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In the Toolbox

Selective Strategies for SRU Stability & Optimization

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We've been down this road before.

142
SRU installs

2005
First SRU install

Technology	# Installations
Naphtha Hydrotreater	1,324
Distillate	655
Gas Oils	620
Hydrocracker	605
Resid	233
Other	183
Lubes	177
Feed Filter/ Guard Vessel	151
Sulfur	**142**
Renewables	137
Reformer	103
Light Ends	98
Adsorbent Beds	83
Isomerization	49
Pygas	47

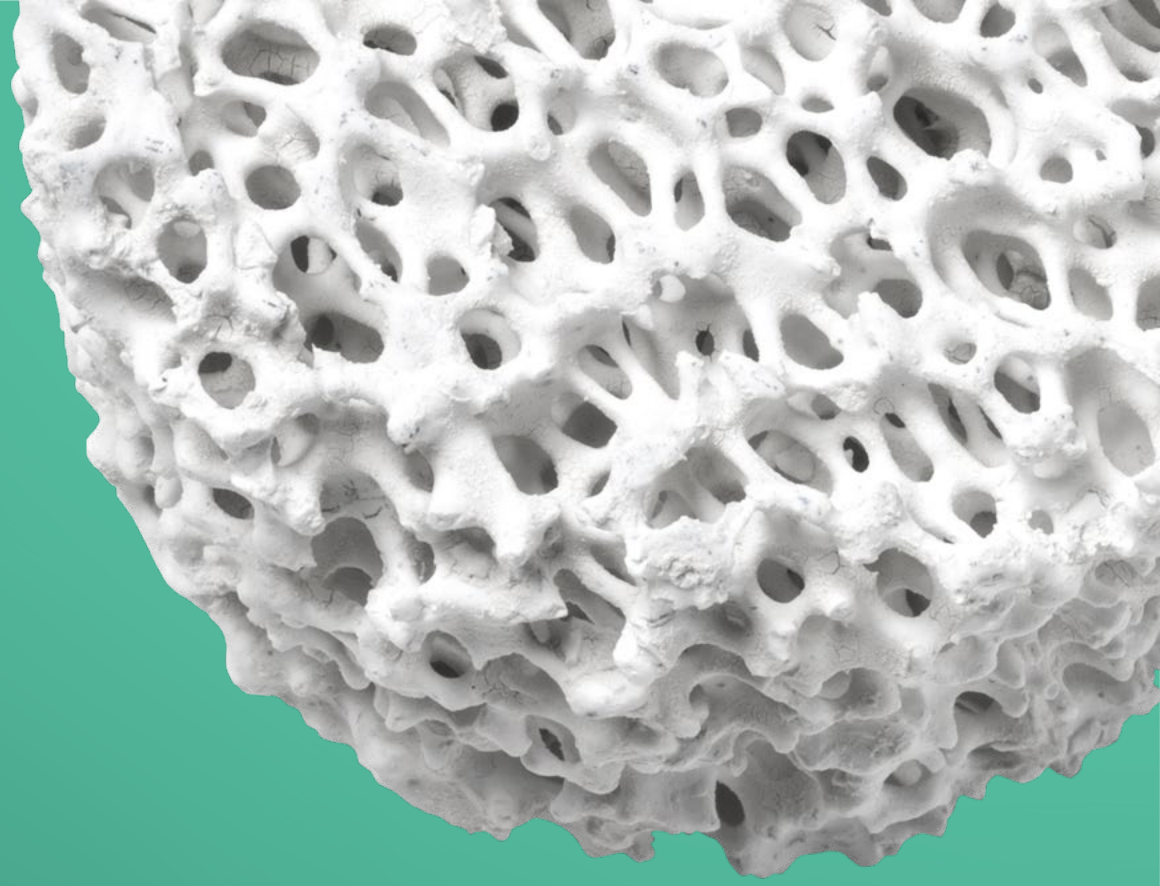
10,400+
Samples processed

4,600+
Installations

490+
Locations

35+
Years in refining industry

Managing the dP growth path in SRUs is critical.



SRUs are low-pressure systems. Even small increases in pressure drop due to fouling can restrict the throughput and cause premature shutdowns.

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Oh soot!

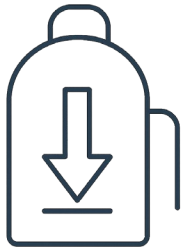
Incomplete Combustion

- Improper air to fuel ratio
- Variance in gas composition
- Burner issues
- Low temperature
- Insufficient mixing

