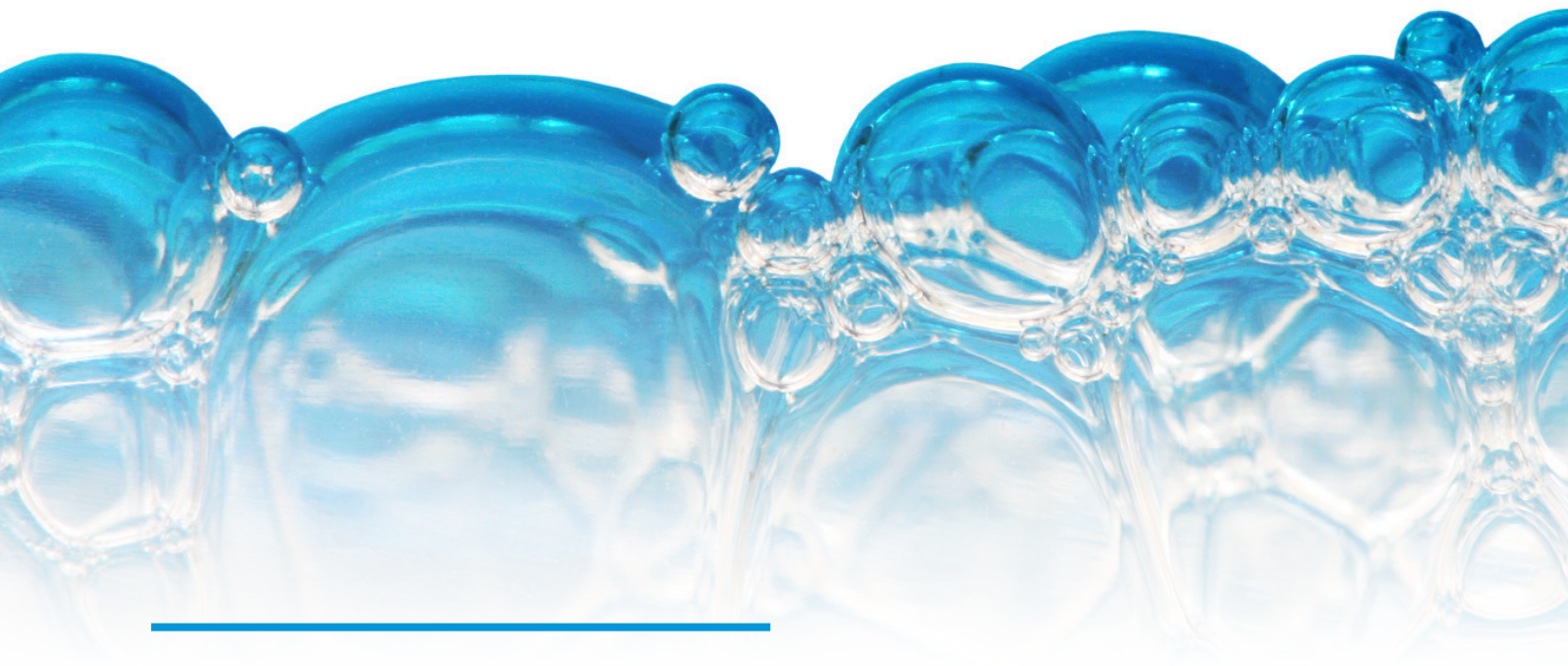


Supporting Innovation in the Manufacture of Liquid Formulated Products

Open-Access Facilities in Liquid Formulation Manufacturing



We address key challenges in the batch processing of liquid formulations through providing a test bed that:

- De-risks innovation by testing new complex liquid formulation processes/new manufacturing technologies in an offline pilot manufacturing setup prior to any capital investment
- Enables rapid and robust process scale-up through smaller scale learning
- Provides scaled-down formulation capability to efficiently test the effects of re-formulation
- Establishes manufacturing control schemes where process parameters can be adjusted in real time to narrow specification tolerances/limit off-specification product



