The increase in brightness of cotton by preventing it from shrinking during treatment with alkali was noticed by Horace Lowe in 1890, about half a century later. In the following years, with the developing technology, different mercerization methods and machines were developed [1]. At the end of the mercerization process, caustic and hot wastewater is formed. The BOD and solids content of the wastewater generated at the end of the process is low [2]. Discharging mercerization wastewater into receiving environments without proper treatment causes environmental problems [3]. The dilute caustic to be used in the mercerization process must be at a certain concentration. Therefore, it is necessary to concentrate the recovered caustic [4]. The caustic recovery system designed within our R&D uses gradual evaporation and condensation principles to evaporate water from waste weak caustic and obtain strong recycled caustic. Recovered strong caustic is used repeatedly in mercerizing processes. A new process will be developed with a pre-caustic zing system. A new process will emerge by performing double-stage mercerization. By reducing caustic consumption with the caustic recovery unit, eliminating the alkaline wastewater problem in the mercerizing machine, reducing the use of chemicals required for neutralization, pollution of nature will be largely prevented and energy savings will be achieved with the heat recovery unit to be designed.



## 2. Materials and Methods

Designs will be realized by calculating the mathematical modeling of the system through thermodynamic analysis, the steam temperature at each stage of the system, the amount of water evaporated, the remaining caustic mixture, and the amount of condensate formed, from the principles of input and output masses and conservation of energy. The most important part of the design of in cascade evaporators is the exchanger. The heat exchanger design reveals the efficiency of the system. The system consists of a total of 4 stages. When the stages are examined, the stage where the greatest thermal power steam is first given is the 1st heat exchanger stage. The weak caustic solution overflowing from the stabilizing/washing section of the mercerizing machine is collected in a collection tank. The weak caustic solution in the collection tank is passed through a self-cleaning automatic filter and filled to the set level in the 1st stage evaporator. In the first stage evaporator, the weak caustic solution is evaporated and passed to the separator. In the separator, the caustic solution and water vapor are separated. The solvent vapor coming out of the solution is used to heat the 2nd stage. When it reaches a certain level, it automatically switches to the 2nd level. The process is repeated at other levels. The system is multi-stage and the concentration of the solution increases at each stage. The recovered strong caustic solution is collected in the caustic receiving tank. In the purification tank, caustic is separated from foreign substances by ensuring that solid particles sink to the bottom and other foreign substances rise to the upper level of the tank. As the concentration of the caustic solution increases, its boiling point also increases. This is controlled by the application of vacuum. Now clean caustic is obtained and this caustic is collected for reuse in the strong caustic tank. The solvent vapor coming out of the last stage is cooled by passing through a surface type condenser. The distillation coming out of the condenser is optionally used as process water in mercerizing machines after pH control. The system schematic of the caustic recovery machine is given in Figure 1.

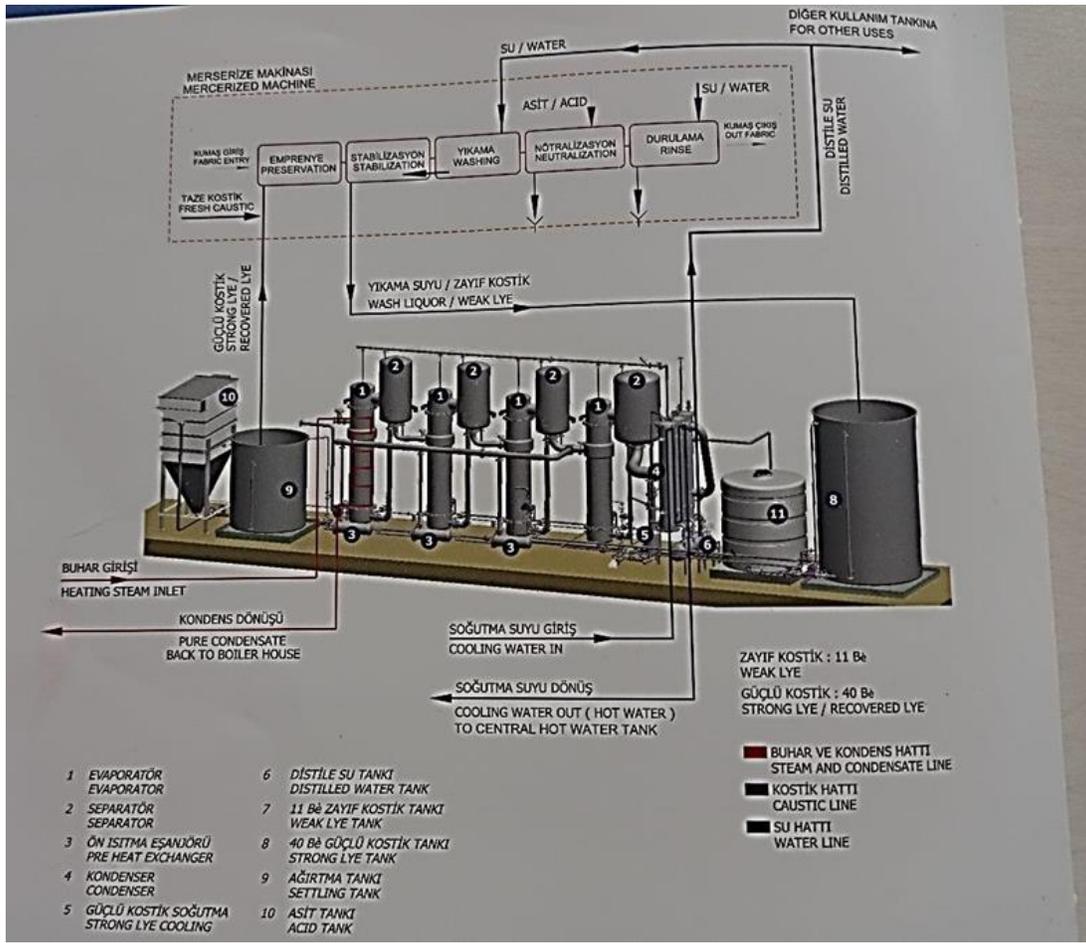


Figure 1: System Schematic of Caustic Recovery Machine

### 3. Results



- A new process was developed with a pre-caustic zing system.
- 8-10 Bé° of caustic water, which was discarded as waste from the 2nd stabilization section, was recycled to be used by completing 40 Bé°
- With the caustic recovery unit, caustic consumption has been reduced and pollution of nature has been largely prevented and energy savings were achieved with the designed heat recovery unit.

#### 4. Discussion and Conclusion

In the textile industry, which is open to innovation, caustic recovery techniques need to become widespread in textile facilities that use high amounts of caustic, such as the mercerization process.

#### 5. Acknowledge

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