Hydrocarbon Carryover

- BTX
- Light hydrocarbons & paraffins
- Lube oils from compressors

The Stakes



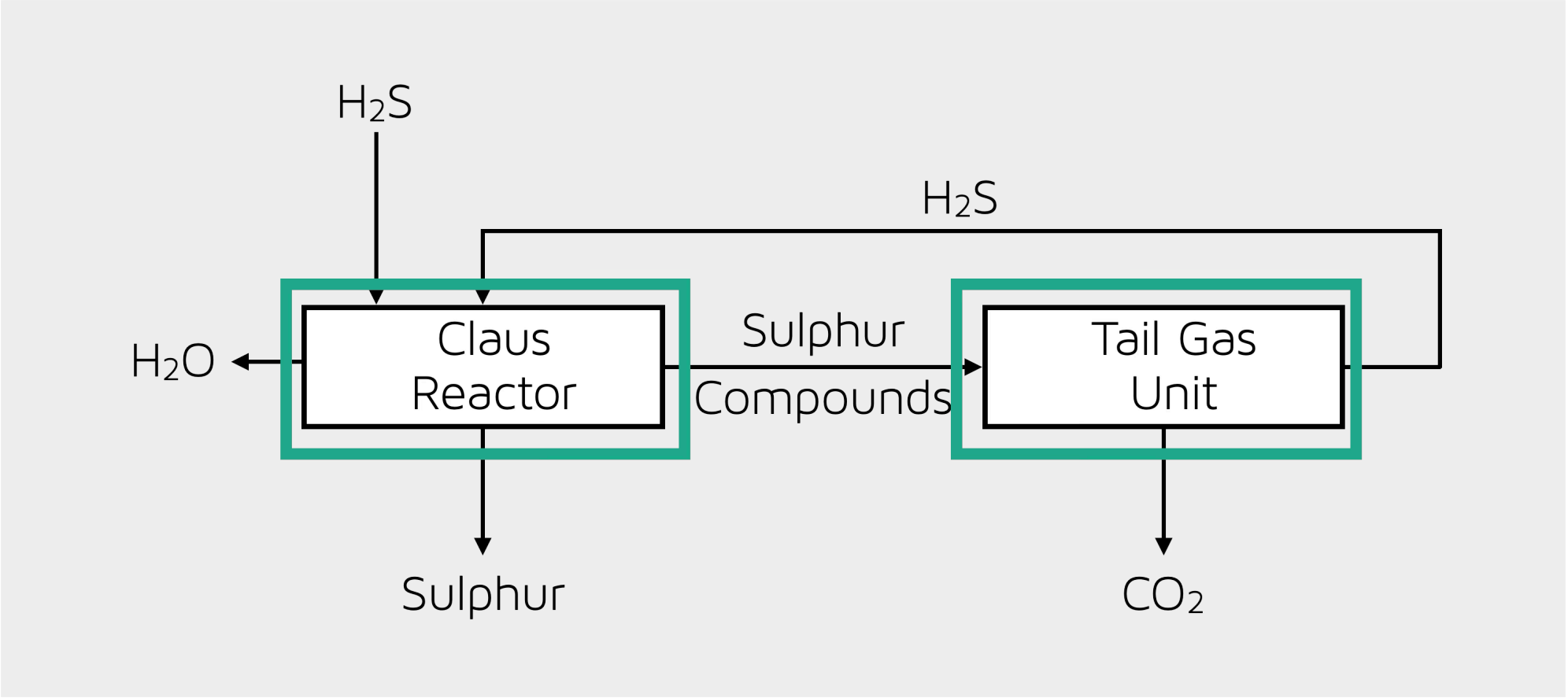
Lower Throughput

More Shutdowns

High Opportunity Cost

SRU Unit

Where is Crystaphase utilized?



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Claus Configuration

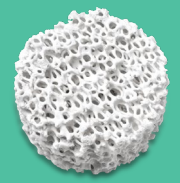
Where is Crystaphase utilized?

Mostly Bed 1. Sometimes subsequent beds when gas fired reheater.

