

## NiTech - Continuous Oscillatory Baffled Reactor™

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 a world leading authority on delivering process improvement benefits through use of baffled reactor technology. NiTech is actively engaged with Chemistry Innovation's Innovation Leadership programme.

NiTech's Continuous Oscillatory Baffled Reactor (COBR) technology is based on a tubular reactor with the presence of annular-baffles. The following figure shows the mixing mechanism in a baffled cell.

When a liquid is pushed up through the tube, eddies are created around the baffles, enabling significant radial motion. On a downstroke, eddies are created on the opposite side and the intensity of eddy generation and cessation can be controlled precisely - thus very effective mixing is created.

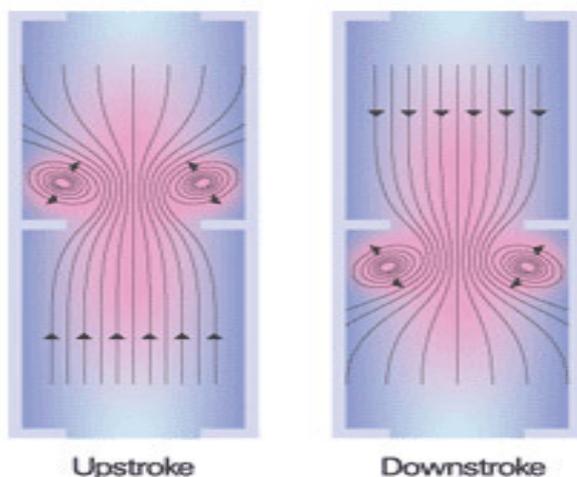


Figure 1:  
Schematic of Flow Eddies in the NiTech Continuous Oscillatory Baffled Reactor

Benefits of COBR include higher yields, reduced waste, greater control of particle formation, increased control over size distribution, increased heat and mass transfer and increased plug flow conditions. A number of these features are illustrated in the following process examples.

### Latex Polymerisation

In traditional batch emulsion polymerisation processes there is usually one short nucleation period of about 2 minutes and hence, one, narrow, particle size distribution is obtained.

The aim of the COBR trial was to create multiple size distributions as demonstrated in figure 2.

This also gave a slight increase in the overall conversion rate when using COBR compared to an equivalent STR (note: exp1 in the following chart was an STR).

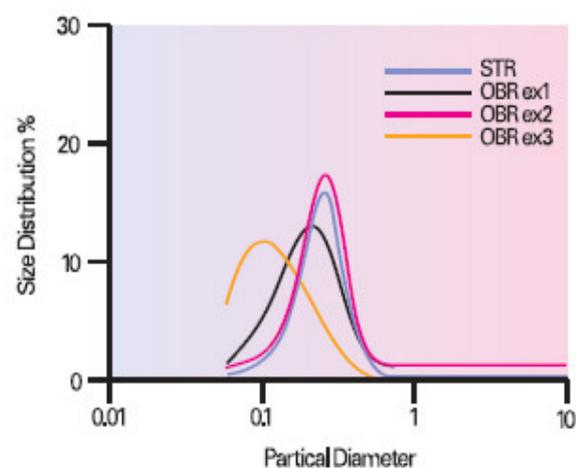


Figure 2:  
Size distributions of latex particles achievable through varying different parameters

### Crystallisation

A crystallisation study using continuous COBR, reduced residence time by >80% (typical stirred tank process ~ 5hours), with equivalent yields and excellent filterability of the crystals.

Greater morphology control was achieved as seen below in figure 3. The more uniform crystal shape leads to improved particle flow characteristics.

