High polymer rheology in bread production
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I would like to talk about the stress-free dough processing technology developed by our company, and its latest application to bread and roll production plant.

The dough processing system is, in short, a dough booking and sheeting technology making use of rheological engineering - that is, utilising the natural extensibility of the dough in sheeting out and shaping finished products, without changing the original characteristics of the dough.

The heart of the mechanism for high capacity plants is the 'stretcher' - a group of 21 free rollers rotating above three separate belt conveyors which are running at an increased higher speed on the outfeed side. Medium sized plants instead use the 'action roller' system, in which a pair of rotating rollers are shuttling back and forth over two separate belt conveyors which also run at a higher speed on the outfeed side. Both mechanisms are designed with the same idea in mind - to sheet the dough without giving excessive work to the dough structure.

What is happening in the stress-free sheeting process is that a group of rollers generates 'positive stress' in the dough by compression from above, and at the same time, a series of belts underneath stretches the dough forward to work as 'negative stress'. By properly controlling the balance between these compression and stretching processes, pressure on the dough is minimised to maintain the original dough quality without deterioration.

In the case of laminated pastry dough, therefore, the system maintains parallel layers of fat, while in bread roll dough, it maintains the natural gluten structure, allowing gas cells to form during the fermentation and baking process.

Standardised plants have been designed with different sheeting configurations according to required products and capacities.

The CWC line is for high output of up to 4 tonnes/hr. The C configuration is for croissants and pastry production, and the I configuration for bread rolls and pizza. The AD-F line is for bread roll production at 1-1.5 tonnes/hr output. The HM-line is a semi-automatic plant for production of a wide variety of pastries and bread rolls on a somewhat smaller scale of up to 700kg/hr. The FZ table is a small scale plant for throughputs of less than 500kg/hr.

Out of these standardised plants, I would like to discuss the AD-F multibread line and a practical application of 'stress-free' dough sheeting equipment in roll production. The plant combines a dough sheeter, with an automatic dough feeder and stress-free action roller, and a shaping section with various attachments.

A batch of dough is fed into the hopper on the dough feeder, is uniformly sliced into billets at the bottom of the hopper, and is automatically booked on the conveyor underneath with a controlled degree of overlapping. At the slicing point, it is important that the level of pressure given to the dough is no more than would be applied when portioning the dough by knife.

A chain of dough slices proceed into the action roller, where they are formed into a continuous dough sheet of uniform width and thickness.

By employing various downstream cutters and moulders, one has a fully automatic roll plant covering all production requirements. For example, a side winder and portioning device creates a plant for baguettes or petits pains of various sizes. A length cutter and cross cutter makes a full automatic ciabatta plant. A filling extruder, side winder and portioning device makes a plant capable of processing filled bread rolls.

Plant is being used in Europe to produce pizza, pitta bread, stollen, hot dog, ryebread rolls and so on. These applications of AD plant in the baking industry have shown us some important practical effects:

Elimination of intermediate prover

Since the dough is handled without excessive work through the sheeting and shaping processes on the AD-line, the original strength of dough is maintained, so an intermediate proof stage for recovery of dough strength can be omitted. Dough development can take place in bulk fermentation immediately after mixing, and the gas cells created during prefermentation will be preserved in the stress-free environment of the action roller.

Not only does this give an energy and space saving, but also labour saving in terms of hygiene and maintenance owing to the simplification of the entire plant.

Increase in range of doughs that may be processed

The AD plant works with a wide range of dough owing to this simplified construction and the fact that little stress is applied to the dough. For example, a dough with a high water absorption is quite difficult to handle on the conventional dough divider or rounder. But the AD plant, though its minimal working of and friction on the dough, handles doughs with more than 70% water such as ciabatta, doughs with a high percentage of fat and sugar such as brioche and pandoro, and doughs with solid pieces of fruit such as stollen.

Ciabatta requires quite long pre-fermentation time before being moulded in order to obtain a more open texture after baking. One of the AD users in Spain is producing good quality ciabatta on four hours' bulk fermentation at a throughput rate of 1 tonne/hr.

Possible application to pre-proved frozen products

When baking fully proved and frozen bread rolls, the dough can expand in the oven only by thermal expansion of the gas cells trapped within it.

Since the AD stress-free process maintains the natural extensibility of the dough, its gluten structure will not deteriorate during frozen storage. This results in proper pre-proved frozen rolls with a structure which can trap the gas during baking.

Variety of products on one plant

Since the plant is not using the conventional style of divider or intermediate prover, limitations on the number of lanes or on the range of portioning weights is considerably reduced. For example, products from 1kg loaves to 30g mini rolls can be produced on one plant.

Furthermore, since the plant is shaping the products from a continuous dough sheet, a variety of shapes can be produced, for example sticks or flat pizza crusts. Filled or flavoured bread rolls can be incorporated into the production programme by combining a depositor or sprinkling device on the shaping conveyor.

Reduced use of additives

This in turn can lower ingredient costs. As mentioned above, the plant handles the dough without allowing its structure to deteriorate. In some practical applications it has been shown that the level of additives needed to restore dough strength can be reduced.

Another report suggests that it is possible to use a lower grade of wheat flour without sacrificing volume on baked products, resulting in savings on production costs.

Creation of new, value added products

As an effect of the flexible shaping features of the AD plant, I would emphasise its potential applicability to new product development. Filled baguettes, two coloured breads and vegetable rolls have been commercialised and are now being accepted on the market.

We are continuing our research with a view to widening the application of the AD plant to other European products.