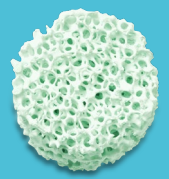
The Tools

Addressing constraints

Pressure Drop Mitigation



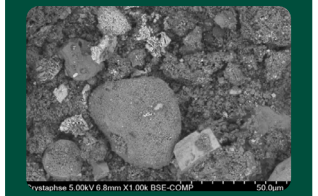
CatTrap® Technology



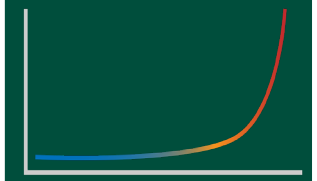
ActiPhase® SRU Technology

HeavyTrap® Technology

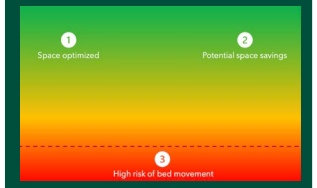
Space Optimization



Sample Analysis



Fouling Models



The Hold-Down Model

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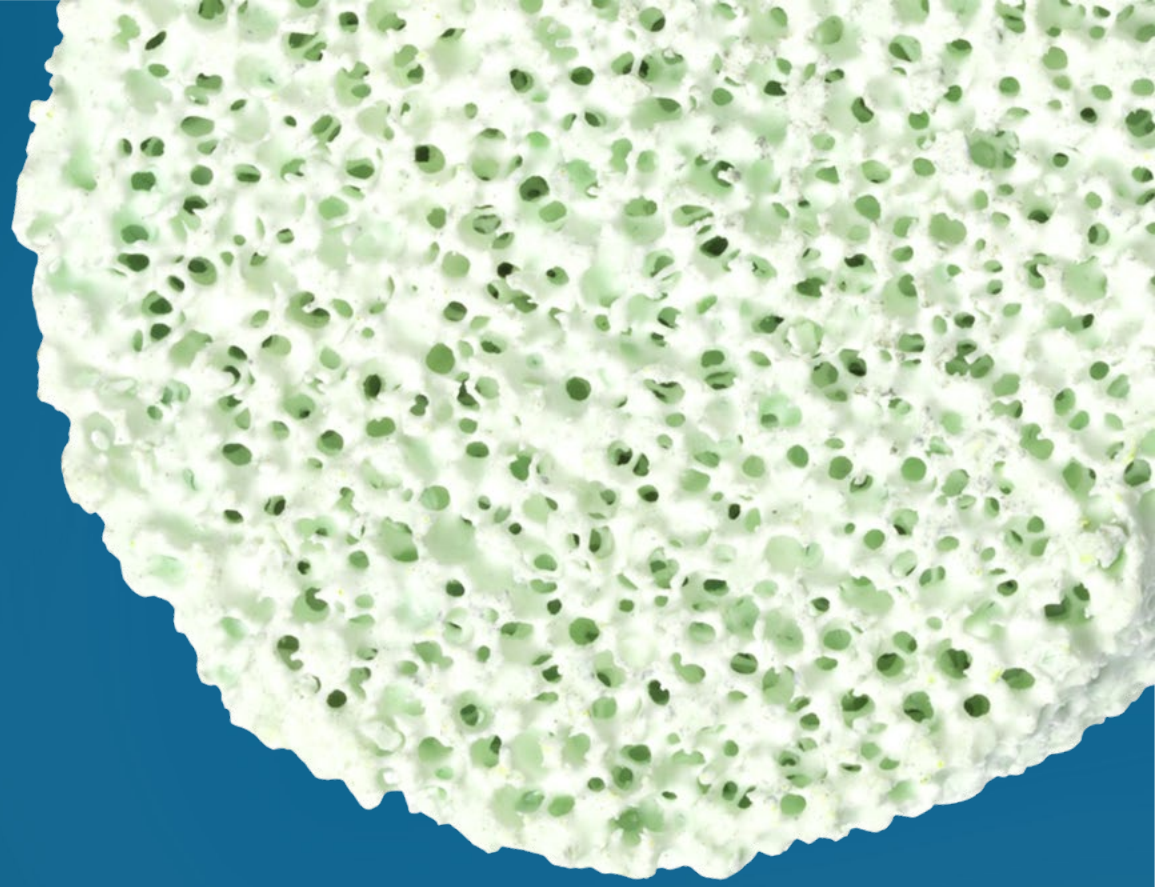
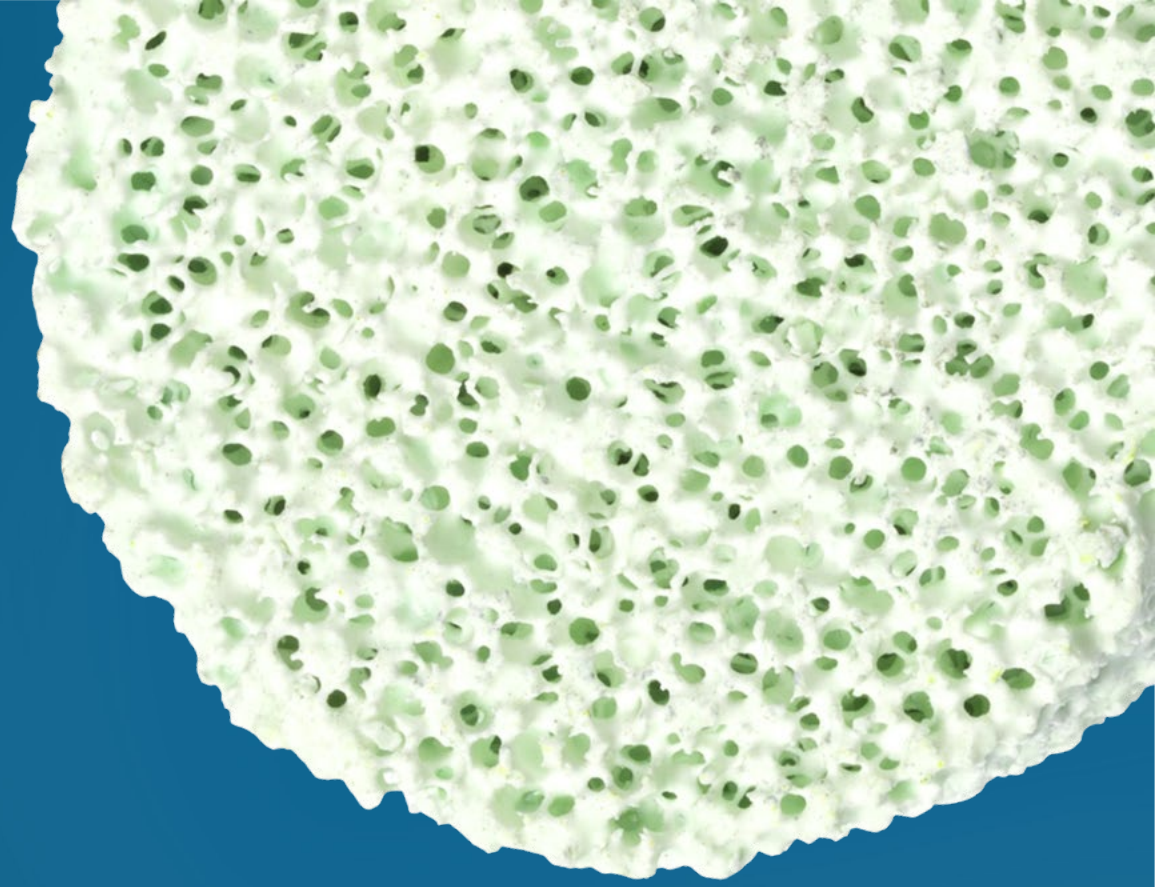
Minimizing pressure drop



