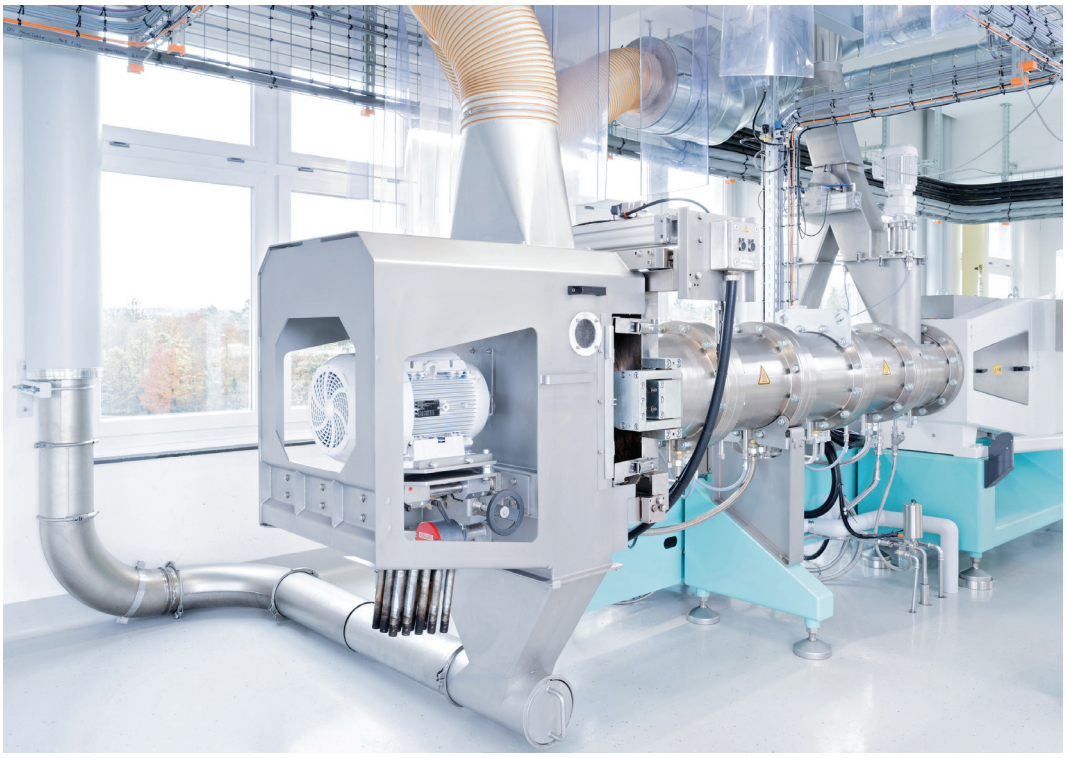
Strong Thanks to Swiss Starch

Due to overcapacity of flour production and the increasing import of dough and baked products, Swiss grain mills are under margin pressure. Against this backdrop, Meyerhans Mühlen AG has developed in Weinfelden (TG) an innovative production process with which it produces a starch product made of wheat flour for the paper industry. The starch product is competitive compared to imported products. The main reason: the innovative manufacturing process consumes much less energy and saves transport costs on a large scale.



The main component of the new facility of Meyerhans Mills for manufacturing a starch product for the paper industry is the extruder with cutting apparatus and extraction. Photo: Meyerhans

Dr. Benedikt Vogel, commissioned by Swiss Federal Office of Energy (SFOE)

Corrugated cardboard is a popular packaging material because it is light and strong. The Swiss paper industry produced about 350,000 tonnes of corrugated cardboard in 2014—a growing trend. While the 11 Swiss paper mills have had to face waning domestic demand, they have increased corrugated cardboard exports significantly in recent years. Corrugated cardboard is made by superimposing layers of smooth and wavy corrugated cardboard paper. To achieve the desired strength, the corrugated cardboard paper is reinforced with starch during manufacture. Since this requires a starch based adhesive ('starch slurry'), paper mills usually produce it from imported wheat, potato or corn starch. The paper mill of Model AG in Weinfelden

A technical report about the results of a pilot and demonstration project in the field of industrial processes, which is financially supported by the Swiss Federal Office of Energy.

