High throughput Formulation –

Can robots formulate for you?

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A little about me

Who is CPI?

- CPI are a leading independent technology innovation company based in the North East and one location in Glasgow
- Founding member of the UK Government's High Value Manufacturing Catapult.
- Supports collaborative, Commercial and ERDF projects
- Innovation across 5 Business units
  - Printable Electronics & Health Care photonics
  - Formulation
  - Biologics
  - Biotechnology
  - Medicine Manufacturing

My Role at CPI

Workflow Creation & Development

- Translation of customer processes into efficient and representative automated or semi-automated workflows.
- Use expertise to utilise correct tools and processes to create most efficient work flow.

Experimentation Preparation

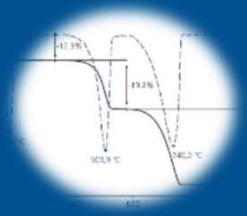
- Dispense parameter testing
- Robot and tool suitability checks
- Dispense tool calibration checks

Process Validation

- Selecting optimum robotic equipment for the customer requirements.
- Validating that the typical results seen can be reproduced on a robot.
- Sample initial tests and scope

Lab Safety Supervisor

- Responsible for the safe operation of the High Throughput Lab.
- 5S and housekeeping audits.



Sample and Data Analysis

- Project dependant on which analysis types or equipment is used.
- Try and use automated equipment where possible.

Robot Troubleshooting & Maintenance

- Fixing damaged robots using expert knowledge and previous experience.
- Carry out required routine and preventative maintenance
- Robot cleaning

