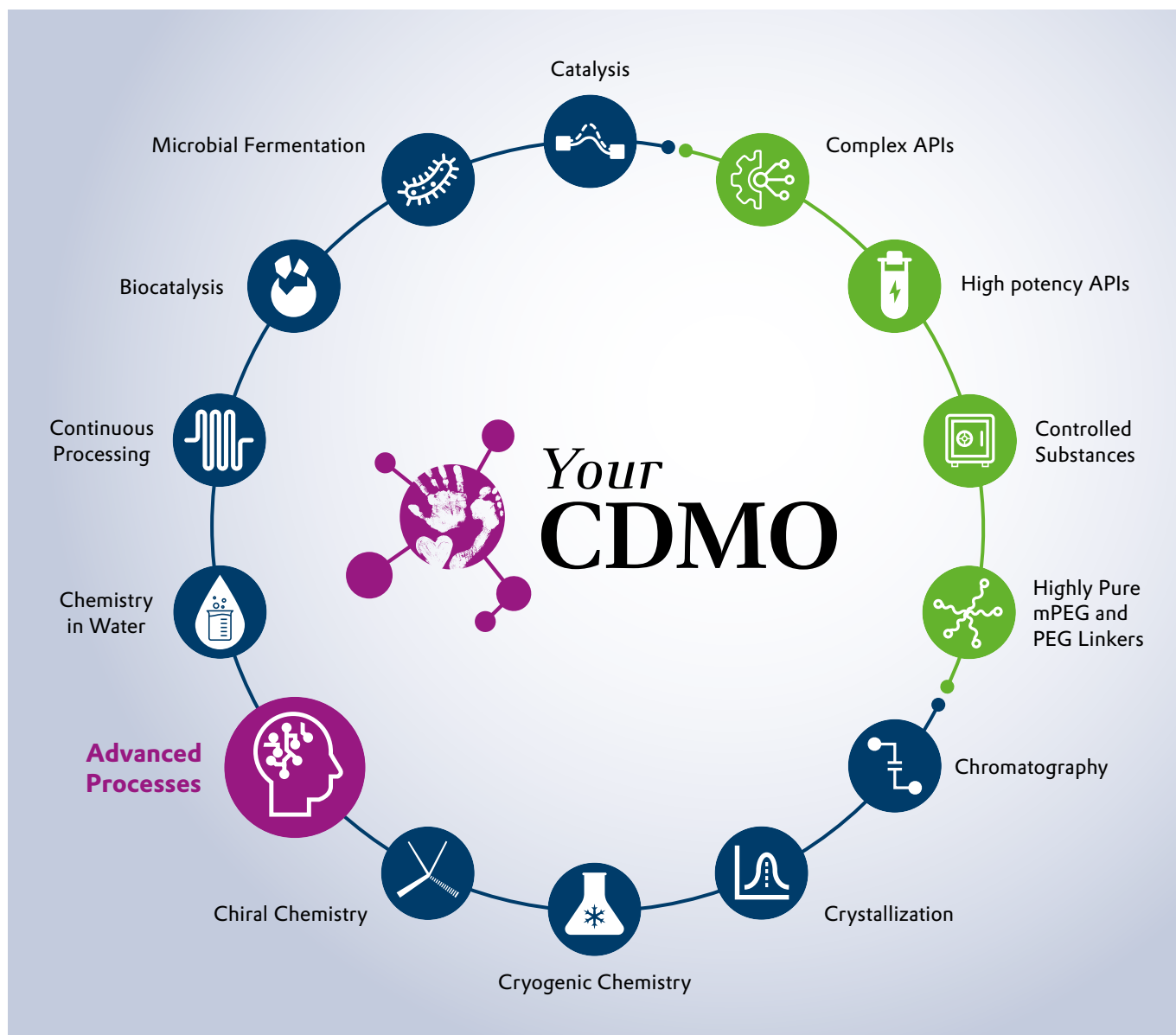


Advanced Processes

"The Fast and The Functional"



- 1 State of the art digital solutions
- 2 Expedited development, optimization, and implementation
- 3 Process analytical technology

ADVANCED PROCESSES - BENEFITS

Evonik applies the full scope of digital and AI-supported screening, development and processing methodologies to enable:

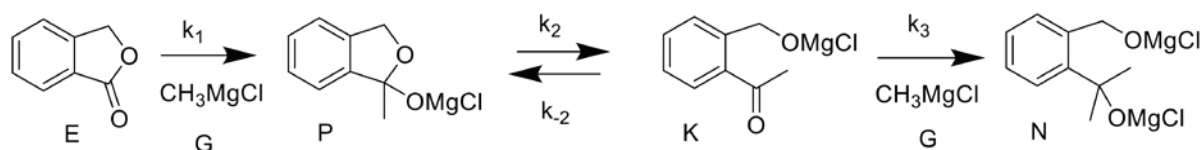
- Faster development and continuous improvement cycles, accelerating time-to-market
- Improved results in terms of cost, quality and sustainability
- A right-first-time scale-up of robust processes

TECHNOLOGY FEATURES

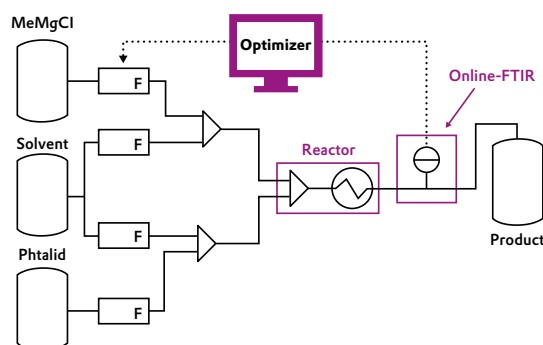
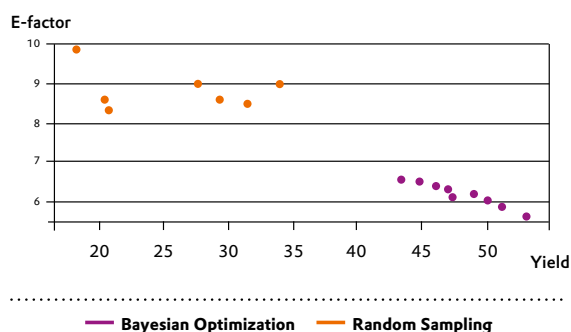
- In-house development platform based on Bayesian optimization
- Rapid prototyping and reactor development featuring proprietary design tools and SLM metal 3D printing
- Process-, thermodynamics and multi-physics / CFD simulation
- Fully integrated and automated laboratory platform
- Dedicated experts for process analytical technology development and implementation at any scale

CLOSED LOOP OPTIMIZATION OF A CONTINUOUS PROCESS

Applying Bayesian Optimization and a Flow Platform to optimize tricky chemistry



$$d[P]/dt = k_1[E][G] - k_2[P][G]$$



- k_3 approx. 100 X k_1
- Kinetic selectivity issue, difficult to control
- Task: Optimize conditions for low E-factor and high yield
- Chemistry performed in a 3D-printed flow setup
- Reaction monitoring by IR, delivering high data density

- AI-controlled autonomous search for optimum conditions
- 50 to 100 times accelerated experimentation
- All available knowledge is learned and collected for each iteration
- Directed evolution of reaction model

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