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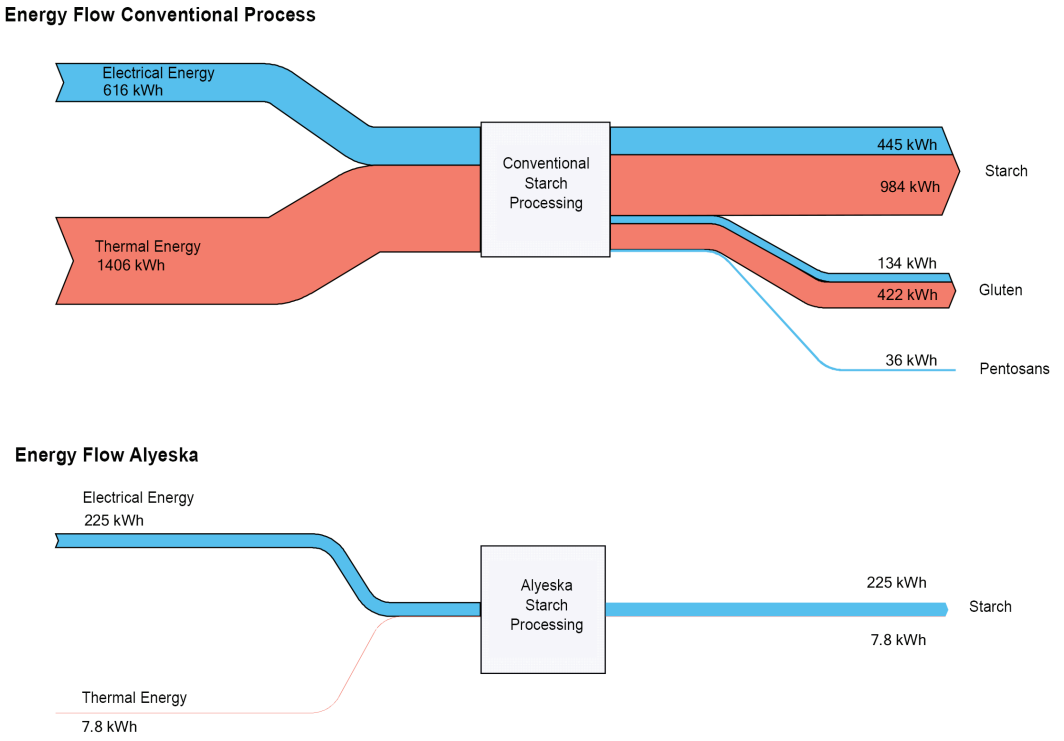
(TG), for example, produces 175,000 tonnes of corrugated cardboard paper annually and imports about 3,500 tons of wheat starch from Luxembourg and Belgium annually. The paper mill in Niedergösgen (SO), which also belongs to Model AG, produces about 200,000 tonnes per year of corrugated cardboard paper, there the volume of imports is much higher.

But this is history. The company Meyerhans Mühlen AG (Weinfelden) has recently become a Swiss supplier of industrial starch products. Thus far, the flour mill has supplied specific bakeries, pasta factories and Müesli producers with flour from wheat and other cereal products. Now the company is also ready to step out of the food industry. The company produces a strong starch product and delivers it to the paper mills in Weinfelden and Niedergösgen. Meyerhans has already signed two long-term supply contracts with this two paper mills, more Swiss paper mill customers might follow. It would appear that the resourceful SME from Weinfelden with its 120 employees has sucessfully staged a coup: to

CEO Dominic Meyerhans demonstrates how by mixing water with a starch product, starch glue can be produced. Photo: B. Vogel



The Sankey diagram drawn for one ton of starch product: to produce starch, the innovative process ('Alyeska') requires significantly less thermal (red) and electric (blue) energy than the conventional process. Graphics: Rytec

relocate an industrial process and its associated value from abroad to Switzerland.

Margin erosion spurs innovation

At Meyerhans Mills headquarters in the industrial area of Weinfelden rises the massive concrete tower of a modern grain mill, next to it stands even higher grain silos. In the four branches of the Meyerhans Mills, Weinfelden (TG), Rheineck (SG), Malters (LU) and Villmergen (AG), a full range of cereals are ground. The mill in Weinfelden has a processing capacity of 100 tons of grain per day. That may be modest compared with major international mills. However, it is respectable for Switzerland: The family-owned business is number 3 among the 70 mills in the country and it is Switzerland's biggest privately-owned mill. The family has owned the former community-mill since 1890.

This 400 m long pipe is located in the industrial area of Weinfelden (TG) and delivers Meyerhans Mills' starch product to the adjacent paper mill of Model AG. Photo: Meyerhans

With the manufacture of starch products for the paper industry, Meyerhans has diversified its activities beyond the food industry. The move was not entirely voluntary. The company management took the step because it became increasingly difficult to earn money from its core business of producing flour. "Since the government-regulated prices of grain and flour were released during the mid-1990s, we have been experiencing an erosion of profit margins," says Dominic Meyerhans, the 39-year-old CEO, a sixth generation family member who has been leading the company since July 2015. Against this background, the Executive Board approved a new strategic direction, which is based on key concepts of customer focus and innovation.

