

From innovation to commercialisation



Formative Formulation: a technical meeting for early career formulation scientists in industry and academia

18 March 2019

POWDER PROCESSING AND THE CATAPULT NETWORK

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Complex Particles, CPI



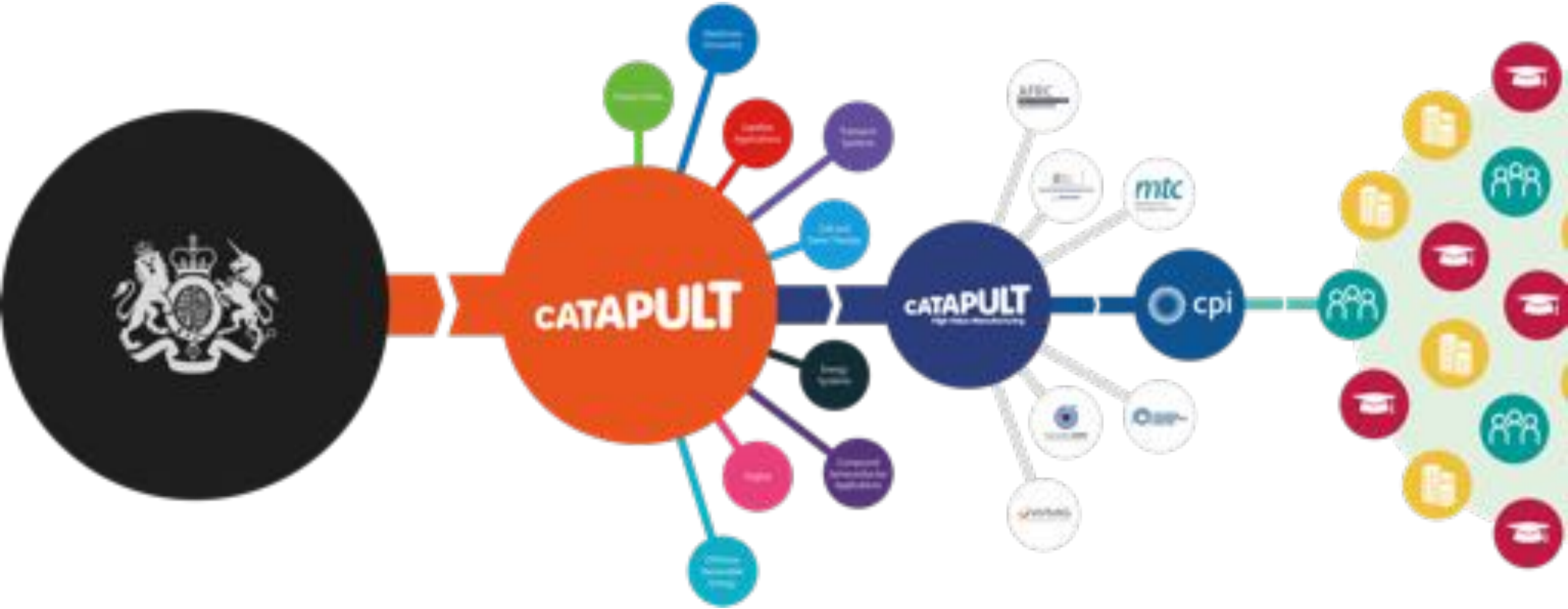
TODAY'S TALK



- Who I am
- Introduction to CPI
- About the Catapult Network
- Projects at CPI
- Process Engineering in Formulation

INTRODUCTION

- BEng Chemical Engineering
- Graduated in 2015
- CPI- January 2017
- Complex Particles



A catalyst for growth and success in the UK

Seven UK-based centres for excellence, covering high value markets, and sharing **expertise and knowledge** to create a robust support network for advanced manufacturing in the UK.



