

Food Factory of the Future 3 conference

Report by Professor Nils Bengtsson

On July 7-9 the third international symposium on the theme "Food Factory of the Future" took place at SIK, organised by SIK in collaboration with Laval Mayenne Technopol, France, and EFFoST. The objective of these symposia has been to highlight the development of new concepts, technologies and systems for food manufacture by presenting results from on-going research and development, and to discuss directions for the future.

This year's conference covered the fields of

- Cleaning and hygiene
- Hygienic design
- In-line process control and optimisation
- Flexible automation and novel technologies
- Lean production and sustainability

In her plenary lecture, Ulla Edling, Carlsberg A/S, discussed the need for improved efficiency in the industry, by "lean production". This concept spells leadership and competence at all levels, clear responsibilities, teamwork and proper standards- and quality systems. The producer no longer sets the price, meaning that profit is a question of reducing losses in time, material, energy and quality. Loss is everything that does not mean added value to the consumer.

Cleaning and hygiene

In her talk on adherent microorganisms in the food industry, Brigitte Carpentier, AFSSA Lerqap, France, proposed a hypothesis that the cells having the highest attachment strength to a surface will also be more resistant to a chlorinated alkaline agent. Another practical consequence of this research may be that the degree of contamination of solid foods, transported in contact with an infected conveyor belt, will depend more on the attachment strength of the adherent flora to the belt than on the initial flora population.

Hygiene in food factories of the future was discussed by David Napper, Euroteknik Ltd, Denmark, looking at some of the drivers and pressures likely to influence the food sector. Important agendas will be the conservation of water, increasing energy costs and the advent of new European legislation. Water re-circulation and heat recovery was discussed, using examples from chicken slaughter and sausage operations, the food industry being one of the "leading" branches in water use and pollution. New technology for disinfection presented comprised Cold Plasma, electrochemical processing and UV on TiO₂.

A paper on hygienic design, presented by Walid Biel, CRTT, France, concerned the effect of hydrodynamics on the cleanability of complex equipment

in the dairy industry. The design of equipment, particularly its geometry, is crucial. An experimental set-up was described for studying the effect of different components on flow rate variation, local wall shear and contamination level before and after cleaning. Velocity profiles were determined inside pipes by Doppler ultrasound technique. Local shear stress values were inversely related to the remaining degree of contaminants. In complex equipment, an increase in local wall shear stress components means a reduction in cleaning costs. For efficient cleaning, turbulent flow is needed. Biofilm formation of food associated Staphylococci was the subject presented by Trond Möretrö, Matforsk A/S, Norway. These organisms are known to be among the bacteria most frequently isolated from surfaces in the food industry. For the project, 150 strains of S. were isolated from surfaces in the Norwegian meat and poultry industry. The ability of Staphylococci to form biofilm was studied for a range of conditions. In general, it was induced by suboptimal growth conditions, such as by lowered pH or addition of salt or glucose. It is concluded that biofilm formation is a survival strategy for the S. and that environmental stress may induce biofilm formation, which should be taken into account when designing procedure to avoid build-up of biofilm.

In-line process control and optimisation

Gilles Trystram, ENSIA, France, discussed the role of optimisation for the design of a decision support system in food process control. A dynamic model was developed for each of the applications of drying rice, the drying, salting and smoking of meats and the baking of cereal products. The method developed is based on a genetic algorithm that permits the selection of a set of optima, a second step being to find the best of these. Results have been excellent for any considered process; continuous or batch process, one advantage being the possibility to use the model for real time control purposes.

Novel microwave sensors for in line process control were presented by Harald Merkel, Food Radar Systems, Sweden. In brief, food flows through a pipe with a microwave transparent section, on both sides of which microwave antennas (1-30 GHz) are positioned, one emitting microwaves and the other receiving, the received signal being converted into a signature of the material flowing through the pipe. When a foreign object passes through, the microwave field is distorted and an ejection unit activated, if the pre-set threshold value for the product is reached. The sensor detects all kinds of foreign objects such as glass, metals, plastics, stones, wood and bones, down to a particle size of 1 mm. A pilot unit is located at SIK for customer demonstrations.