Benefits of Product optimisation through High Throughput Formulation

More cost effective / fewer ingredients minimising bill of material

Supply chain optimisation and robustness

Remove / reduce ingredients to meet regulatory standards

- Reformulate for sustainability

Discover ingredient synergies to drive disruptive innovation

Process parameter Optimisation

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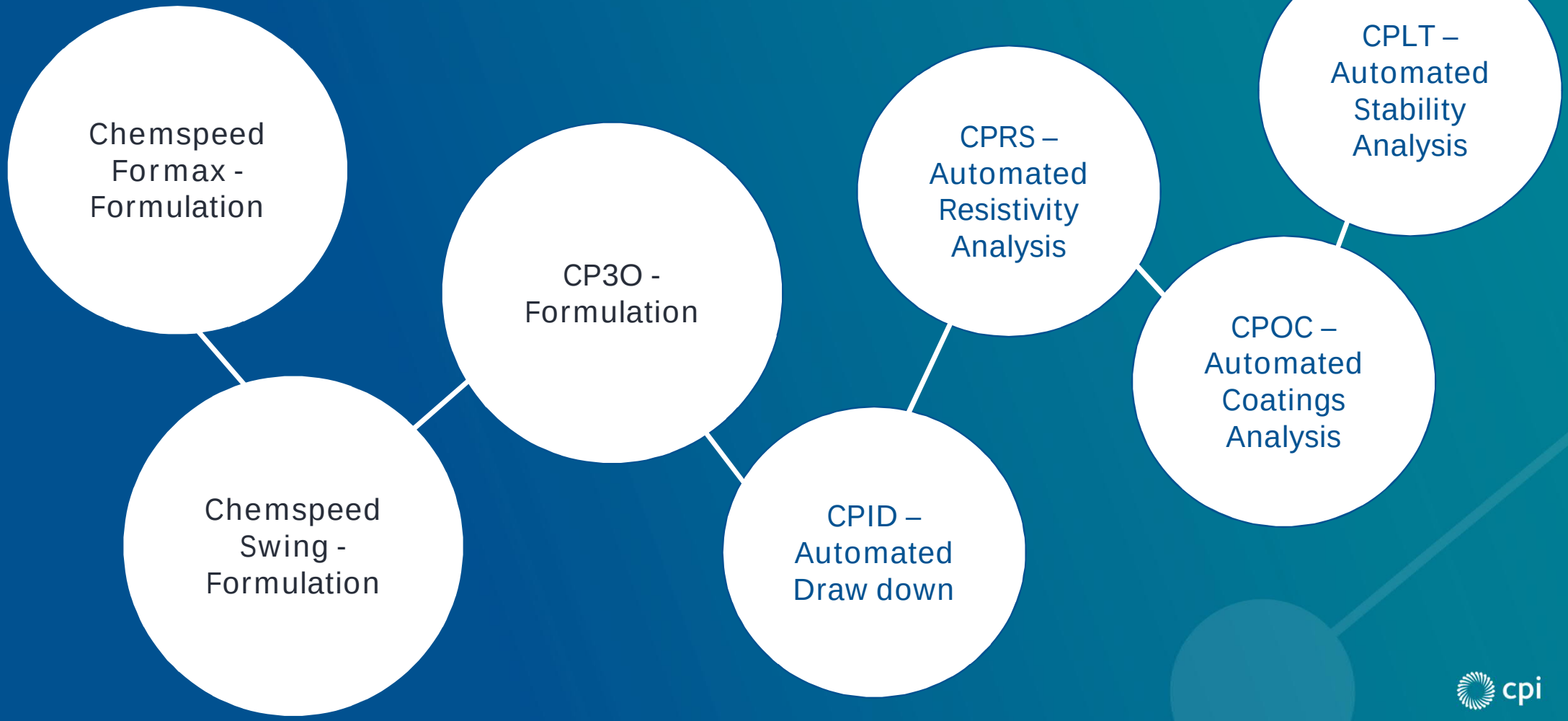
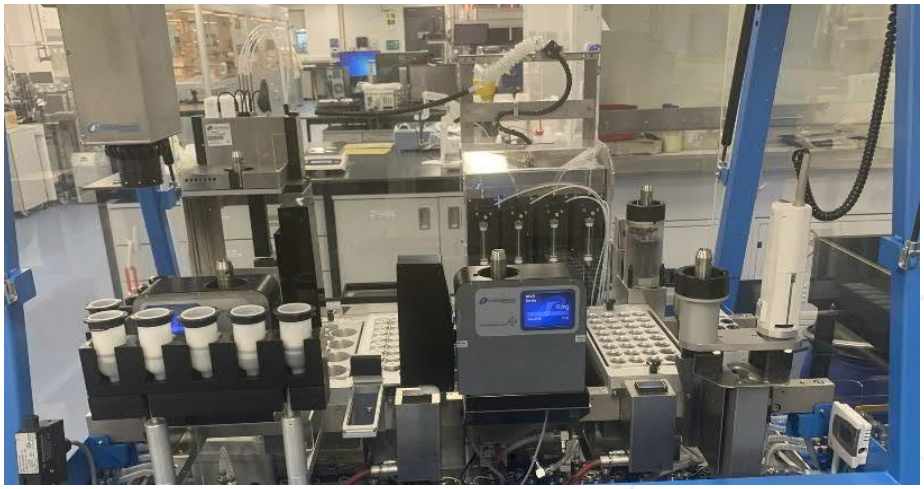
Overview of the Robots



Chemspeed Robots

- 2 bespoke robots created from off the shelf tools.
- Capable of handling a wide range of materials
- A number of inline analyses possible.
- Contains 12 formulation vessels, can be used for scale up comparisons and larger formulations
- Has been involved in a large range of projects across sectors such as FMCG, batteries, coatings, inks and lubricants.
- Maximum daily sample output is very much project and material dependant.