Home to four
NATIONAL CENTRES



National Printable
Electronics Centre



National Industrial
Biotechnology Facility



National Biologics
Manufacturing Centre



National
Formulation Centre

Helping
COMPANIES



in high value
MARKETS

PROJECTS

CR&D PROJECT

AJAX



UNIVERSITY OF
BIRMINGHAM

CHARIOT

P&G



CHARIOT



TSM 125



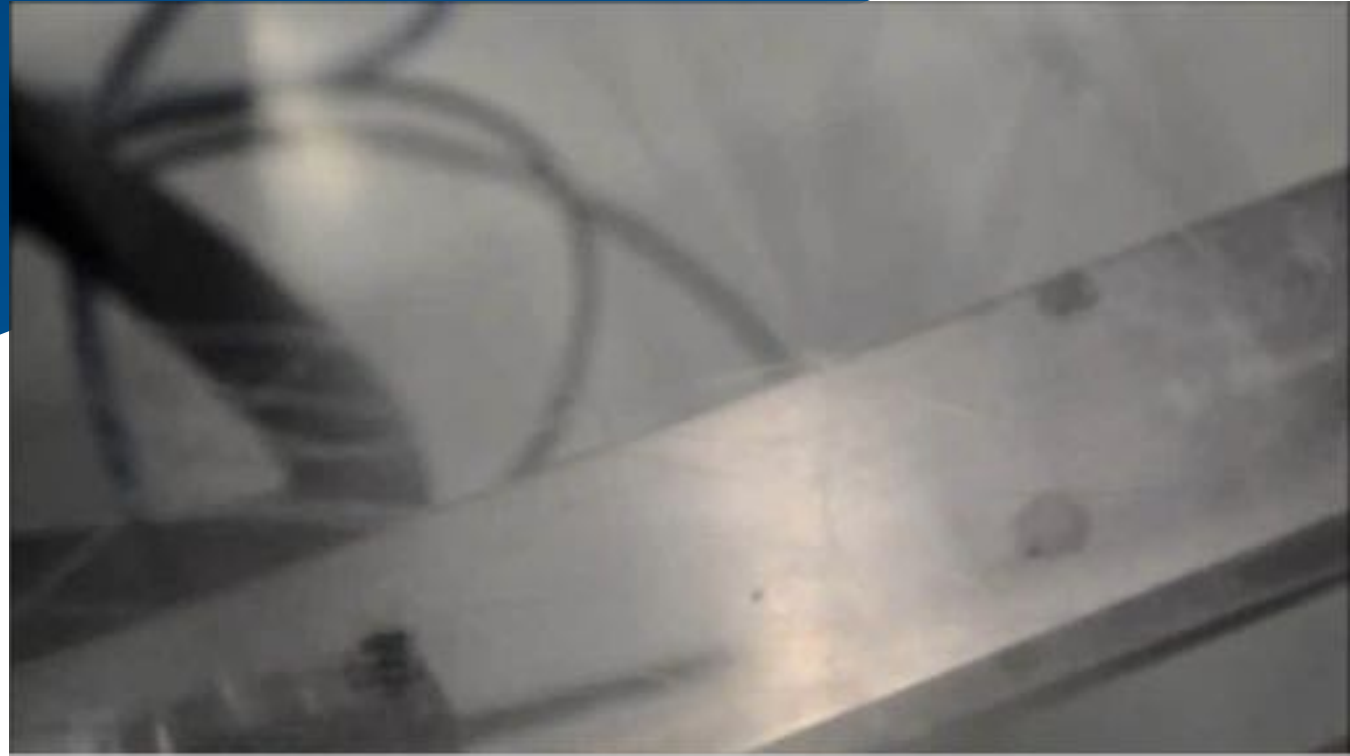
TSM 75

- Pilot Plant facility at CPI
- Twin Screw Mixer (TSM) 125 & 75
- Multiple powder feeders
- Liquid Addition
- Flexible
- Easy to Clean

LIQUID ADDITION

Top Spray

- Spray via hotmelt
- High level dust generation
- Powder build up on blades, metal casing
- Agglomeration on certain areas

