

Optimization of Enzymatic Starch Preparation and Working Station to Filmpress including a Case Study

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INTRODUCTION:

With high prices for common and widely used raw materials like starch in additive processing within the paper and board industry as well as extremely high costs for gas and energy, the savings of resources and the reduction energy and electricity consumption is more important than ever. It is also another step in achieving sustainability goals and reducing the carbon footprint of paper mills worldwide. Proven technologies can support producers in this matter.

The use of starch as an additive in the paper industry is very versatile. For example, starch is used to treat the paper surface, the so-called sizing or impregnation. Thanks to improved surface properties, starch also helps to improve writing property and printability. Furthermore, the strength and rigidity of the sheet is improved by applying surface size. In the manufacturing process of corrugated cardboard, starch is used as an adhesive to bind and glue the layers of paper. However, when native (unmodified) starch is used, it must be prepared in advance in order to be able to use it as an adhesive. For the processing of starch, the colloquial term "cooking of starch" is also used.

If you mix starch powder with (cold) water, you get a cloudy liquid that looks like diluted milk. In contrast to milk, which can be mixed/diluted with water indefinitely, a water/starch mixture (starch slurry) is a two-component mixture, since the starch powder does not dissolve in water. Thus, the starch granules are undissolved and finely distributed as a solid in the water. Such a two-component mixture is also referred to as a suspension. If a sample is left to stand for a longer period of time, the sedimentation of the starch granules can be observed.

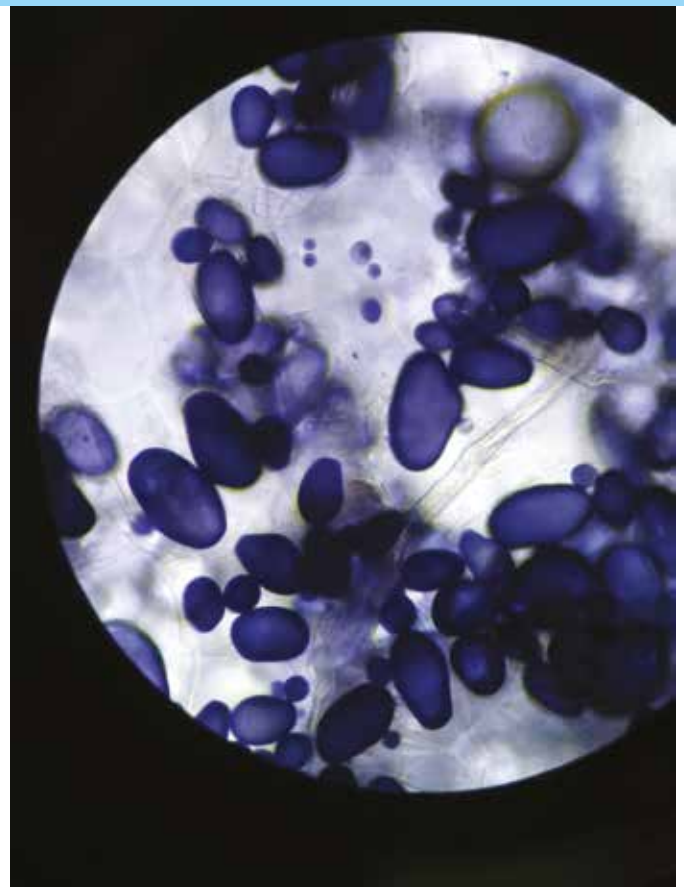


Figure 1: (Above) Starch cells under the microscope.

Figure2: (Left) GAW starch preparation make-down station.

If the starch suspension is heated, the starch granules will swell. The solid particles "grow" continuously in volume until the cell walls of the starch granules burst open. Only then the starch is able to dissolve in the water and can be used as a paste for the paper web. The swelling and subsequent "going into solution" of the starch granules is also referred to as "gelatinization" in technical terminology. As an undesirable side effect, however, there is also an increase in viscosity during swelling.



Figure 3: (Left) GAW enzymatic starch preparation rental unit.

Figure 4:(Below) GAW starch preparation jet cooker, Andhra Paper, India.



Classic enzymatic starch preparation

There are some good examples of how to achieve impressive savings in resources during the processing of starch. In the GAW enzymatic starch processing - when native starch is used - two operating methods are combined in a very special way. At the end of the modification process a starch glue is produced with the viscosity and optimized molar mass distribution required for the respective application – regardless of the starch type, starch temperature and solids content. Since the dwell time in the system can be adjusted as required - and is also kept constant during a stop or start of the system - expensive raw material losses can be significantly reduced. In addition, this ensures an almost waste-water-free operation.