Capturing soot with reticulated ceramic technologies

Crystaphase

Minimizing pressure drop



Capturing soot with reticulated ceramic technologies:

- CatTrap Technology
- ActiPhase SRU Technology
- HeavyTrap Technology

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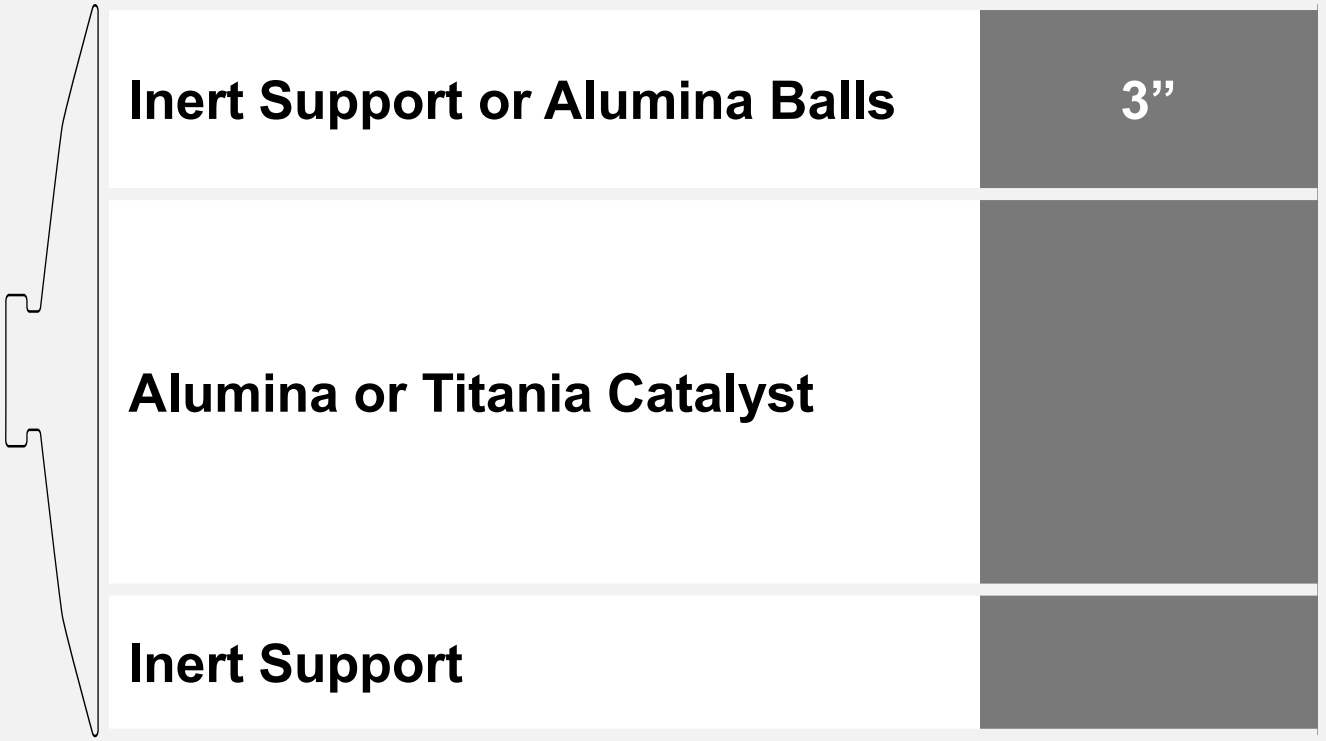
Typical Claus Reactor Design