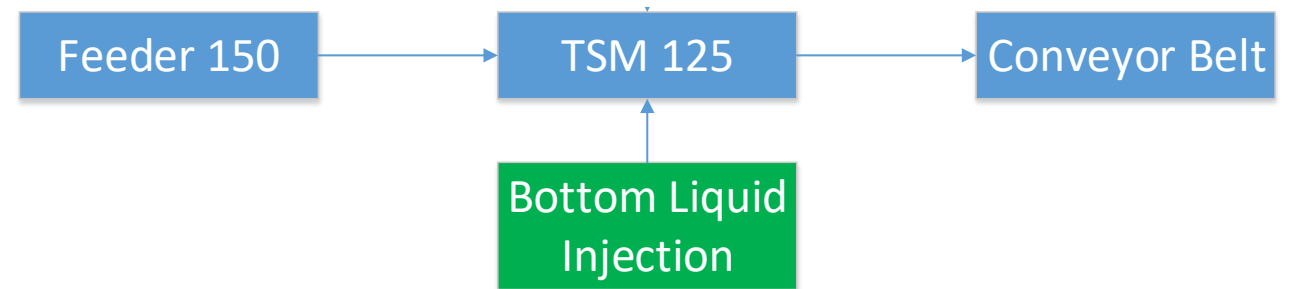


LIQUID ADDITION

Bottom Liquid Injection



- Spray nozzle at the bottom of powder bed
- Better coating, less dust
- Importance of Spray Flux



IMPORTANCE OF SPRAY FLUX

$$\psi_a = \frac{3\dot{v}}{2\dot{A} d_d} \quad (\text{Hapgood et. al})$$

ψ_a = Spray flux

\dot{v} = Volumetric flow rate

\dot{A} = Area flux = bed velocity \times spray width

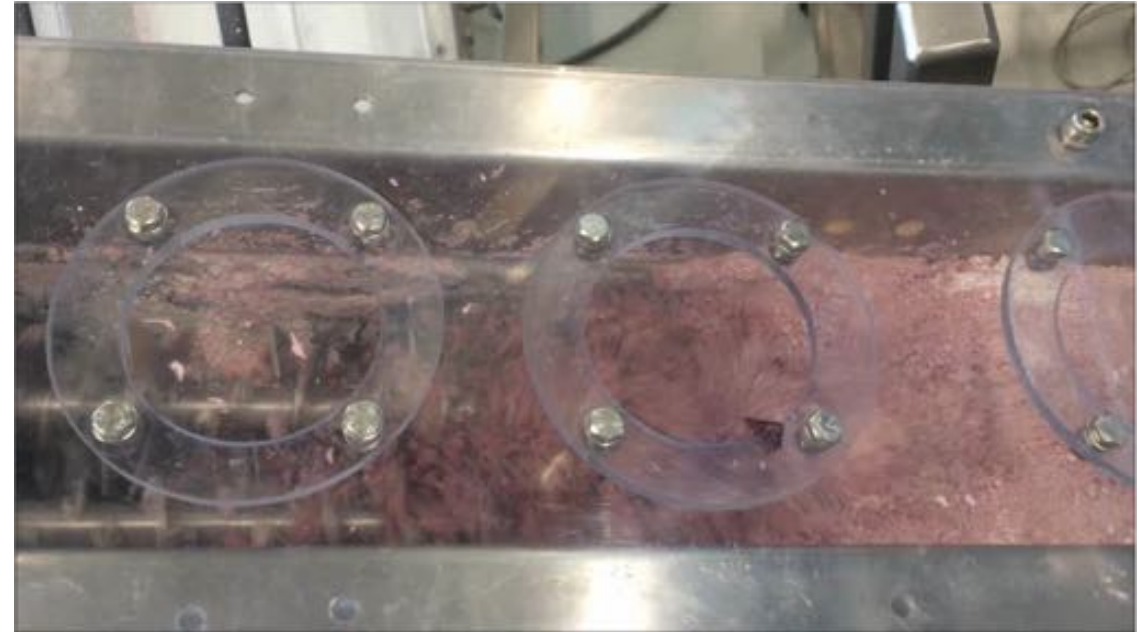
d_d = droplet diameter

1. bed velocity \rightarrow tip speed
2. spray width \rightarrow measure width from angle
3. droplet diameter \rightarrow from nozzle spec.