All Flour is Not the Same

Innovation - the case of Meyerhans Mills, this means a new look at the old product of flour. "We look at flour no longer simply as a constituent of a meal, but as the sum of its ingredients, which gives us new ideas," says Dominic Meyerhans. Flour is, in addition to proteins, fats, polysaccharides and minerals, mainly made of starch. In the area of the flour component strength, the company is now building a new foothold.

In this shift of focus, chance also played role: Years ago, Dominic Meyerhans visited a paper manufacturing facility of Model AG, which lies in the immediate vicinity of the industrial area of Weinfelden, where he learned that the starch component of flour is used to stiffen corrugated cardboard paper.

With this system, the Model AG in Weinfelden produces paper rolls, which are later processed into corrugated cardboard. Photo: Model AG

Meyerhans followed up by testing two conventional methods to manufacture starch, but neither convinced him. With the support of Brümmer Extrusion Consulting (Wittenbach / CH), the Fraunhofer Institute (Potsdam-Golm / D) and the Paper Technology Foundation (Heidenau / D), he developed instead an innovative process for producing starch. Six million Swiss francs flowed into a development and production facility. To cushion the entrepreneurial risk of investing in the innovative process, the Climate Foundation Switzerland and the state of Kanton Thurgau (project waste heat utilization) provided financial support to the projects. The Swiss Federal Office of Energy (SFOE) supports the project as part of its pilot and demonstration program, because of the high innovative nature of the developed process and the large energy savings potential in Switzerland and abroad. On November 12, 2015, the plant in Weinfelden was ceremomoniusly officially opened.

Massive energy savings

The new plant extends over 4 floors. Here it is expected that several thousand tons of starch product will be produced annually. The starch product will be transported over a 400m long pipeline to the neighboring paper mill and transported to the paper mill in Niedergösgen via truck. Compared with the conventional production of starch with a wet process (see text box p.6), the new method can produce the starch using 84% less energy - the electricity requirement is reduced by 49%, the heating requirement by as much as 99% (see Sankey diagram p.2). The bottom line is that a good 14,000 MWh of energy per year can be saved compared to the conventional process. This corresponds to the heat and electricity needs of 1,800 four-person households (new building). In addition, there are further energy savings in the paper mill and in truck transportation.

The engineering company Rytec AG (Münsingen / BE) have confirmed the beforementioned savings in the fall of 2015 as part of a comprehensive series of tests. "The Meyerhans mills have substituted an industrial

process by an efficient alternative process. This is the ideal solution for large efficiency gains and other entrepreneurs going in the same dircetion would be highly appreciated, "says Dr. Michael Spirig of Fomenta AG, who accompanied the project on behalf of SFOE.

The technical expertise developed for this project strengthens the position of Swiss machine builders in export markets and contributes to energy and CO_2 savings abroad. Spirig also stressed that the development process is product-specific, it could hardly be transferred 1 : 1 to other industries. But what is transferable is the idea of substituting an industrial process with a more efficient one and the form of collaboration: The new process could only have been implemented by Meyerhans in cooperation with Model AG. "When suppliers and customers come together, it is an ideal breeding ground for innovation," said Spirig.

Trust between supplier and customer

The customers in this case are the paper mills of Model AG in Weinfelden and Niedergösgen. The paper mill in Weinfelden, meanwhile, has already collected several months of experience with the starch product made by Meyerhans. "For us, this new starch product has two advantages," says plant manager Andreas Klumpp, "On the one hand we can save about 800,000 kilometers of trucking per year, because we can now get the starch product for our paper mills from Weinfelden and don't need to go abroad. Secondly, at our manufacturing facility we are able to carry out a double process step and thereby again save 5,000 tons of steam because Meyerhans provides the starch product in a ready to use form.

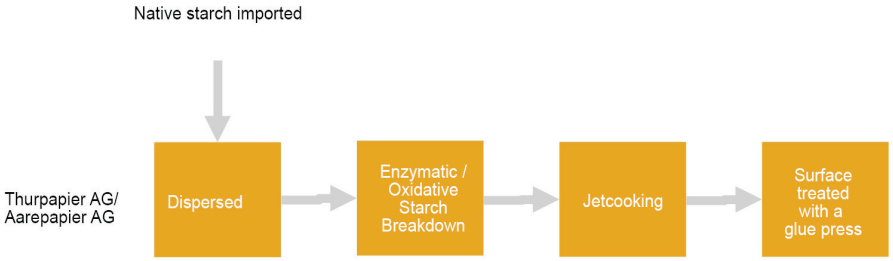
The impact of the associated energy savings, the slightly lower starch production costs and the reduced usage of breakdown chemicals on overal cost reduction is so significant, that Model AG will have likely recouped its four-million investment in the two plants in Weinfelden and Niedergösgen, which was necessary to adapt the process, in four years.