CHEMSPEED® TECHNOLOGIES

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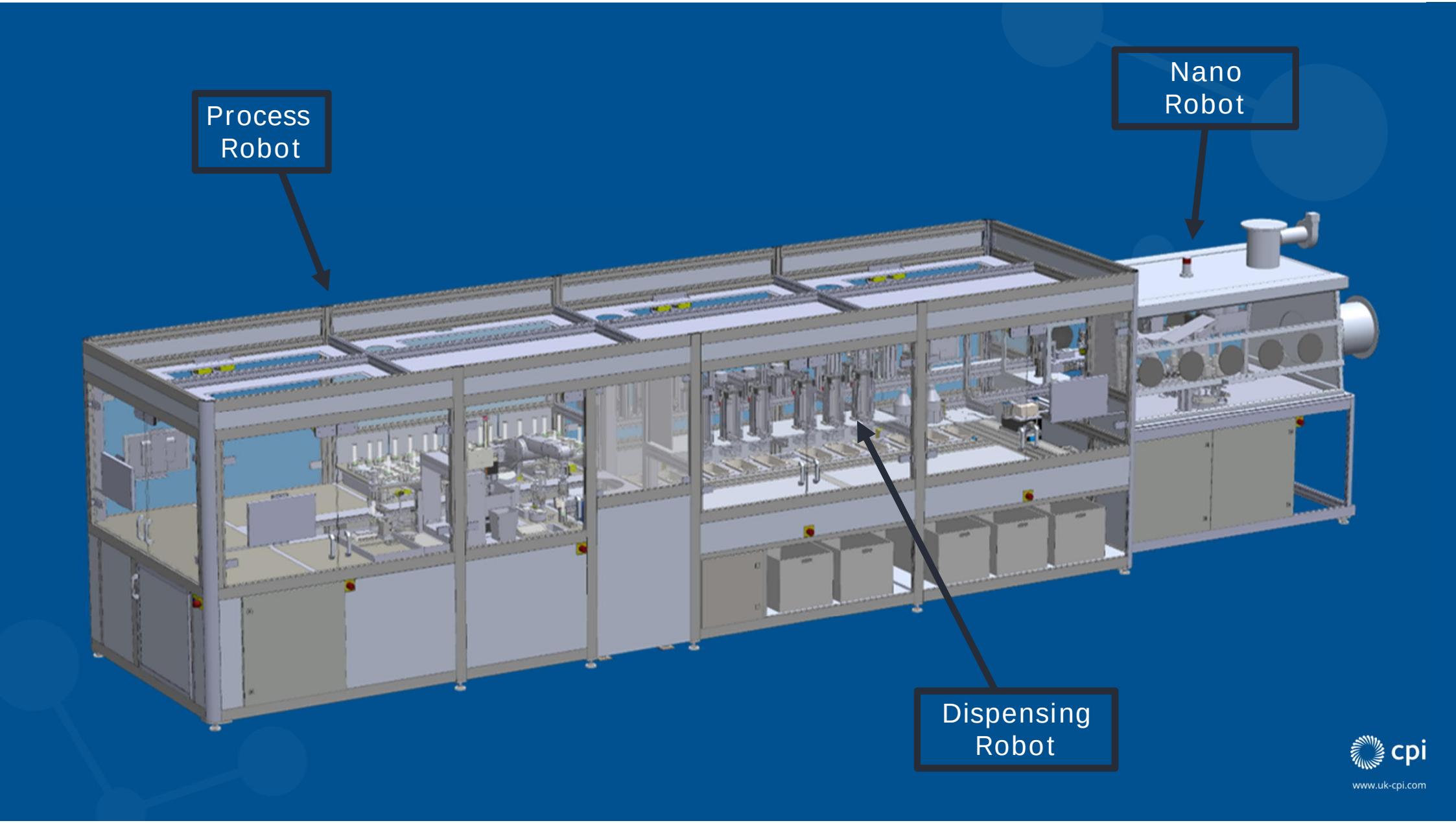
Process Robot
Nano Robot
Dispensing Robot
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New Formulation Robot – Unofficially CP3O

- Created to fill identified capability gaps – targeting battery, ink and adhesive formulations.
- Dependant on workflow, system can formulate ~100 samples per day.
- Resulted in a 10x increase in productivity on manual battery formulations
- Safe handling of hazardous/nano-materials in automated, HEPA filtered enclosure.
- Automated , multi-position Dual Axis Centrifuge mixing.
- Characterisation including surface tension and recent addition of an automated probe station
- Labman sample manager database links all current Labman systems and sample info, analysis and barcodes can all be recalled.