BACK MIXING



Blade angle reversed



TSM tilted at 20°



OUTCOME

- Positive feedback from partners
- Designed experimental plans
- Designed equipment layout/ set-up
- Led characterisation and data analysis
- Communicated results to stakeholders

STRATEGIC



PROSPECT CP

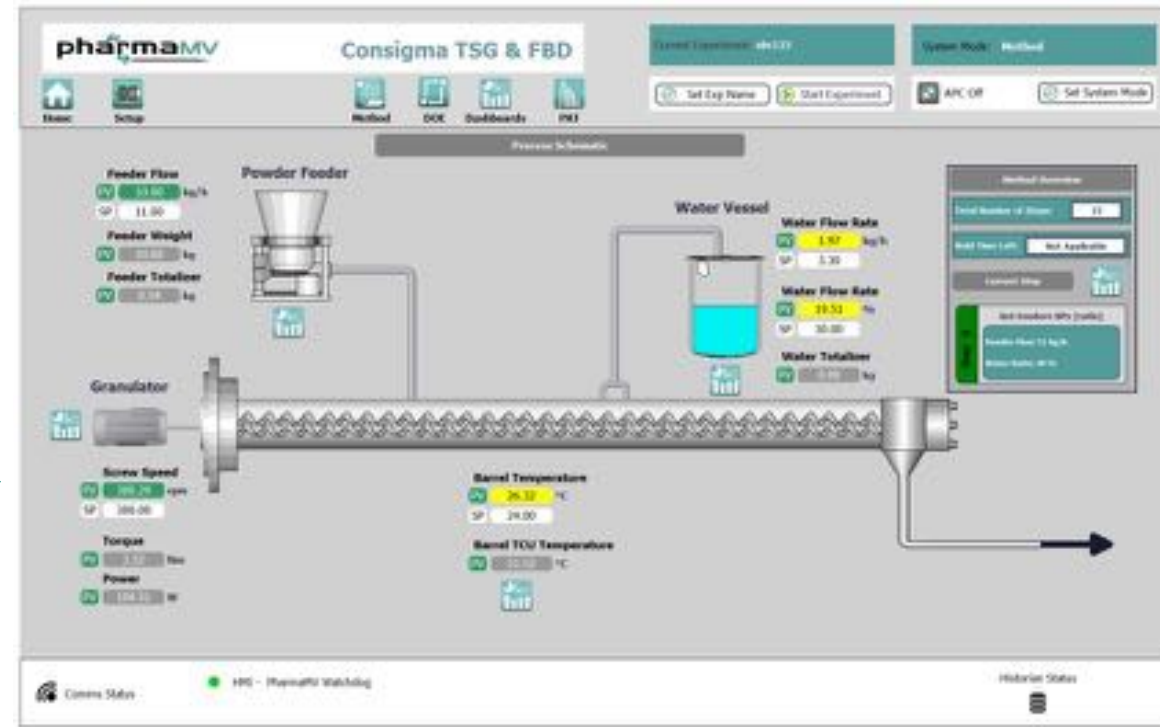
Proving of Real-wOrld, Scalable, PrEdiCtive Tools and technologies for Complex Particles



