Changing mercerising waste water into money

Caustic recovery for mercerising lye

Körting
HANNOVER AG

THE
EJECTOR
COMPANY

The Körting Caustic Recovery Plant (CRP)

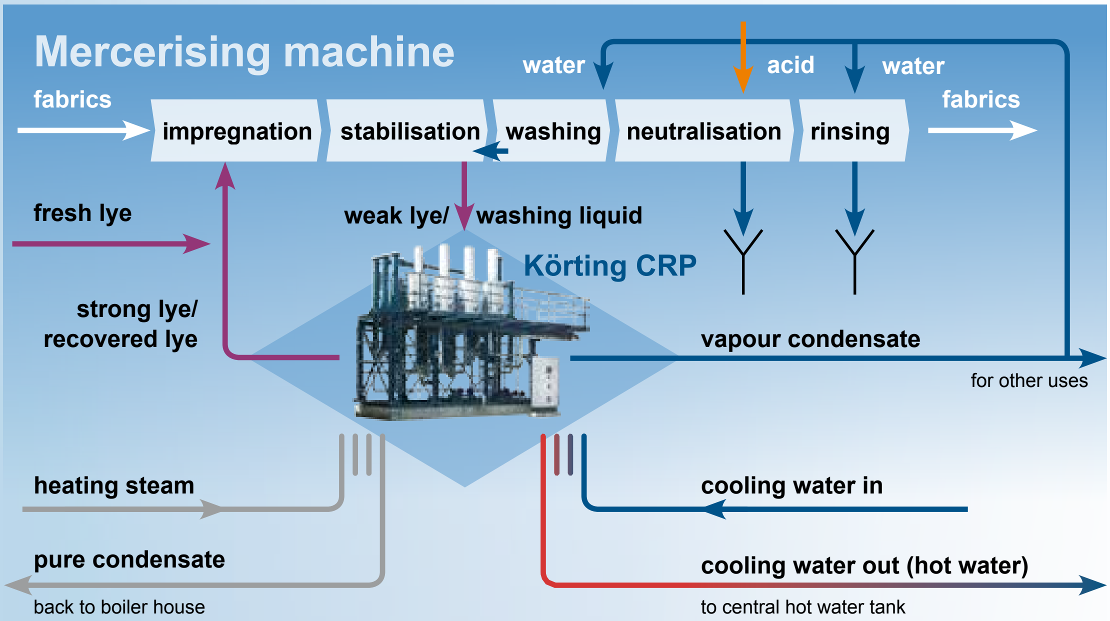
During the mercerising process the diluted caustic soda (weak lye) from the stabilisation compartment is normally drained. Körting has found a way to recover this diluted caustic soda by evaporating water. We have been supplying Caustic Recovery Plants (CRP) for mercerising lye to the textile industry since 1956 and have installed around 200 plants world-wide.

As shown in the sketch, the CRP separates the weak lye (washing liquid) into strong lye and vapour condensate. The strong lye (recovered lye) can be reused at the mercerising machine.

Depending on the quality of the fabrics an additional lye cleaning with hydrogen peroxide might be advisable. Körting has developed a lye cleaning system with peroxide to ensure that the recovered lye can meet the high quality standards of a modern production. The vapour condensate is slightly alkaline soft water without any hardness.

It has a temperature of approximately 90 °C. It can be used for washing, e.g. in the mercerising or bleaching machine, or in other pre-treatment. The CRP requires heating steam and cooling water. Almost the same amount of steam which is used for the recovery of the mercerising lye can be saved in the hot water generation. This hot water generation is a by-product in which the cooling water is heated up to 60 °C to 85 °C. The CRP is very energy efficient, especially when hot water generation is integrated in the central hot water system.

There is no direct contact between the heating steam and the lye, therefore the heating steam condensate can be reused as boiler feed water without additional treatment.



Payback time:
Less than one year!