Labman Robots – Workflow design

CPID

- Automated drawdown system.
- Can create draw downs on to both microscope slides and metal panels
- Uses syringes prepared on CP30
- Can run 20 samples in a single run
- Able to run 8 different thicknesses of panel drawdown

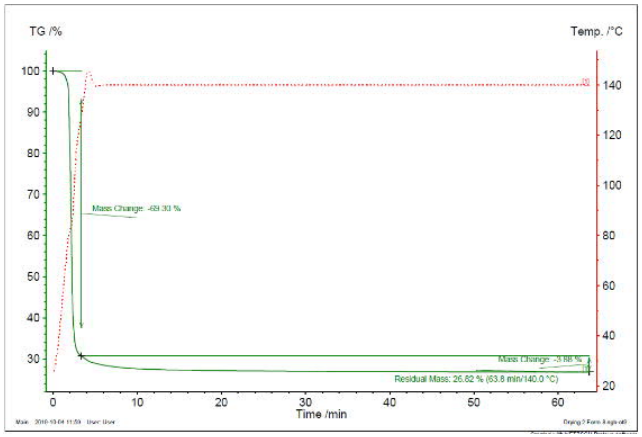
CPRS

- Uses the microscope slide draw-downs created by CPID
- Analyses surface profilometry and resistivity of conductive inks
- Can also run 20 samples in a single run

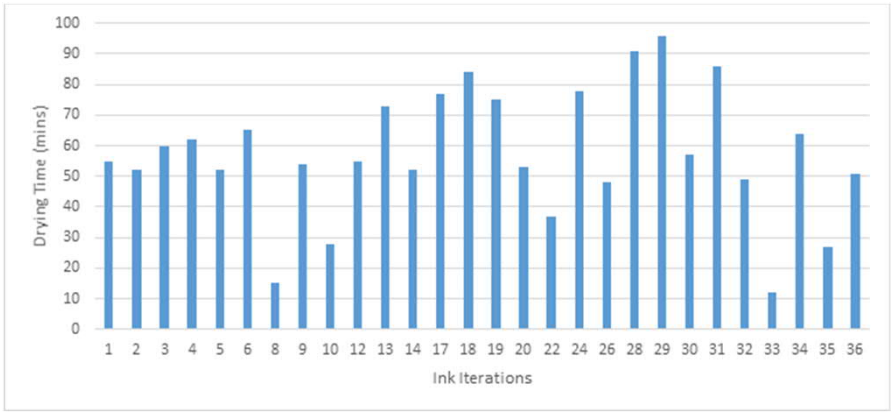
CPOC

- Analyses the metal panels produced by CPID
- Includes, surface profilometry, gloss & colour analysis
- Run size of 8 samples

Case study 1 – LEEBED – A Statistical Approach to Ink Formulation



TGA drying results graph



Over all drying time for all samples

- High throughput project to investigate the addition of copper nano particles into inkjet ink for printable hybrid electronics, to replace the current industry standard of Silver.
- 12 solvents picked for study, narrowed down to 5 using Principle Component Analysis.
- Formulations were then prepared and analysed using a variety of automated analytical equipment
- All analysis was input in to JMP software to give optimum ink formulation, which was verified experimentally

