Innovative kneading processes

Baking may not be facing revolutionary changes and the investment climate may be tough, but improvements to existing systems still mean important advances in the field.

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The international bakery exhibition (iba) to be held in Düsseldorf in October 2003 will showcase the marketplace for innovative ideas in the field of baking technology. What news will the iba offer? Although major technological breakthroughs are not to be expected, a number of improvements regarding proven solutions are likely to be presented.

A new kneading process

The Rapidojet® process – that is, the preparation of dough by means of a high-pressure water jet – that has been recently introduced in Germany, is a real innovation. The process is based on the fact that the mere combination of water and flour will result in the immediate formation of gluten strings. The Rapidojet process allows dough preparation in one single process step: a high-pressure water jet will grasp the falling flour particles, which are, thus, moistened and flung against a rebounding wall, the dough then being carried on owing to the angle of pitch (see Figure 1). The high-pressure nozzle is supplemented by a second nozzle for compressed air, which forces the system to take in gas for a modified pore structure.

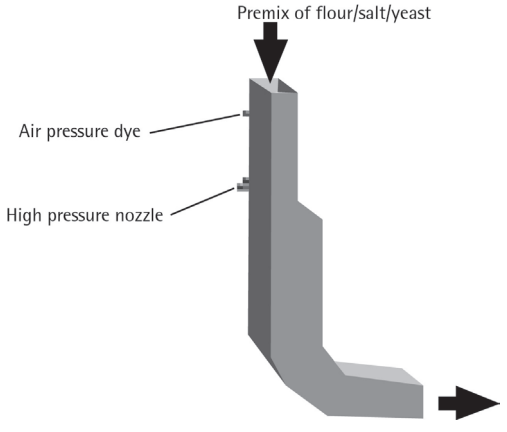

Figure 1. Mixing chamber for high-pressure dough preparation.
Source: www.rapidojet.de

Table 1. Continuous dough kneeding.

	Conventional mixers	High-pressure kneeding procedure
Power consumption (kWh/to dough)	8–16	1.3
Space needed (m^2)	3	0.1
Water pressure (bar)	0	70

Whereas conventional mixers work on the basis of three parameters – degree of filling, kneading time and speed – the relevant Rapidojet parameters are: angle of water injection, water pressure, nozzle characteristics, water consumption, air pressure, air flow and water temperature. This results in a better energy balance and less space required (see Table 1).

As to the production of bread, developments in the field of continuous kneading have only recently been achieved. This is a process that has been successfully employed already for some time in the field of long-life bakers' wares. Continuous kneading is the logical complement to line production that has been standard with respect to bread preparation in large bakeries for decades. While all other processes in bread production run continuously, the kneading procedure itself has been characterised by 'batch processing' up to the present.

During kneading, the following physical and biochemical processes run partially at the same time, partially in succession:

- Moistening of the flour particles
- Solution and rising processes
- Gas feed-in and gas linkage
- Conglutination and interlacing processes

These processes are characterised by their differing intensity in the case of rye doughs, on the one hand, and wheat doughs, on the other.

Which tasks will continuous kneading have to fulfil? To be practical, continuous kneading processes will have to meet the following requirements:

- Integration of the kneading system into the technological process
- Continuous adding of the raw materials
- Continuous measuring of the components of the recipe
- Synchronisation with the subsequent production steps

Figure 2 shows how continuous kneading is performed. The system is made up of two kneading spirals rotating in opposite direction that serve for both mixing and kneading the ingredients of the recipe and ensure transportation at almost pulse-free shear rates. The dwell time in the continuous kneader lies between 90 and 120 seconds.

The design of the system is based on two kneading zones providing different kneading intensity. The kneading instruments may be designed freely, thus allowing free determination of the effects of the radial and axial forces.

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Figure 2. Presentation of the continuous kneading process – action principle.

The major advantages presented by continuous kneading consist in the improved integration into the complete continuous process, a lower space requirement, an easier control of the dough quality and reduced energy costs. The investment costs are about the same as those for customary kneading systems.

Acrylamide challenges

At present, research projects are being carried out in several European countries aiming at modifying baking technology so as to allow a reduction of the acrylamide content in the crust of bread. To date, there has been no prospect of finding a final solution. The manufacturers of crispbread, however, have succeeded in significantly reducing the acrylamide content by modifying the manufacturing process. This is partially achieved by considerably restricting the 'rework'. Another option is to modify the temperature-time regimen.

Clean-room technology

With regard to all kinds of bread, sufficient microbiological stability has, thus far, been a problem, which might be solved by the application of clean-room technology after the baking process. Meanwhile, numerous large bakeries have turned to clean-room technology, which results in a significant improvement of the shelf life of breads.

Tracking, tracing and modified heat

Both the EU Ordinance on Basic Principles for Foodstuffs and trade requirements call for the establishment of tracking and tracing systems in the foodstuff manufacturing enterprises. This is, at present, being worked on in all large bakeries.

The establishment of such systems turns out to be a difficult undertaking, as the processes in large bakeries are relatively complex, and the number of ingredients – particularly in the field of pastries – is extraordinarily high. The tracking and tracing systems are combined with automated documentation, which allows tracing ingredients – even after years. These systems play an important part within the framework of external manufacturer audits carried out by the foodstuff retail trade.

There are also other lines of development. In various countries, the development of modified heat transmission systems is at present being advanced. Apart from further developments in the field of microwave technology, infrared systems play an increasingly important part. They are, however, still in the stage of R&D.

General outlook

Owing to the decreasing number of baking enterprises in Europe and the adverse consumption climate, the investment behaviour is characterised by some restraint. However, should there be an upswing in the economy, this may change. ❖