Example

Fabrics for dry mercerising: 50 000 m/day, width = 2.0 m, specific weight = 150... 250 g/m² (average 200 g/m² = 0.2 kg/m²). The mercerising machine is in operation for 20 hours a day.

$$\text{Quantity of fabrics} = \frac{50\,000\ m/day}{20\ h/day} \times 2.0\ m \times 0.2\ kg/m^2 = 1\,000\ kg/h$$

1 000 kg/h dry fabrics are processed every hour. As a rule of thumb you can calculate with 5 to 6 litres of weak lye per kg of fabrics. With 5.0 litres you get 5 000 l/h with approximately 8° Bé = 55 g/l.

$$5\,000\ \frac{l}{h} \times 55\ \frac{g}{l} = 275\ \frac{kg}{h}\ (100\ \%\ NaOH)$$

With the price of caustic soda equalling 0.30 € per kg and a production time of 20 h/day, 25 days/month, wastage would amount to:

$$275\ \frac{kg}{h} \times 0.30\ \frac{€}{kg} \times 20\ \frac{h}{day} \times 25\ \frac{days}{month} \times 12\ \frac{month}{year} = 495\,000\ \frac{€}{year}$$

The savings of 495 000 €/year are just for caustic soda. Other savings are in the neutralisation process, the waste water rates, waste water treatment and the generation of soft water for rinsing. These costs can also be reduced considerably by our Caustic Recovery Plant.

Advantages

- Payback-time is less than one year!
- no alkaline waste water from mercerising machine
- generation of hot water from the waste energy
- generation of soft water, the vapour condensate is slightly alkaline
- recovery of surplus lye for wet-on-wet mercerising
- no contamination of the heating steam
- environmental protection: less chemicals for neutralisation are needed


continuous
self-cleaning
weak lye filter
swirl generator in each
separator for low pH-value
of vapour condensate
control cabinet with PLC and touch
panel for automatic operation


lye cleaning system for effective cleaning of recovered lye to ensure a constant quality of the lye and therefore of the fabrics
hot water up to 85 °C
membrane pump for hydrogen peroxide
peroxide can be delivered with forklift, it is sucked into the lye cleaning system

Operating method of the evaporation plant

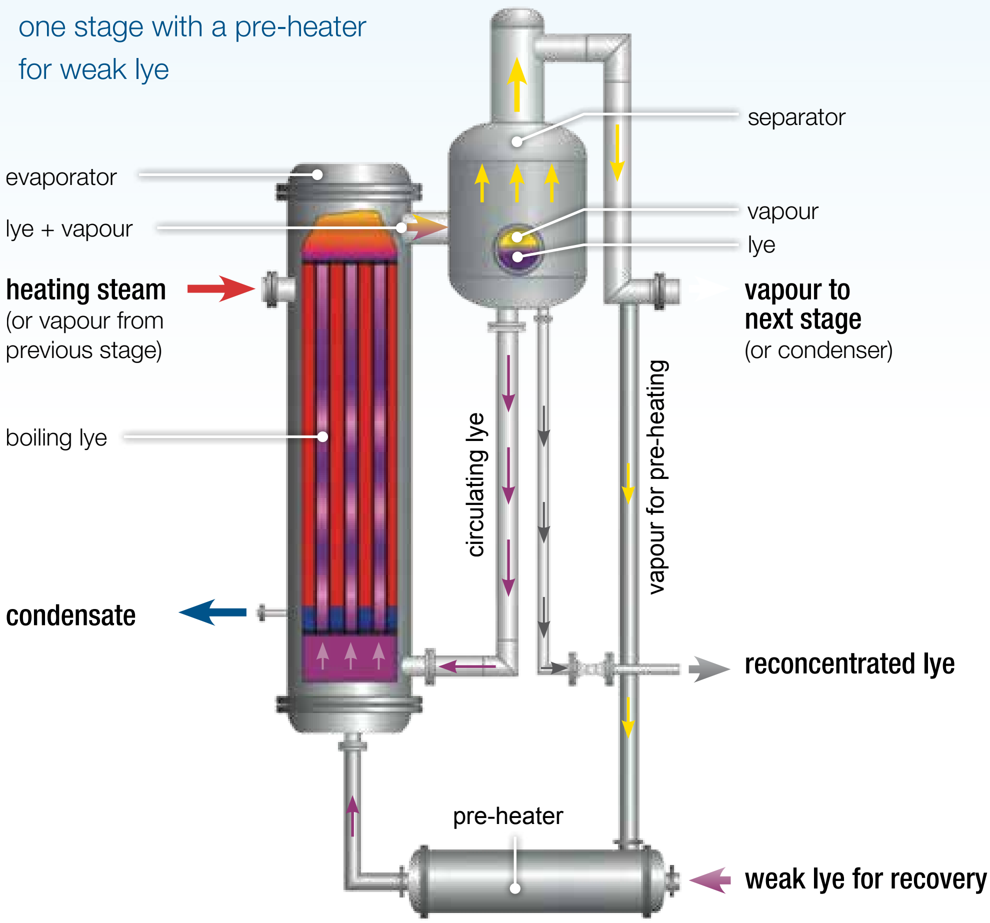
The weak lye is reconcentrated by water evaporation. The CRP is based on the natural circulation evaporation. The heating steam is condensed on the outside of the tubes and heats the lye inside. The lye boils up in the heating tubes, the mixture of lye and vapour flows into the laterally arranged separator, where the vapour is separated from the circulating lye. The vapour is used as heating steam in the next stage. A partial vapour flow is used to preheat the weak lye.