Twin Screw Wet Granulator



PAT interface

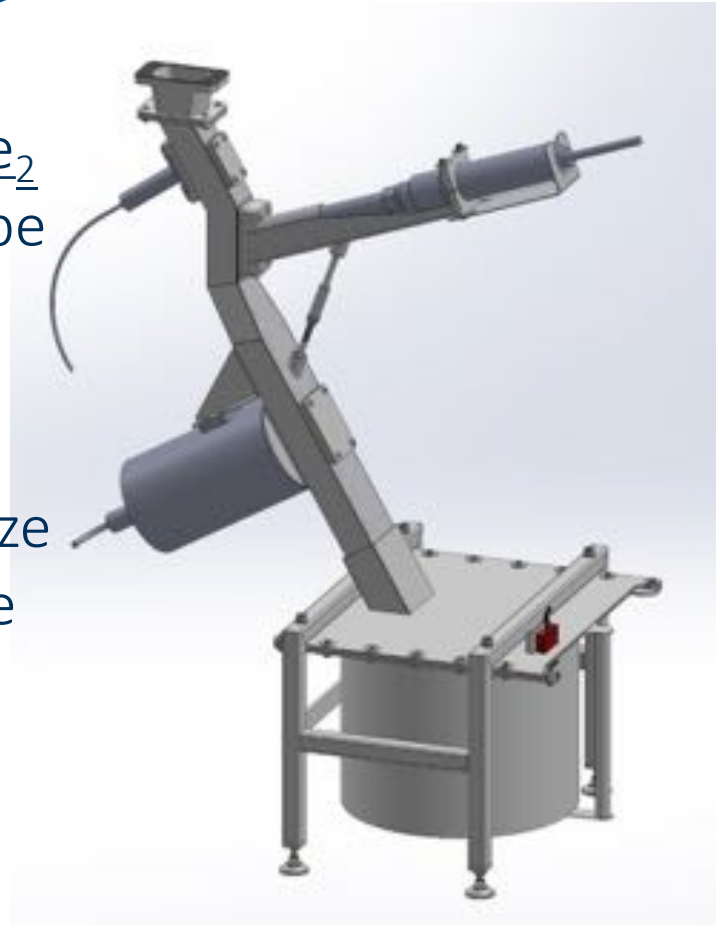


Advanced Process Control (APC)

PAT INTERFACE

MultiEye₂
NIR probe

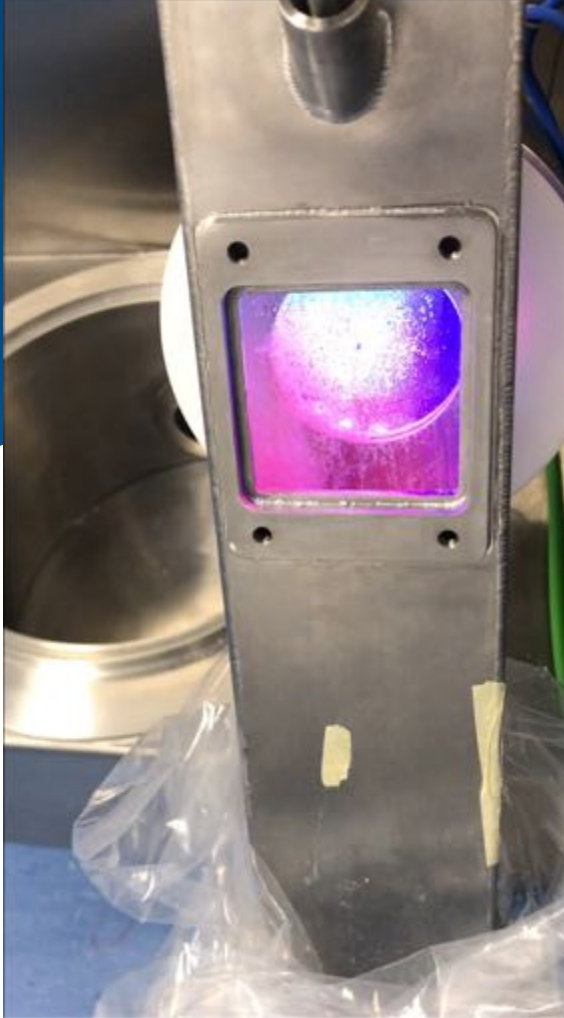
Eyecon₂
Particle size
and shape



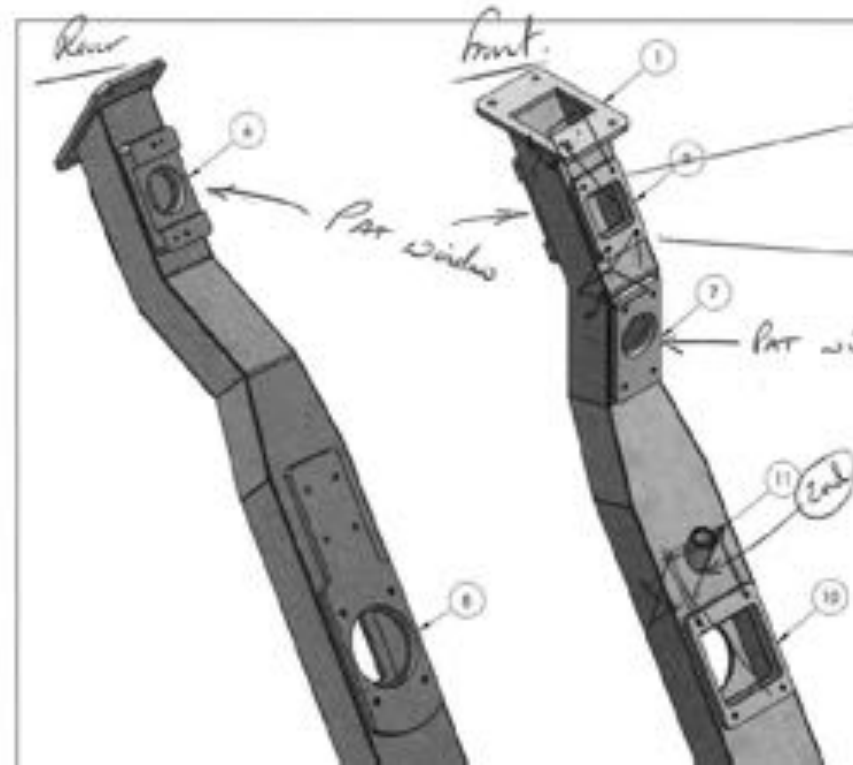
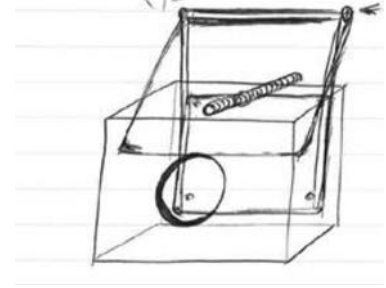
Raman PhAT
probe
Chemical
composition