Pressure drop control and activity



DRAWINGS NOT SO SCALE

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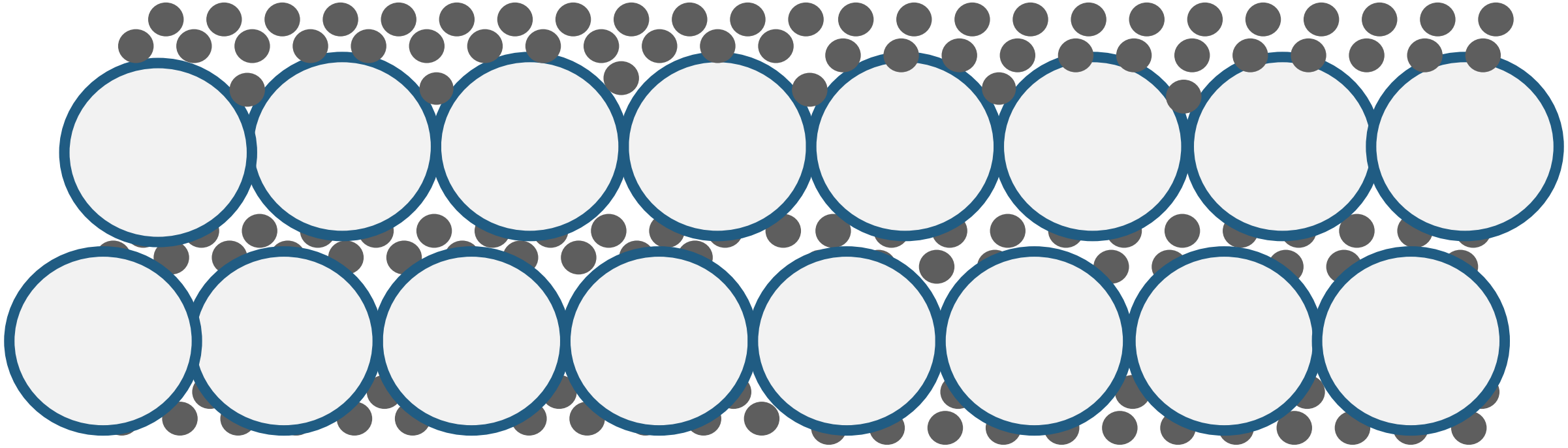
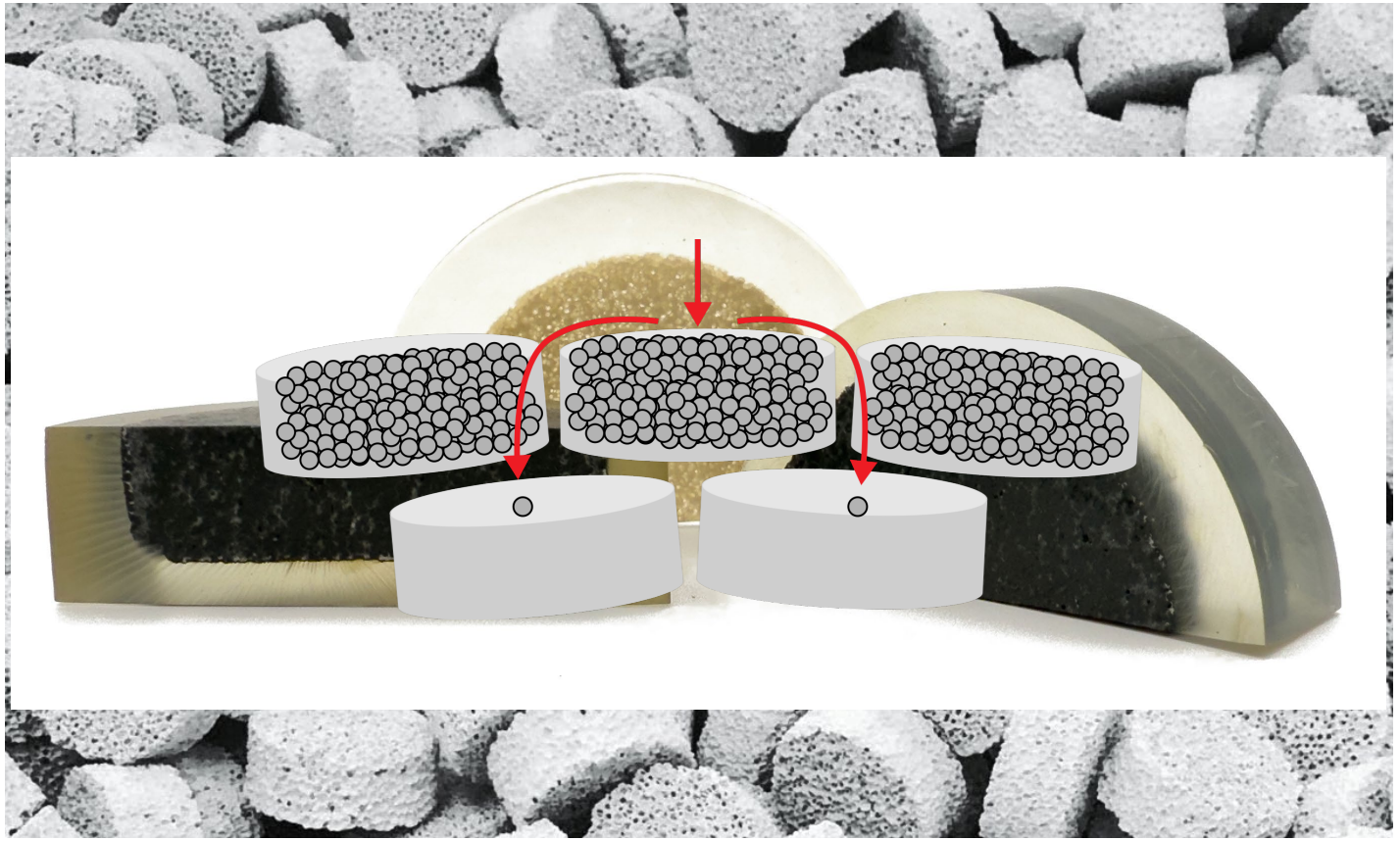