Multi scale rig



Real time measurement display

Technical Capability

We work with our clients to facilitate rapid learning of how formulated product properties discovered at the lab scale can be manufactured economically and flexibly by allowing them to:

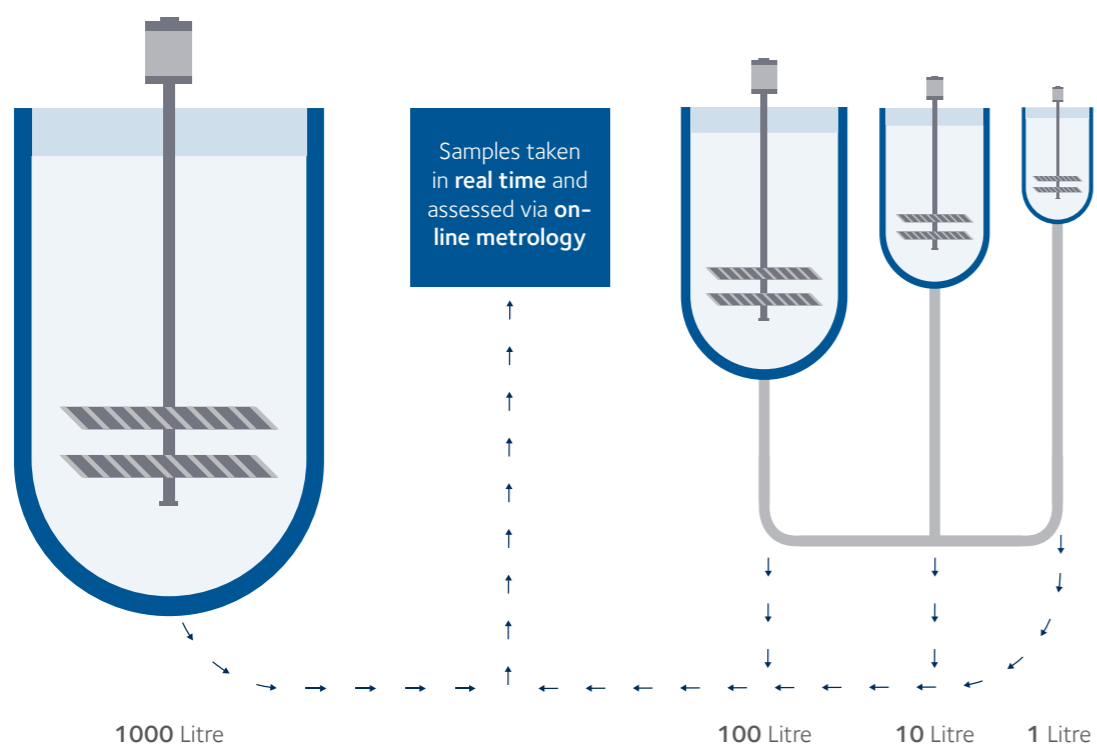
- Understand the dynamics of manufacturing formulations at different scales and enable predictive scale-up of batch formulation processes
- Develop, validate and utilise new sensor technologies and process analytics technologies
- Develop automated process control schemes

The fully digitally-enabled test bed at CPI consists of:

- a series of **scaled vessels** from 1–1000L with a sample flow loop to allow in-line and at-line monitoring of process parameters; the configuration is highly flexible and can be adjusted to specific project needs
- **instrumentation** that produces data for understanding and predicting product behaviour in-processing
- a **control system** for the rig and metrology that is capable of monitoring and controlling product quality attributes

This includes:

- a data acquisition system for process, lab and spectral (PAT) data;
- capability to implement process models for the real time prediction of process parameters