- PAT chute attached at the granulator outlet

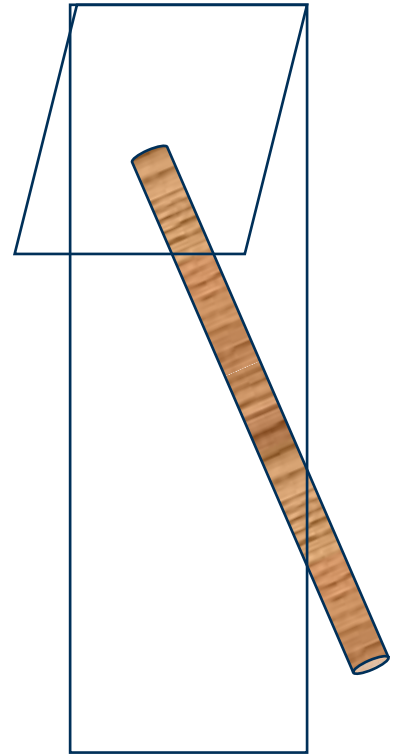
PAT INTERFACE



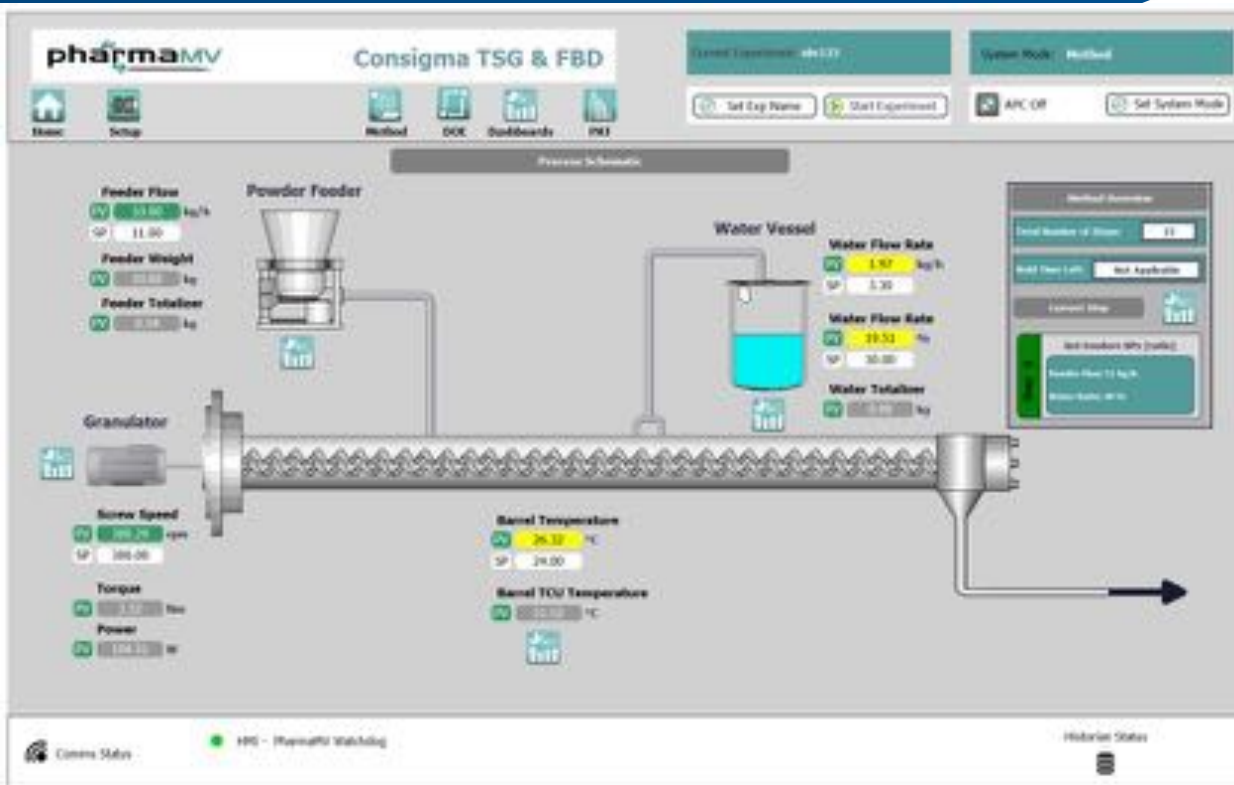