Furthermore, this process is also available in a modular block design in the form of a rental system. Customers use it to bypass production in the event of failures or bottlenecks, but also for planned parallel run raw material tests.

In addition, a very compact and modular system for heat recovery was developed - the patented Heat Recovery System. This ensures that the flash steam produced after the starch is cooked (including the heat energy it contains), does not escape unused into the atmosphere. More than 50% of the energy required by the jet cooker can be saved with this heat recovery system. For decades, GAW has been focusing on new technological developments on reducing the use of water, energy and raw materials in the customer's production process.

Figure 5 & 6 (Below) GAW starch preparation Model Eilenburg, Germany.





Figure 7 & 8 GAW starch preparation Model Eilenburg, Germany



Figure 9:(Below) GAW working station.

Working Stations

The working station is a circulatory system, via which homogenized coating colour, surface starch and other coating agents from the storage containers of the coating colour kitchen are pumped via filters into working containers. They are then pumped via further filters to the coating heads. Surplus coating colour is returned to the working tank after passing the coating unit via return lines.

In order to avoid disturbances in the coating strokes (e.g. squeegee strips), deaerators are used in addition to filter systems. The deaerators remove air and gas bubbles from the coating colour.

Depending on the design of the coating heads, the working stations are tailored to the application and adapted with quality control instruments. A big advantage of the GAW working stations is the unique piping, which minimizes the air content of the coating mass from the outset and prevents the build-up of agglomerates.



Case Study: Optimization of an existing system

Task & definition of the problem:

An enzymatic starch processing plant at a customer in America was running at a much lower capacity than originally planned after four years of operation.

Amongst other things, steam hammering and vibrations in the system caused production stops every 120 minutes. Concentration fluctuations in the slurry preparation as well as temperature fluctuations throughout the system were also observed.

At the working station, overused rejection of the filter systems generated a large amount of wastewater and product loss.

The operating staff was new and insufficiently trained.

Consequences & Impact:

The piping system and the cooker were already showing wear and tear. This resulted for example in high levels of wastewater and product losses at the starch preparation and the working stations.

But also, the overall starch and energy consumption was very high due to fluctuations in concentration levels.

Also untrained operating personnel caused various operating errors.

That all summed up to a lot of paper quality problems, especially when it comes to strength.

Solution statement / approach:

All parts of the system were observed and analyzed by a GAW Performance Coach during operation, using trend recordings. Furthermore, intensive conversations with the operating staff followed with discussions about the operation mode as well as the best possible operation of the entire system.

Measures & actions:

Maintenance and cleaning works were carried out and the operating personnel received in-depth training.

By optimizing the controllers/levers, concentration fluctuations with a maximum of $\pm <0.5\%$ and temperature fluctuations of $\pm <1.0^\circ\text{C}$ were ensured (which were $<3\%$ and $<5^\circ\text{C}$ before optimization).

The flushing times were optimized and a general optimization of the plant capacity was executed.

Another effect was the reduction of the amount of wastewater by optimizing the filter systems.

Customer benefits (figures, data, facts):

Thanks to the optimization, the starch preparation and the working station now operate synchronously with the production consumption of the paper machine. The amount of wastewater and starch losses was significantly minimized. Due to the training and optimization, the customer achieved increased availability of the system and thereby also reduced the production costs. Furthermore, the lifetime and operational life of the system was significantly extended.

Savings in starch processing (through continuous operation and reduced concentration/temperature fluctuations):

• Starch and energy savings: €90,000 / year

Minimizing working station losses:

• Starch and energy savings: €60,000 / year

Total wastewater/fresh water reduction:

• Wastewater reduction: 1,193 m³ / year

TOTAL: AROUND 150,000 EUR / YEAR

About GAW technologies:

For more than 70 years, GAW ("Great Applications Worldwide") provides a guarantee of technological competence in the international paper and cardboard industry as well as in other industrial segments. In addition to its traditional core market of paper and cardboard production, GAW also invested strongly in plastics recycling in recent years. GAW technologies and the sister companies of the GAW Group are working on numerous projects that help customers achieve their sustainable development goals and reduce their carbon footprint.

The focus is on sustainability and the savings of valuable raw materials, water and energy - specifically in the production of pigment, the preparation of coating colour and coating compounds, starch and chemicals, or the cleaning and recycling of process wastewater.

The portfolio of GAW technologies includes systems, products, services and digital applications and serves five essential markets in almost all regions of the world: paper, chemicals, automation, composites and water and wastewater treatment.

More than 150 employees at the headquarters in Graz/Austria and in worldwide branches generate an annual turnover of around 56 million euros.

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