"We have taken with the new process a significant risk because our supplier had no previous experience in starch production," says Klumpp. The fact that Model AG decided to take this step and with that made it possible for a Swiss SME to be a model of innovation, rests significantly, according to Klumpp, also on soft factors: "the collaboration was likely also made possible because of the trusting relationship that has existed between the two family-owned businesses for a long time."

- www.meyerhans-muehlen.ch, www.modelgroup.com
- For further information on the project, please contact Dr. Men Wirz (men.wirz[at]bfe.admin.ch), Swiss Federal Office of Energy, Cleantech section, pilot and demonstration program.
- For more technical papers on research, pilot, demonstration and flagship projects in the field of industrial processes, see www.bfe.admin.ch/Cleantech and www.bfe.admin.ch/forschungverfahrenstechnik.

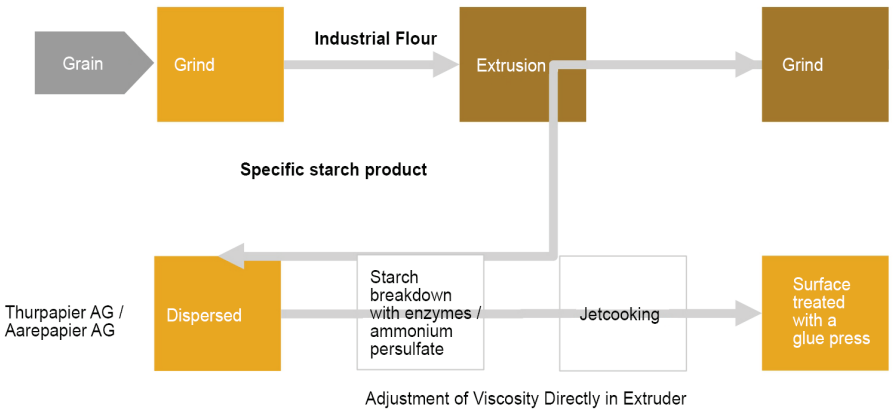
From Flour comes Glue to Produce Paper

Wheat starch is a common raw material used to make glue which is in turn used to fabricate corrugated cardboard paper. *In conventional manufacturing processes* native (natural) starch is extracted from wheat flour. This is then further processed in paper mills to a starch based glue that is used for the production of corrugated cardboard paper.



To obtain starch from wheat using the conventional process, an energy-intensive wet process is applied: The starting material wheat is mixed with 55 ° C water to form a dough, which is then split during several steps and using electrical energy into the components starch, gluten and pentosans. The starch must then be dried; for this step, considerable heat energy is required. After drying, the starch is sold in this powdery, native form. At paper mills, the starch is subsequently broken down oxidatively or enzymatically in a double process step and by means of Jetcooking at about 120 ° C, is solubilized, which in turn requires a lot of energy.

To produce glue from flour for the production of corrugated cardboard paper, the Meyerhans Mühlen AG and partners have developed *an innovative manufacturing* method to produce a starch product directly from wheat for use by the paper industry.



In a newly built process, Meyerhans Mills uses a so-called extruder. An extruder is very simply described as a kind of meat grinder, which with the help of processing aids, wheat flour is pressed through a perforated plate of a spiral conveyor. This produces pellets that are then finely ground. The result is the starch product in a soluble form. The starch product is then used by paper mills to produce starch glue. About 2,900,000,000 m^2 of paper are produced on three paper machines owned by Model AG per year, whereby the amount of starch applied can vary between 2.5 g and 7.5 g per square meter of paper.

The novel process carries the advantage that starch production by the double step process is eliminated and along with it, the heating and subsequent drying steps, thereby saving energy on a large scale. The new process is also advantageous for paper mills: They don't use native starch to produce glue anymore but starch product, whereby the starch is already in a digested form. The paper mill can thereby save two processing steps (oxidative / enzymatic degradation of starch and Jetcooking) - and thus again save energy.

The starch product must have quite specific characteristics so that it can be used in corrugated cardboard production. These properties are in particular dependent on the quality of the wheat flour, the processing aids and the settings and configuration of the extruder used. With these 'adjustable screws,' Meyerhans Mills can selectively influence specific properties of the starch product, so that it best meets the specific requirements (e.g. the viscosity of the starch glue) of manufacturers of corrugated cardboard. BV

SFOE Supported Pilot, Demonstration and Flagship Projects

The project of Meyerhans Mühlen AG is one of the pilot and demonstration projects with which the Swiss Federal Office of Energy (SFOE) is promoting the economical and rational use of energy and the use of renewable energy. In addition, the SFOE has referred to a number of flagship projects, which are also geared to the objectives of the Energy Strategy 2050. The SFOE supports pilot, demonstration and flagship projects with up to 40% of eligible costs. Requests can be submitted at any time.

www.bfe.admin.ch/pilotdemonstration
www.bfe.admin.ch/leuchtturmprogramm

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