Powder Presentation on PAT chute



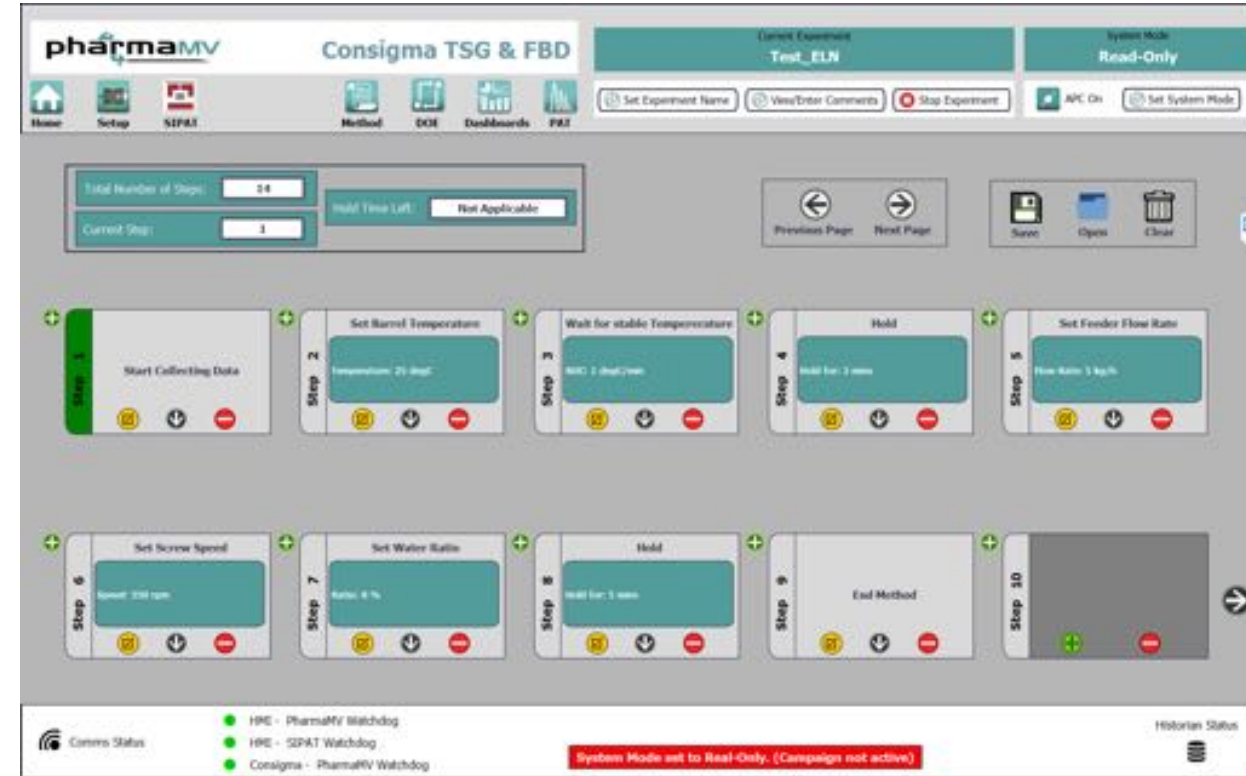
Modification being made on PAT interface