The separated lye flows back to the evaporator through a return pipe. A swirl droplet separator integrated into the separator prevents the alkaline liquid from being carried over into the vapour phase.

The evaporation plant is driven by the pressure gradient between the stages. The highest pressure is in the first stage. The last stage operates under a vacuum maintained by a steam jet vacuum ejector (v)

Multi-stage evaporation plant

one stage with a pre-heater for weak lye



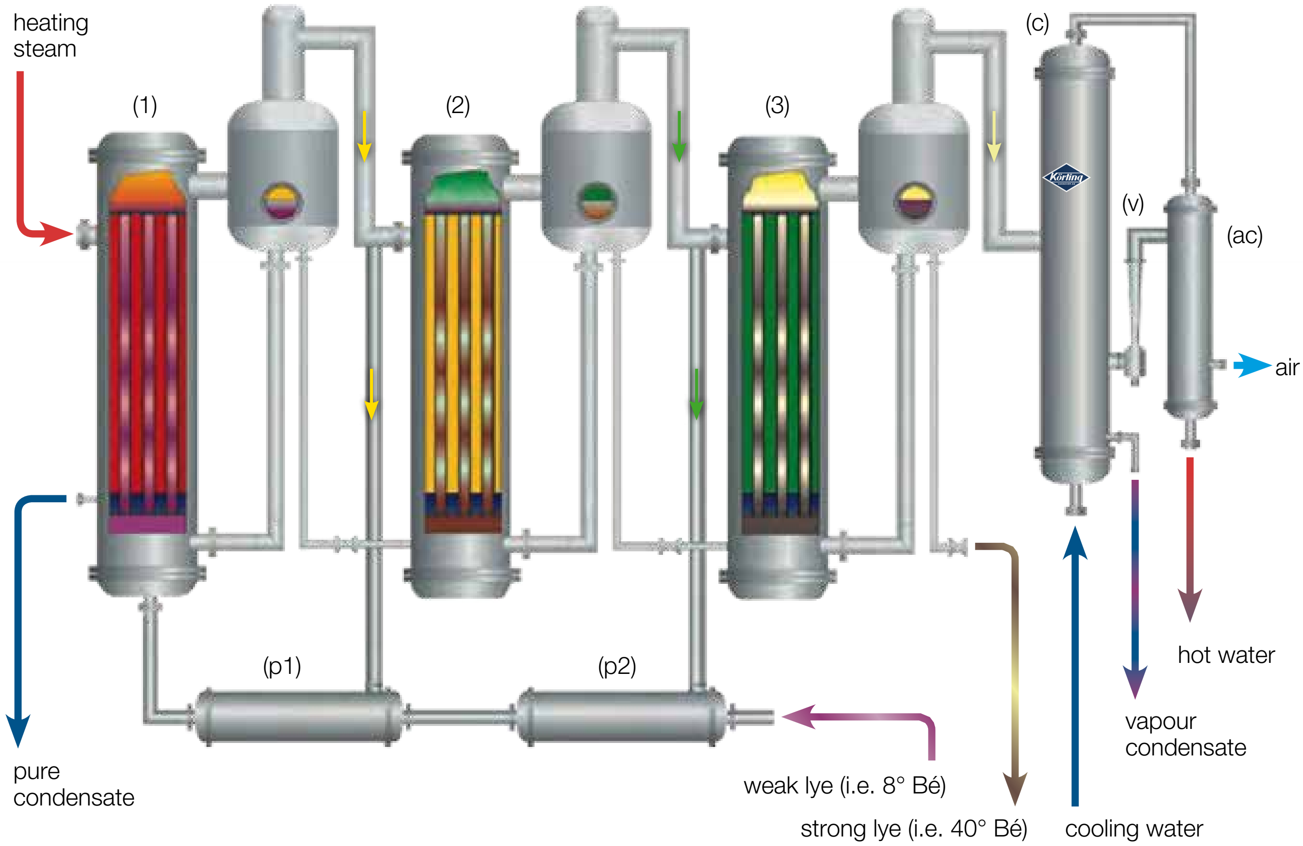
with an after-condenser (ac), or by a liquid ring vacuum pump. In the first stage (1) live steam generates vapour which flows as heating steam into the second stage (2). The heating steam condensate from the first stage flows back to the boiler.