Spheres and catalyst

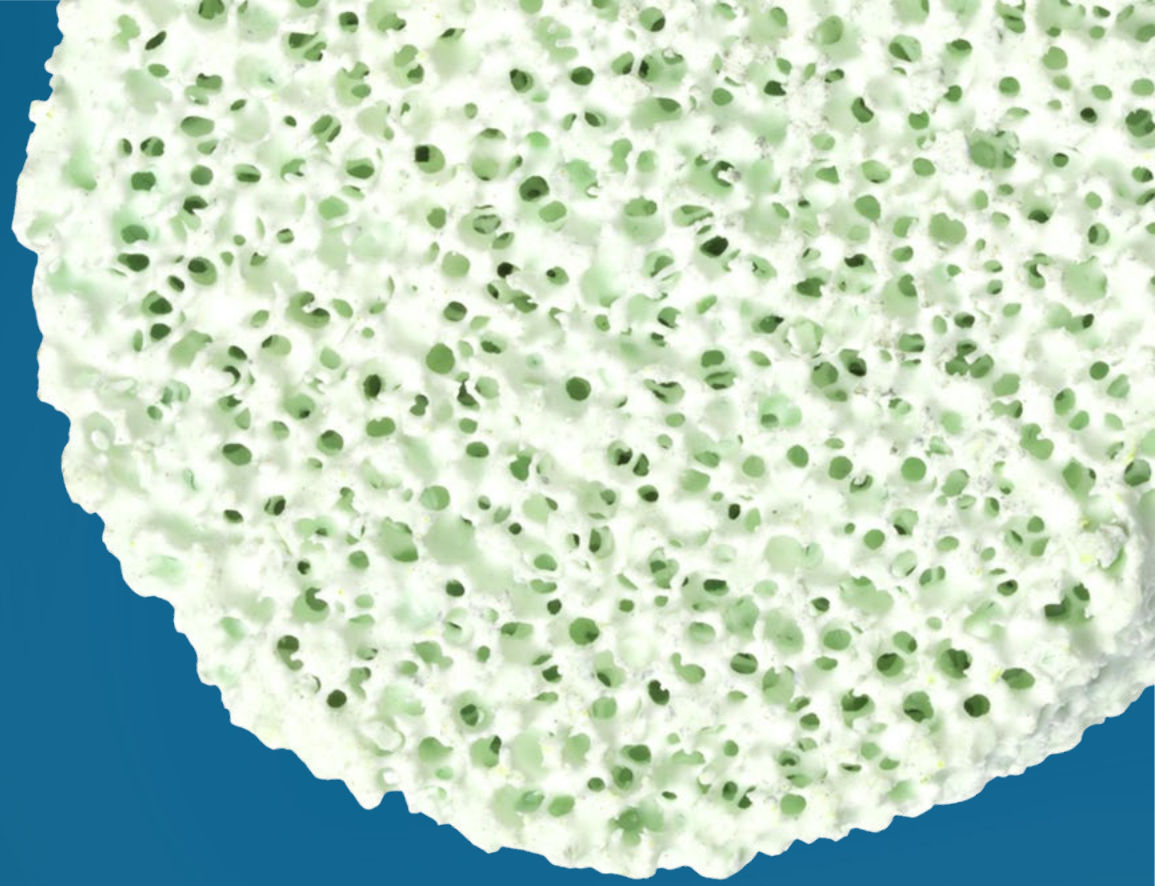
External filtration: crust layer formation leads to ΔP growth



Reticulated ceramics

Internal filtration: external bypass mitigates ΔP growth

Optimizing space



Evaluating feasibility of reducing head space using advanced model.

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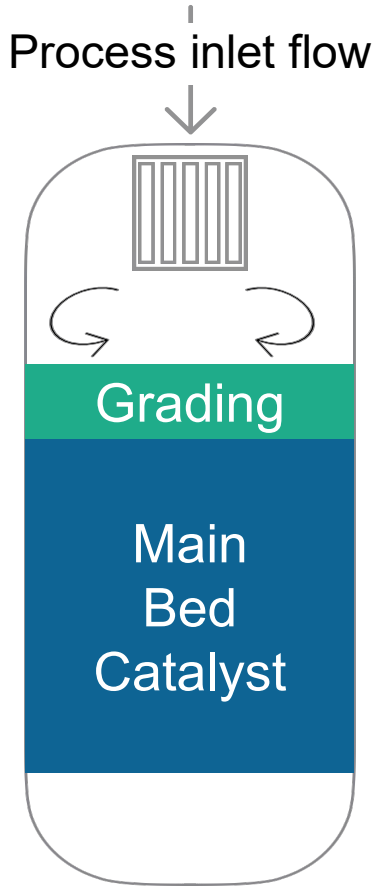
The Crystaphase Hold-Down Model

Assessing risk. Preventing movement.



V_h
Horizontal velocity being produced in the vessel

$V_{h,max}$
Horizontal velocity at which a given material moves

FoS
Factor of Safety: function of $V_{h,max}$ and V_h

The Crystaphase Hold-Down Model relies on information provided by sites as well as assumptions relating to diffuser design and the density of the top-bed materials. Changes to these inputs will change the results. The model calculates risk of bed movement and does not predict whether actual bed movement will occur. Actual bed movement depends on a variety of operational factors that Crystaphase cannot control and Crystaphase cannot guarantee no bed movement will occur.