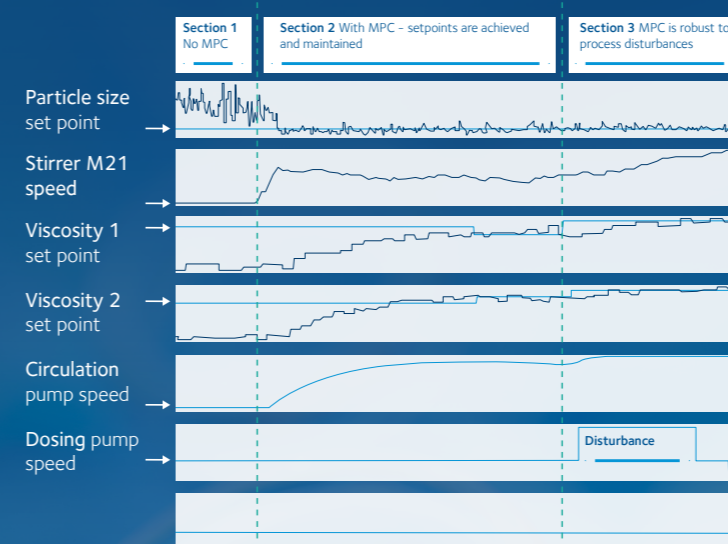
Case Study:

Scale-up and manufacturing of a high internal phase emulsion using model-based control

High internal phase emulsions (HIPEs) have a variety of cross-sector applications, including food products, personal care body creams and drug delivery systems. Such products require careful control of the process to achieve the desired product properties such as viscosity, particle size and shelf life.

CPI in collaboration with Perceptive Engineering Ltd – a company expert in advanced automation – have developed an advanced process control (APC) model that is able to control and optimise the processing of HIPEs on CPI's liquid test bed. This control model will enable CPI to work with clients to develop and scale up industrially relevant HIPEs and other formulation types, optimising their processes more robustly and efficient than can be done currently.

The advanced process control model was built which enables the control of interdependent process parameters such as water content, mixer speed and temperature, on the product performance parameters of viscosity and particle size. Model-based Process Control (MPC) was then implemented to enable HIPE water in oil emulsions to be manufactured with specified particle size and viscosity – “set-points”. This is demonstrated in the chart below, where the particle size and viscosity set-points are set, but before the MPC is initiated (Section 1), these product parameters are outside of the desired set-points, and in the case of particle size, highly variable.



However, once the MPC software is initiated (Section 2), incremental adjustments are made to both the stirrer and pump circulation settings until the particle size and viscosity set-points are achieved. The product has now reached a steady, controlled state, and is seen to be stable to process disturbances (i.e. a sudden increase in the dosing pump speed) – through the application of model based fault detection.

This capability can be applied to a range of different liquid formulations and CPI would welcome further discussion with any interested partners.

About CPI's National Formulation Centre

CPI's National Formulation Centre is a UK based open-access innovation centre for advanced formulated product design and scale-up. The centre works with industry to bring together cutting-edge cross sector expertise, technology and infrastructure, providing the environment for innovative companies which increases productivity and accelerates the commercialisation of their next generation formulated products.

Based at NETPark, the centre is conveniently collocated with both CPI's Printable Electronics and Graphene Centres and utilises a broader multi-partner network spanning key knowledge partners and SME innovation enablers. We are driving a step-change in the way formulated products are delivered, providing the platform for UK-based companies to bring new, high value innovations to market years ahead of competitors.

Collaborating to de-risk and innovate

By bridging a wide range of market sectors, knowledge partners, and the UK's most innovative technology companies, CPI helps solve the key challenges for the formulating industries and drive sector and value chain synergies. We welcome the opportunity to engage with pharmaceutical companies of all sizes, from university spin-out to multi-national, to overcome key technical and industrial challenges to overcome barriers to innovation and de-risk commercialisation of new products and processes.

Engage with us via:

- Consortia to deliver projects that will create sustainable open access capability and enable the UK formulation industry overcome innovation barriers
- CR&D bids for European and UK funding calls in formulation science areas
- Fee for service projects focused on your specific needs and challenges

 www.uk-cpi.com

 +44 (0) 1740 626 030

 info@uk-cpi.com

 National Formulation Centre, NETPark, TS21 3FE