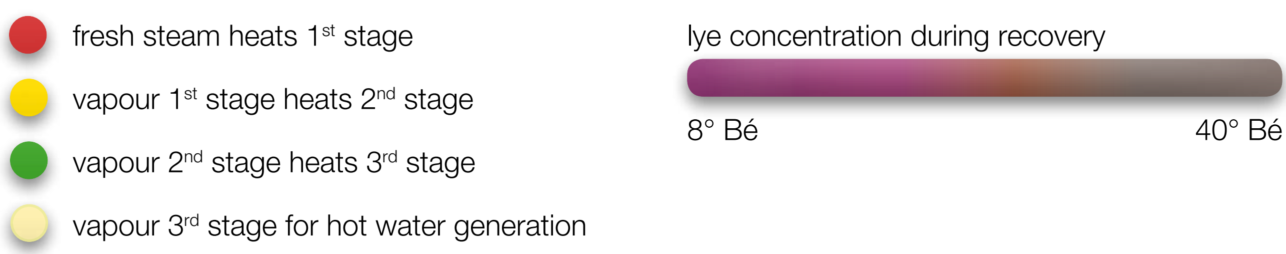
The vapour from the second stage heats the third stage (3). The vapour from the last stage (here the 3rd stage) is condensed with cooling water in condenser (c). So cooling water becomes hot water by utilising waste heat from the last stage.

The more stages a system has, the less heating steam is required. As textile factories need large quantities of hot water, the number of stages of the CRP should be adapted to the required amount of hot water. Sometimes a 3-stage evaporation plant is more economical than a 4-stage one.

3-stage Caustic Recovery Plant (CRP)

with two pre-heaters (p1) and (p2) and a steam jet vacuum ejector (v) with after-condenser (ac)