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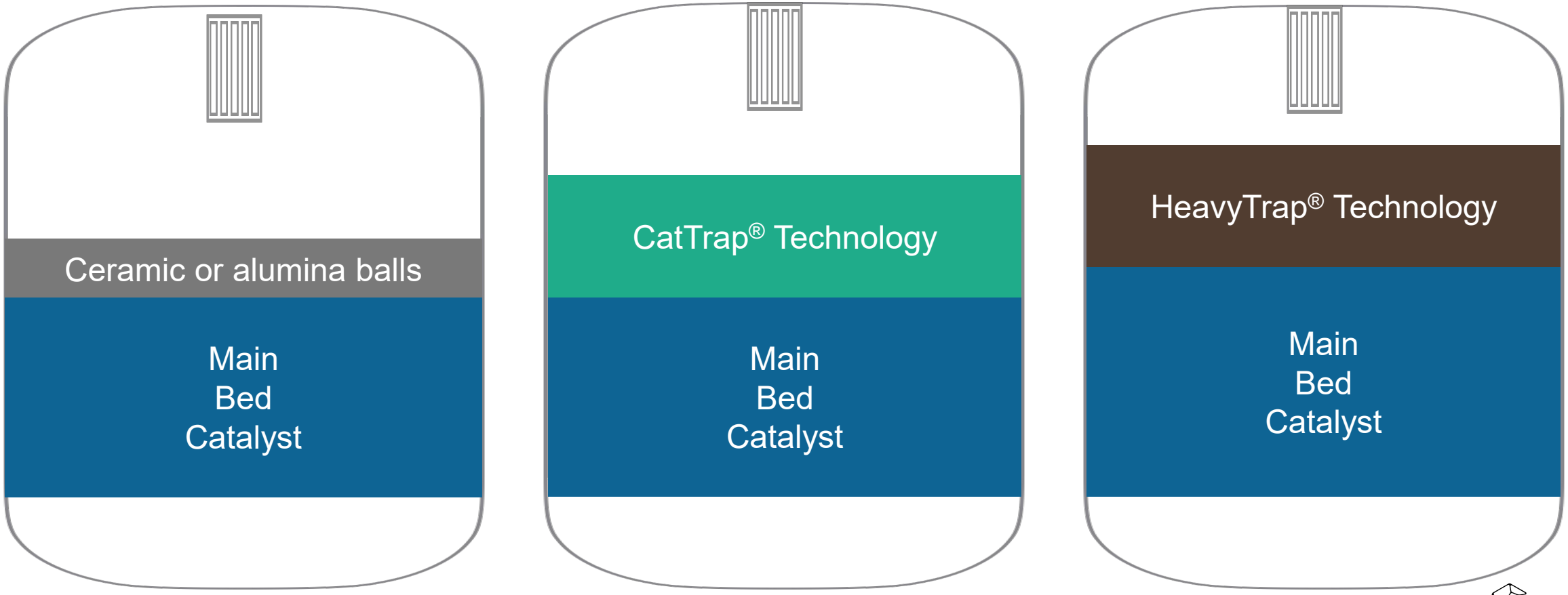
Reducing the head space

