ISPT
Institute for Sustainable Process Technology

ISPT experiments with continuous crystallization highly promising

By Anne Geert Bosma

When compared to the 'stirred pot' (batch) system, the use of the Oscillating Batch Flow Crystalliser (OBFC) in the process industry is not only improving process control, but is also making continuous crystallisation possible. This was the conclusion that resulted from practical experiments carried out at the laboratories of the Scottish technology company NiTech, in which the Dutch companies Cosun, Purac and Croda also took part. The experiments were carried out on behalf of the Institute for Sustainable Process Technology (ISPT) and NL GUTS, a knowledge network specialising in separation technology (see 'Who is who').

The initiator of the study was Henk Akse, the Director of the Netherlands-based consultancy Traxxys, which focuses upon introducing sustainable practices into the process industry. Akse, who was also the project manager of the experiments carried out in 2010, explained how the experiments were carried out and why: "When it comes to crystallisation, Dutch companies in the process industry generally use the 'stirred pot' method. For each and every crystallisation run, it is then a case of putting the raw materials in, filling up the pot, changing the temperature and stirring, after which the crystallisation process takes place. The pot must then cool off, before being emptied and cleaned. The subsequent crystallisation can then take place. This whole way of working is extremely time-consuming, but is nevertheless one at which a great many companies in the Netherlands have become highly adept. The process is certainly a laborious one if we compare it to the OBFC that was launched onto the UK market about five years ago by NiTech, however the OBFC is still hardly used in the Netherlands at all."

Simpler

The OBFC system is simpler. The liquid for crystallisation is pumped continuously into one end of the equipment, and the crystallised product then emerges from the other end. The basic principle behind the process involves accelerating crystallisation in a controlled way by causing the liquid to oscillate and using baffles in order to alter the direction of flow. The improved substance transfer then gives rise to more rapid crystallisation and more uniform crystals. The question that Cosun, Purac and Croda each hoped to answer by carrying out the tests was whether it is possible to achieve continuous crystallisation and if so, whether the resulting product would be better than the product already being obtained using the 'stirred pot' method. The purpose of the experiment was to find the answer. It appeared that the solution that the OBFC represented gave rise to positive results for two of the companies involved. In the case of the third company, this Scottish device was no better, but also no worse than the batch crystallisation method.

Proof of principle

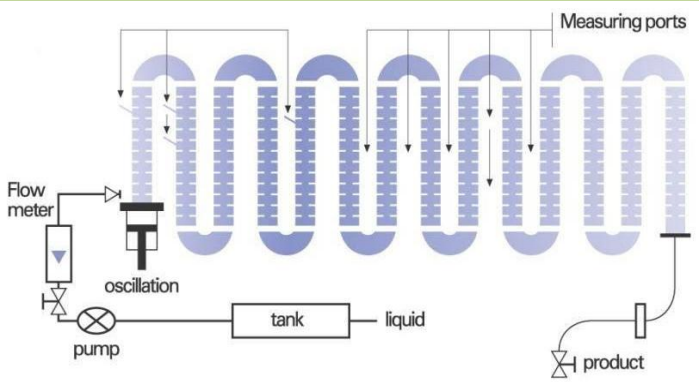
As far as the ISPT is concerned, the test phase has now been completed. As Henk Akse, the project manager, explained: "From our perspective, the experiment was a 'proof of principle'. We wanted to conduct a trial in order to see whether the installation would work in that way in reality. Now

that it has been established that Cosun and Purac can actually achieve a higher-quality product, it is down to each of them, either jointly or separately, to work together with NiTech in order to develop a device that is tailor-made to their own particular production process."
According to Akse, the use of the OBFC provides even more advantages other than just more effective product control and the suitability to operate on a continuous basis. In his view, commercially produced OBFCs in the United Kingdom have demonstrated that the device requires twenty times less production space and also requires twenty times less production time. Thirdly, the capital investment that is required to set up a continuous crystallisation plant is only half the investment that is required in the case of a "stirred pot" installation. Fourthly, the use of the OBFC provides an energy efficiency saving of around 30%. The reason for this lies mainly in the fact that the energy lost when starting and stopping the pump do not occur during continuous crystallisation. Not only does this mean that the company can save costs, but it benefits the environment as well.

Another benefit for the company and the environment arises from the fact that crystallisation using an OBFC generates fewer production losses. This is because the form, dimensions and quantity of the crystals are more controllable (the morphology of the crystals can be controlled more effectively). The reduction in production losses can even be as high as 50 to 75% if the OBFC is not used as a crystalliser, as was the case in the experiment involving the companies from the Netherlands, but as a reactor. This offers many prospects in the pharmaceuticals sector, due to the fact that in medicine production, large quantities of raw materials are lost during the many process stages.

Highly suited
Looking back, Henk Akse believes that the OBFC experiment was highly suited to NL GUTS and the ISPT: "This particular technology was already available, but was not yet in use in the Netherlands and yet it offers a great many benefits for the businesses and the environment alike. This was a cost-effective proof of principle that may well mark the start of a period of rapid innovation."

Technology description:



OBFC consists of a tubular crystalliser through which the mixture is pumped continuously that has to be crystallised.
1. Superimposed on the feed flow is an additional flow that can be manipulated in amplitude and frequency.
2. The tubular Crystalliser contains baffles with orifices perpendicular to feed flow. This introduces various design parameters: distance between baffles, diameter of orifices, variation in diameter and distance along the tube.
3. It is possible to superimpose a heating and/or cooling profile axially along the tubular crystallizer.

Who is who?

ISPT (Institute for Sustainable Process Technology) aims for Sustainability by Innovation in Processing. As a public-private partnership ISPT actively manages a trust based network of process technological companies, research institutes and universities to achieve a strong, active and world class knowledge infra-structure. ISPT believes that innovation in sustainable processing can only be achieved by cooperation in integrated chains where companies are inter-dependent for their supply chains. Find further information, please visit www.ispt.eu.

NL GUTS (Netherlands Group of Users of Technology for Separation) www.nlguts.nl aims to promote, exchange and disseminate knowledge of separation technologies among industries and between industry and knowledge institutions. NL GUTS is partner in ISPT and enables SMEs to validate their technology by means of technology projects carried out in collaboration with and at the premises of other industrial partners that form part of ISPT. The experiments involving the OBFC is just one such technology project. www.nlguts.nl.

NiTech® Solutions was formed in 2003 as a spin out company from Heriot-Watt University Edinburgh by its founder Professor Xiong-Wei Ni. The company is the world's leading authority on process improvement through the use of baffled reactor technology. NiTech® specialises in the design of baffled chemical reactors and processes known as the continuous oscillatory baffled reactor (COBRTM) and the tubular reactor (TBRTM). www.nitechsolutions.co.uk

Traxxys Consultancy for Sustainability focuses on sustainability enhancement in the Process Industries. In this project, Traxxys acted as initiator of the project and as project manager. (www.traxxys.com)