Lye cleaning system with peroxide

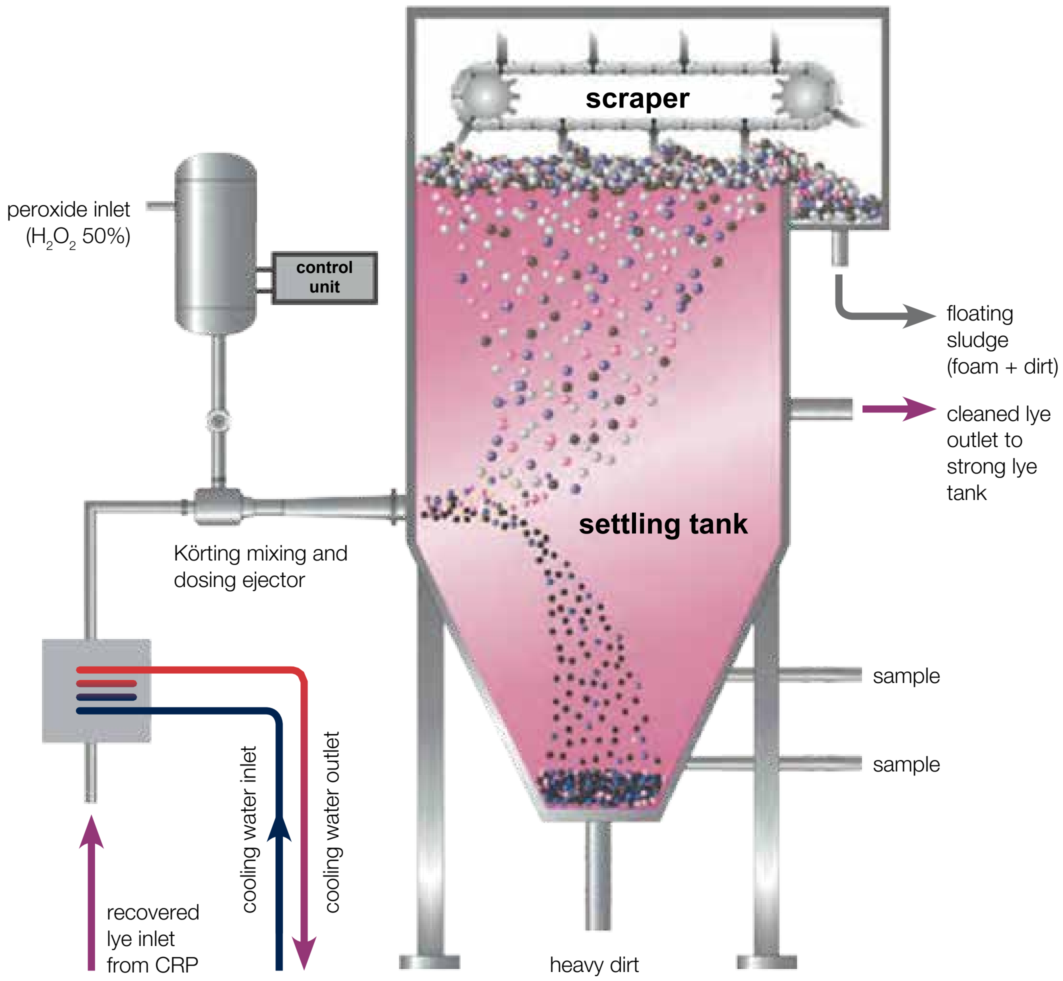
The lye is reconcentrated by a multi-stage water evaporation process. As only water is removed from the weak lye during evaporation, dirt, fibres and size residue from the earlier treatment remain in the recovered lye and are also reconcentrated. The level of pollution depends on the quality of the fabrics which are mercerised. In order to remove these impurities from the recycled lye, Körting developed a lye cleaning system with hydrogen peroxide (H_2O_2) based on the reliable Körting ejector technology. The recovered lye from the CRP is cooled down before it enters the settling tank through the mixing and dosing ejector as shown in the figure below. In this ejector, peroxide is added to the lye and creates fine gas bubbles. The 3-phase mixture of strong lye, solid dirt particles and finely dispersed gas bubbles passes into the settling tank.

Peroxide dosing system

Körting lye cleaning system consisting of peroxide dosing system, scraper and settling tank

Please take note:

The lye cleaning system does NOT replace a proper washing and desizing of the fabrics before the mercerising machine.



Because of the small gas bubbles a large phase interface for mass transfer and oxidation is generated. The gas bubbles are formed by thermal decomposition of the peroxide and chemical reactions on the surface of the reactive impurities.

The consumption of peroxide (50 % H_2O_2) is approximately 0.25 - 1.5 vol.-% of the strong lye flow depending on the quality of the lye.

Bleaching and washing of the fabrics before mercerisation is the best way to ensure a clean lye. Filters at the circulation pumps of the mercerising machine are recommended.

Most dyes will be destroyed by the peroxide. To check the effect on a specific lye, a simple test can be done in the lab. To get the detailed manual of this test please contact us.

Strong lye before lye cleaning

Strong lye after lye cleaning

The lye cleaning system consists of three main parts:

Peroxide dosing system: It consists of a specially developed mixing-and-dosing-ejector, peroxide storage tank and lye cooler. There is no moving part in the dosing system, therefore it is maintenance-free.

Settling tank: In the settling tank the separation of lye and dirt can take place without any disturbance. The tank is designed in such a way that floating sludge and sludge on the bottom can be removed easily.

Automatic scraper: The automatic scraper ensures a constant removal of the floating sludge before it sinks back into the recovered lye.

The peroxide has the following effects on the lye:

Flotation: The majority of dirt particles mixed with bubbles rise to the surface **(flotation)** and form a foam layer. Non-reactive particles attach themselves to rising gas bubbles **(physical adhesion),** so that they are part of the foam layer as well. The foam layer or the floating sludge is removed regularly by an automatic scraper.

Sedimentation: Other dirt particles with higher density, partly agglomerated, sink to the ground. This is improved by the peroxide treatment, which reduces lye viscosity, by destroying the starch residuals from sizing. Therefore the separation of dirt can take place successfully.

Bleaching: The peroxide bleaches the dirt and dye particles. The colour of the lye is much brighter after the peroxide treatment.

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