ADVANCED PROCESS CONTROL (APC)



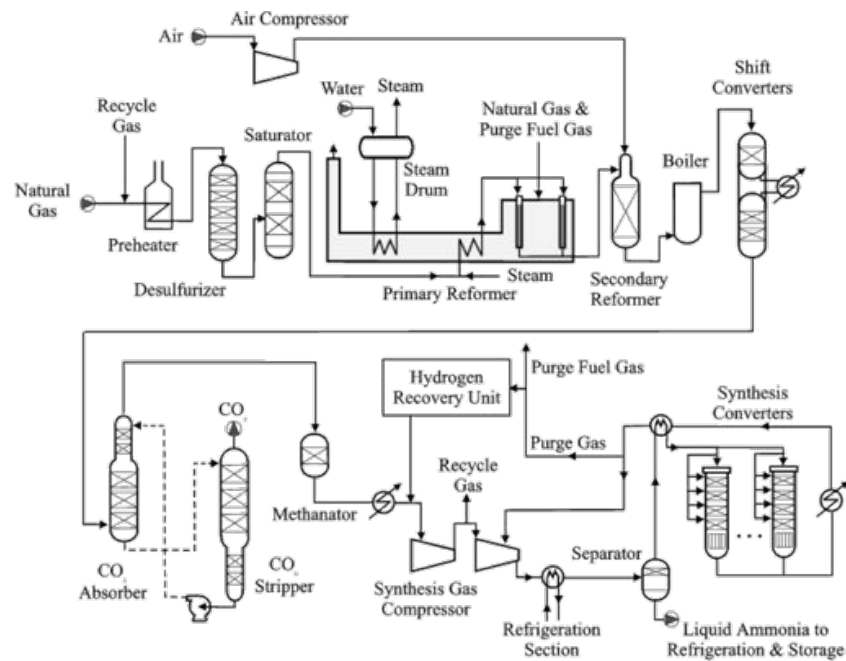
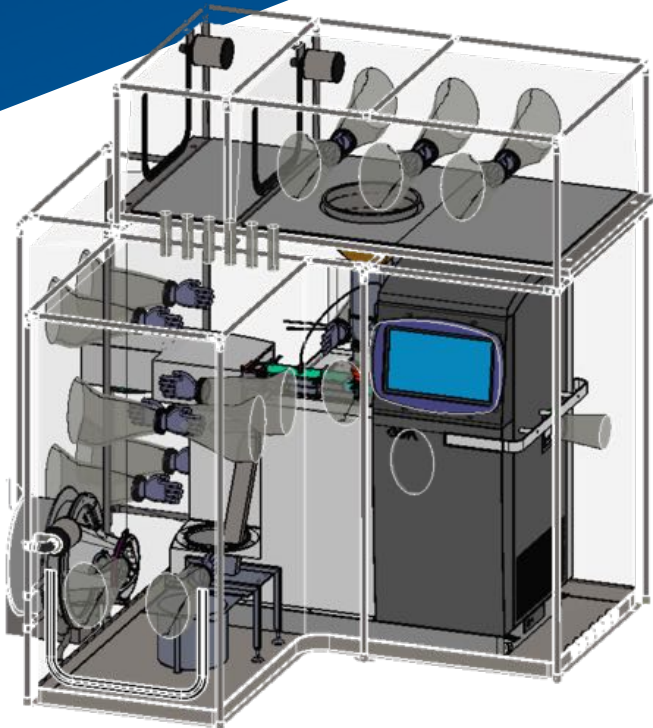
- Unit Operation of ConsiGma-1
- Real-time monitoring of PAT



- Define granulation method
- Key for process parameters (e.g. Screw speed, powder flow rate, liquid flow rate, barrel temperature)

PROCESS ENGINEERING IN FORMULATION

Process Safety



Process Optimisation



Scale-up

THANK YOU

for more information
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