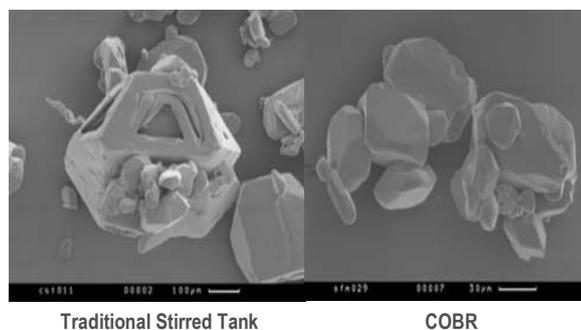


Figure 3: Morphology Control

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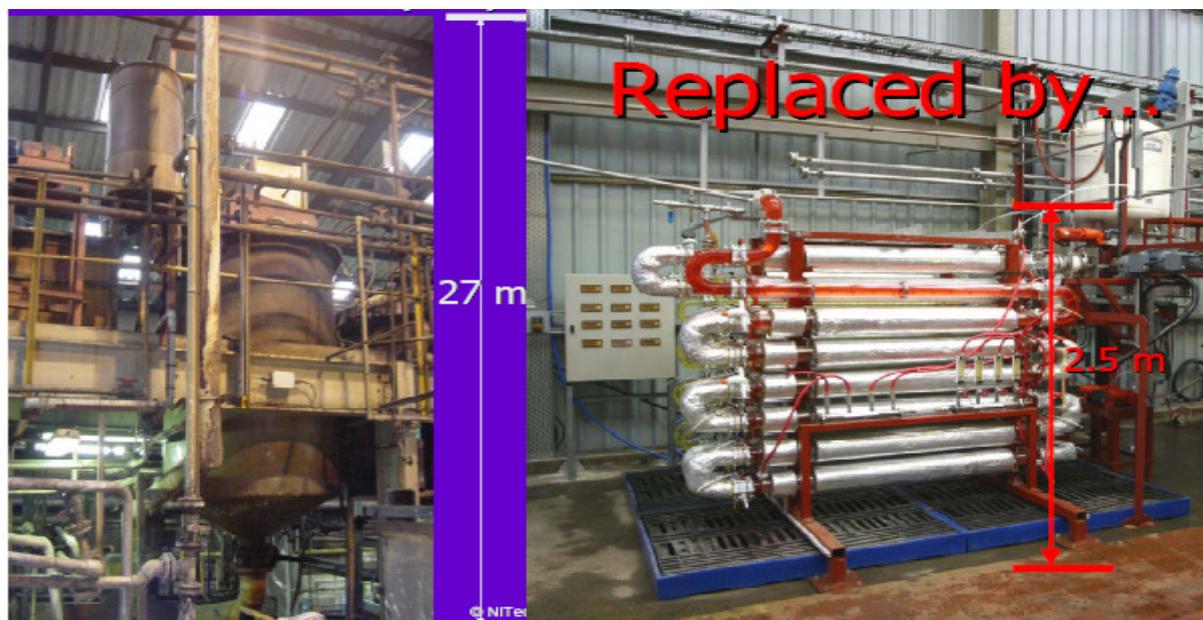


Figure 4: Comparison of space requirements of COBR and Conventional Batch Process Equipment

### Space Advantages of COBR

The space advantage of a COBR is shown in fig 4 above. This installation at James Robinson is shown alongside the replaced stirred tank reactor.

Inserting the oscillatory reactor was an easy retrofit and gave a reduction in capital cost of ~60% over the conventional reactor.

Other benefits of the COBR replacement are shown in the chart opposite.:

Parameter	JR Reactor	COBR
Reactor Volume	16,000 L	270 L
Floor area used	1200m <sup>2</sup>	45m <sup>2</sup>
Reaction wetting time	12 hrs	<0.1 hr
Diazotisation reaction time	2 hrs	<0.1 hr
Cyclisation reaction time	0.3 hr	<0.1 hr
Yield	83%	89%
Purity	99%	99%
Kg/day	180	180-205

### Benefits of Company Membership

As Chemistry Innovation's first Company Member, NiTech Solutions has now extended its engagement into a strategic relationship in order to benefit from bespoke support in forging new collaborative projects. Through its strategic relationship with Chemistry Innovation, NiTech Solutions is seeking to accelerate the exploitation of its unique mixing technology in key application areas such as crystallisation and across Chemistry Innovation's priority areas.

As a fast growing high tech SME, NiTech is passionate about building a strong innovation culture. As such, the company is actively involved with Chemistry Innovation's 'Innovation Leadership' programme.