Flexible automation and novel technologies

J.O.Gray, Centre of Robotics and Automation, University of Salford, UK. presented their visions for automated food manufacturing. According to Gray, almost all processes in the food industry can be automated, either through a piece of fixed automation or by using a robot based solution. However, very few

robots have been designed specifically for the food industry, and they tend to be far too expensive to introduce into conveyor belt systems. One problem is that the food industry expects automation to mimic human operators instead of using a machine-based approach to reach the same production goal.

The systems needed must not be too sophisticated but must withstand wash down for cleaning and be reliable. In the future, shelled robotic modules (built-in production inside a tubular system) may be the solution, eliminating or simplifying many of today's problems in hygiene, process automation and factory design. To achieve this, more direct cooperation is needed between robot-and automation producers and food industry.

Tone B. Gjersted, NTNU, Trondheim, Norway, presented development work with needle gripper technology for automated picking and packing of fresh pieces of fish meat. The needle gripper is based on the surface hooking principle to grasp, transport and deliver fish pieces, the system including a manipulator and additional vision system. The gripper has been developed according to EHEDG principles for hygienic design. Both salmon and cod fish were tested, demonstrating excellent holding capability and minimal impact on product surface and product quality. The impact on product was less than in conventional human operation.

S.Bulut, University of Bristol, UK, related results from a continuous process for steam sterilisation of fresh herbs. This cost-effective method uses superheated steam to surface sterilise herbs to 100-125°C in 5-20 seconds, reducing the microbial load to below 10³ cfu/g. Bacteria, yeast, moulds and enzymes are destroyed, extending shelf life without damaging the natural characteristics of herbs such as parsley, mint, coriander, thyme, chives and basil.

As a basis for economical utilisation of high pressure processing, R. Buckow, Technical University of Berlin, presented an efficiency analysis and optimisation of treatment conditions. Data from systematic inactivation work with pathogenic microorganisms and viruses in pork and poultry meat, and sensory analysis over a wide range of treatment combinations, were used for developing models for process optimisation. It was shown that high pressures at low temperature and treatment times of only seconds gave high stability with retained raw meat characteristics.

Lean production and sustainability

With reference to an ongoing project at SIK, Karin Östergren, SIK, discussed lean production for the food industry. This discussion described the philosophy and benefits of lean production and the needs for new tools in research to meet demands for a wide range of products, low inventories, short lead times and high accuracy of delivery. Lean manufacturing means doing more with less and eliminating non-value activities by value stream mapping and profiting from the

involvement of employees in daily improvement activities.

Håkan Nordblom, Direkt Chark AB, discussed the implementation of lean production in the food industry, requiring good leadership encouraging a well thought out, well-defined process and clear responsibilities. Examples were given on how a program for daily improvement in a factory resulted in 20% efficiency improvement in 3 months time and a reduction of buffers by 60%.

Lean philosophy and environmental concern applied in the food industry was the subject of a presentation by Johanna Berlin, SIK. To meet the requirements of the food industry for quick response to customer needs, small batches, low inventories and short lead times, and to meet environmental concerns in society, a method was designed and applied using lean philosophy and environmental system analysis. In value stream mapping (VSM), the aim is to map and improve value streams in order to add value and eliminate waste. To incorporate the environmental perspective during the implementation of lean production gives the food industry the ability to relate their actions with their environmental outcome.

In his talk on exploiting food waste and integration of research and technology in a market economy, K. Waldron, Institute of Food Research, UK, penetrated the problems and possibilities in exploiting food processing co-products and waste into valuable chemicals and functional ingredients. However, exploiting co products also requires an understanding of social values and economical limitations. The success in the whey industry demonstrates that waste streams can be turned into valuable income streams. The sustainability of the Food Chain Experimental Platform at the institute is developing novel and integrated approaches to add value to surplus plant-based co-products. Examples were given from on-going research on cereal bran and brewers grain and from the progress in the EC REPRO project.

In his closing remarks, Nicolas Chomel, Laval Mayenne Technopol, France, welcomed all to Food Factory of the Future -4, which is to take place at Laval, France in 2008.