LEE BED

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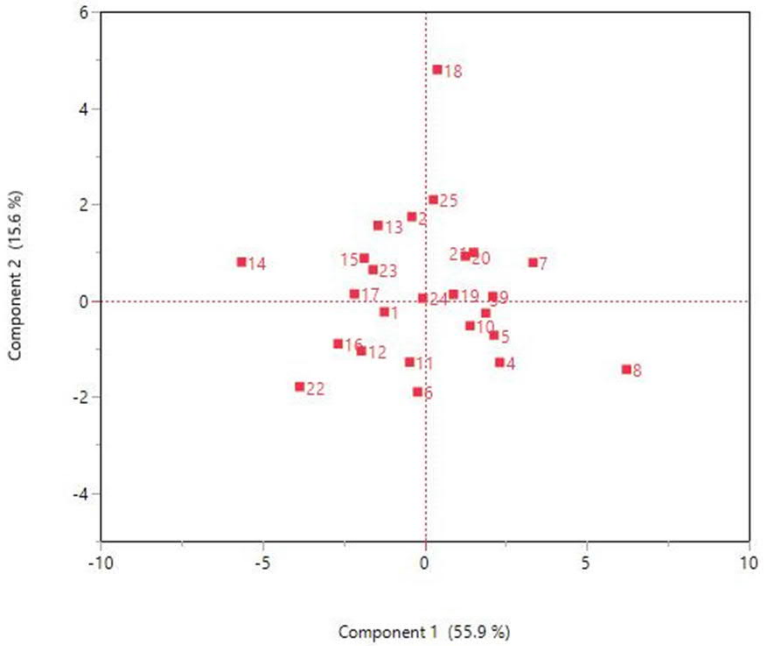
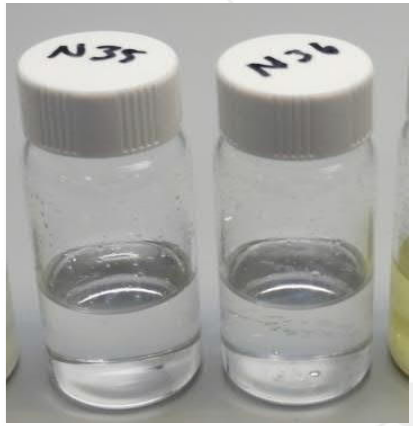
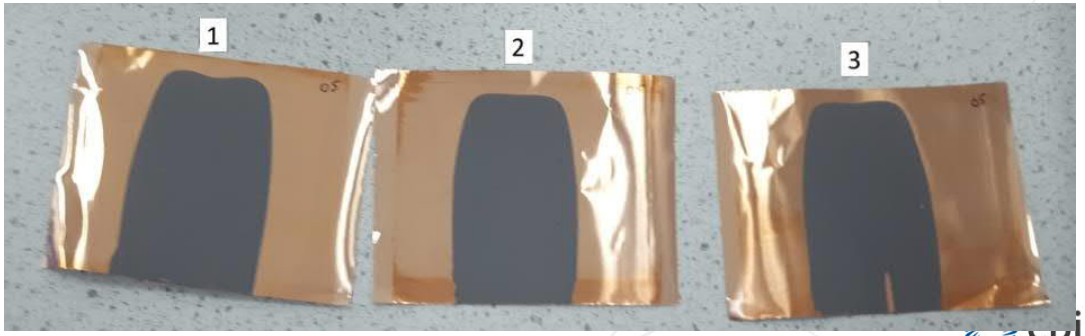
Case study 2 – Battery Solvent Solubility study

- A campaign to find a suitable replacement for binders and solvents within battery formulations
- PCA was once again used to narrow down the solvent range to 10 solvents and 10 binder alternatives.
- 392 samples were created, consisting of different ratios of the solvents and binders
- Samples that were deemed successful were carried forward to make full battery slurries
- These battery slurries were drawn down on CPID, difficult due to slurries requiring a foil substrate not a metal panel.





After heating & mixing



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Summary

- Robots can be a powerful tool when it comes to formulating
- Very good at formulation optimisation as formulations can be made very quickly and repeated rapidly should they be required.
- Not a case of pressing go and letting a robot take over
- Case studies have shown the benefits of high throughput approach on new product creation and formulation optimisation.

Thank you

For more information visit **www.uk-cpi.com**

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