

How insects & grain mills are improving sustainability

Starch production plants produce a range of intermediate products for human and animal consumption, as well as for industrial processing.

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Grain mills produce the flour we need to make bread, pasta and animal feed – but that’s not all. Starch mills also produce intermediate products used in various applications including recyclable packaging.

In this article, Dirk-Michael Fleck, Senior Advisor Biorefinery at Bühler’s Milling Solutions

Business Area explains how new grain processing solutions can be connected in a sustainable and intelligent way.

As a general rule, grain is used to make flour but by using specifically adapted grinding and separation processes, other products such as starch, protein, fibre and germs can also be obtained from different types of grain. These semi-finished products form the basis for a number of end products including modified starch, glucose, alcohol, gluten and organic fibres.

The Milling Solutions Biorefinery Segment of Bühler is specialised in designing and building the plants for manufacturing intermediate products such as these. Other business units offer solutions for the downstream value chain.

We are all familiar with flour mills, but Dirk-Michael Fleck is mainly involved in engineering and building starch mills and he begins by discussing what differentiates one type of mill from the other.

Comparing a flour mill with a starch mill is like comparing a road system of a large city with an intercity highway, both are roads, but whereas one is used for local transport services, the

other is a high-speed link between two cities.

In the same way, while a flour mill needs to be able to produce different qualities and quantities of flour, a starch mill must be as simple and robust as possible in order to produce consistently a specific quality of flour at high capacity.

A starch mill has to be designed to fit perfectly into the operating environment of a highly modern biorefinery. Upstream and downstream processes must be seamlessly interlinked, and when it is in fully automated 24/7 operation, the mill must continuously supply a constant product quality for the downstream process.

This is particularly important because starting and stopping wet separation and biotechnological processes cause great expenses and losses. The mill has to be fully automated and operate safely at high capacity in order to achieve economic efficiency. A medium-sized starch mill, therefore, has a capacity of 800 t/24 h.

What a starch mill produces

Starch mills usually produce one main flour and several secondary products such as bran from grain. The flour has to meet specific requirements so that, in the wet separation process that follows, starch, protein and other high-quality products can be obtained as efficiently as possible, with high yields and high levels of purity.

In the next step, semi-finished products such as starch, protein, fibre or germs are obtained from the flour through specifically adapted grinding and separation processes.

At Bühler, by “biorefinery” they mean a deep-processing plant that separates cereals into their pure natural components and then processes these intermediate products into high-quality end products. A modern biorefinery has major advantages – it not only creates a sustainable circular flow economy but also recovers energy in a synergetic way.

Yes, it is very multifaceted and complex, but it also an extremely interesting and challenging area in an industrial sector that has great potential. It’s amazing to see the huge variety of high-quality, sustainable products that can be produced from grain: not only starch and its derivatives – which include alcohol, sweeteners and acids – but also protein, fibre products, fats and oils from germs, wheat and corn gluten, dried distillers’ grains with solubles (DDGS) and organic fibre.



Without a doubt, protein is the most valuable fraction. Whether it is obtained from wheat, corn or pulses. Even though this protein fraction accounts for only five to 30 percent of total production, depending on the raw material and process, the demand for them is highest, and therefore the profit, too. These proteins are mainly used in the food industry for meat replacing products but also in the fish feed and petfood industry.

How this starch is used

Most of it goes into food, especially if you include sweeteners for soft drinks and confectionery. Often the starchy fraction is being converted in a fermentation and distillation process into alcohol. It can be portable alcohol or biofuels to ensure more environmentally friendly combustion.

In times of Covid-19 hand disinfectant also has to be mentioned. It contains around 80 percent alcohol, which is derived from starch and thus from grain. However, the greatest potential for growth in the recent past has come from the rapid increase in e-commerce and the booming online trade.

Packaging has to be of a certain strength to protect transported goods. It is starch that provides this strength. The huge advantage over plastic packaging, for example, is cardboard's high level of recyclability and environmental compatibility. Recycled cardboard contains around 10 percent starch, which acts as an adhesive holding the cellulose fibres together and providing stability.

Bühler's contribution to this growing sector

Biorefinery is in the center of Bühler's main focus areas. A significant amount of grain is processed in biorefineries and Bühler is one of the world's leading technology companies in

grain processing. But the finished products that are produced in a biorefinery are probably of even greater importance.

Here, Bühler offers an exceptional platform for producers and investors: with solutions for animal nutrition, aqua feed, pet food, bakery and confectionery, extrusion of meat analogues and, more recently, our innovative insects business, Bühler provides holistic solutions for these promising products and markets.

The bakeries & insects biorefinery connection

Take sponge cake or tasty bread - the glucose used for sweetening cake and the wheat gluten used to improve the baking properties of bread flour are both products that come from a starch plant. With insects, we have great upcycling opportunity in the value chain of a Biorefinery plant.

In future, a significant amount of our animal protein requirements will be met through protein production at large insect facilities. This because of insect's high sustainable and low ecological footprint on protein production. Recently, Bühler commissioned one of the first large-scale industrial plants for insect protein production.

The feed for these insects can be produced from by-products of a cereal-based biorefinery. The protein obtained from the insect plant can then be processed into a high-quality aqua feed, with extrusion technology from Bühler.

Biorefinery is becoming increasingly important and the key to success in a growing market for biorefinery plants is to combine each solution to a high sustainable and profitable value chain.

The example of insects shows how a sustainable and intelligent combination of a wheat starch mill and insects can play an important role in tackling the major challenges that our planet faces with its growing population.