Optimizing for dP control & activity



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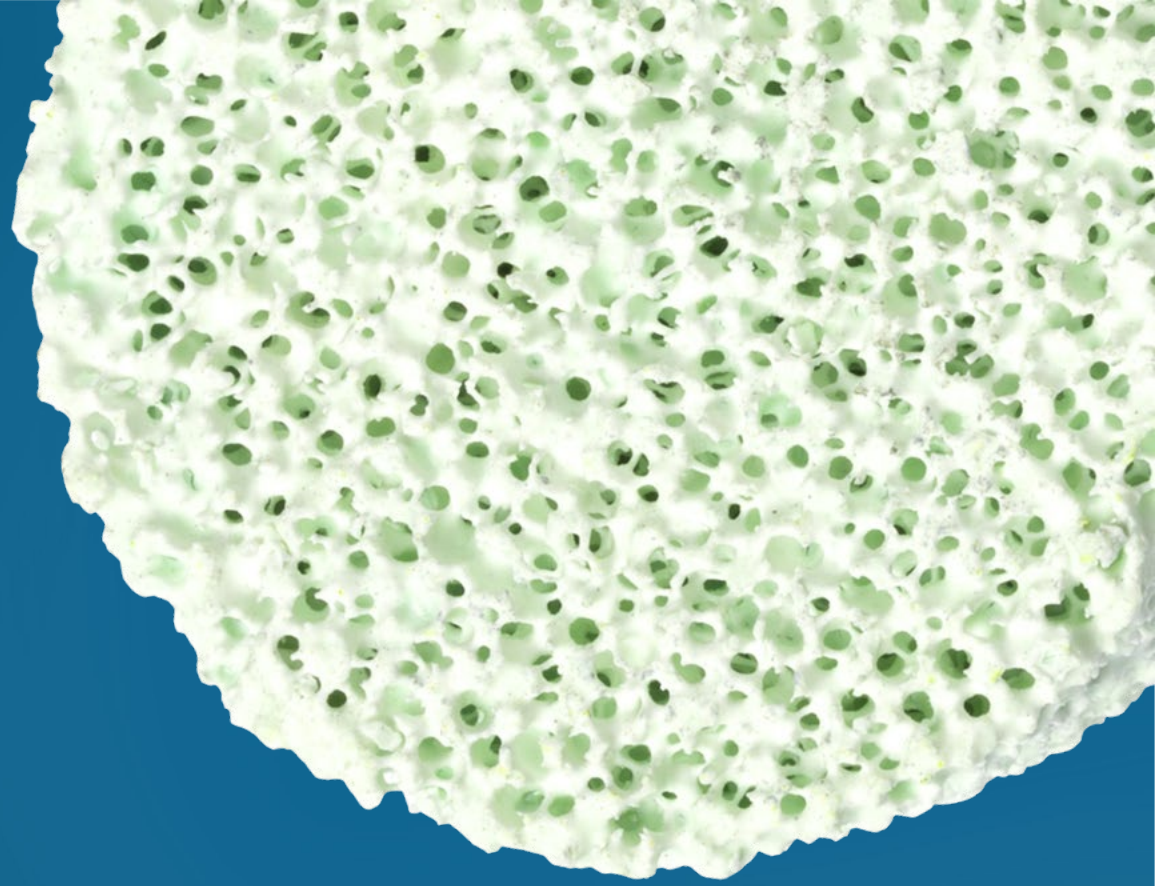
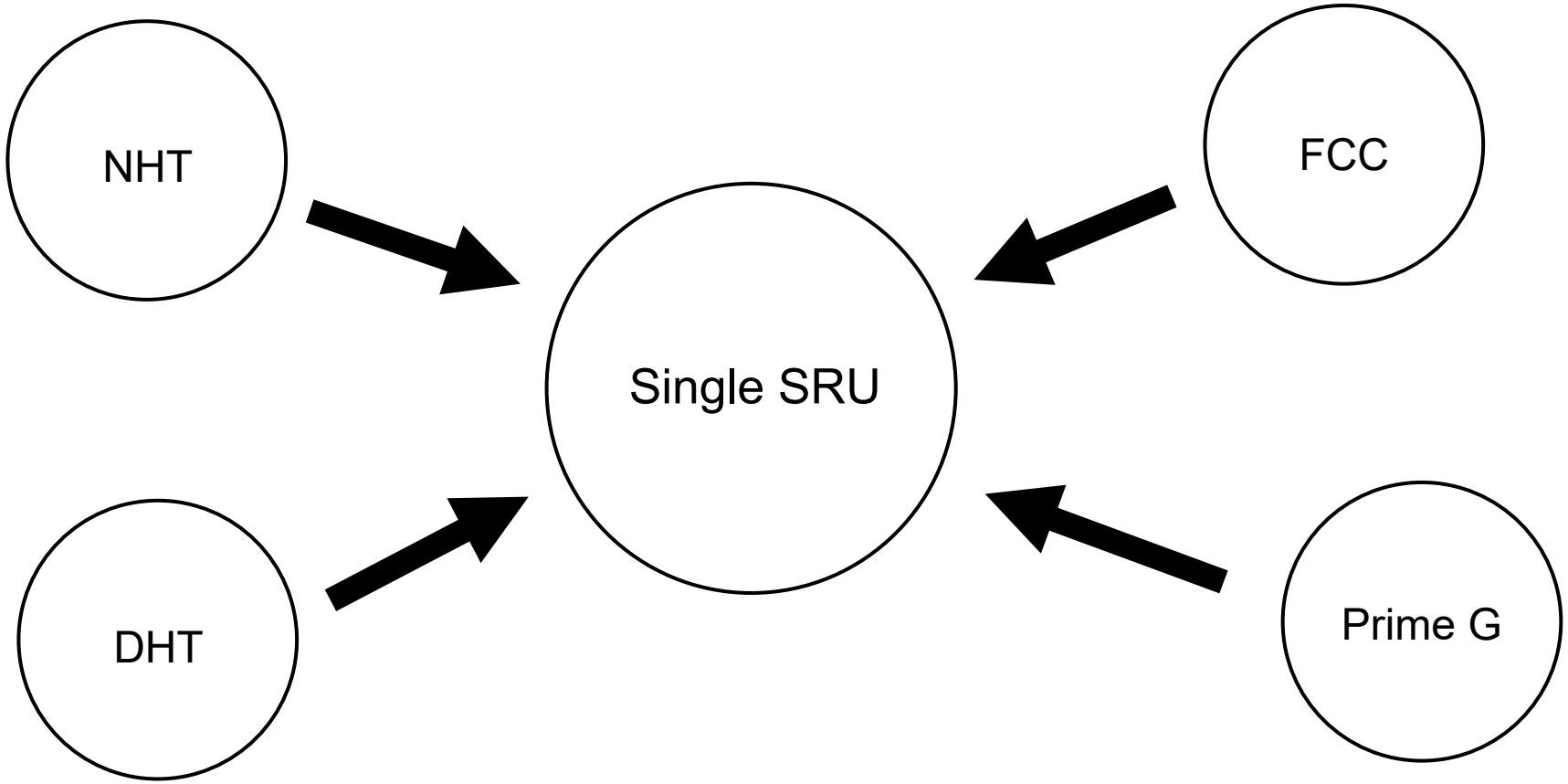
Using the tools



Crystaphase

Reducing the head space

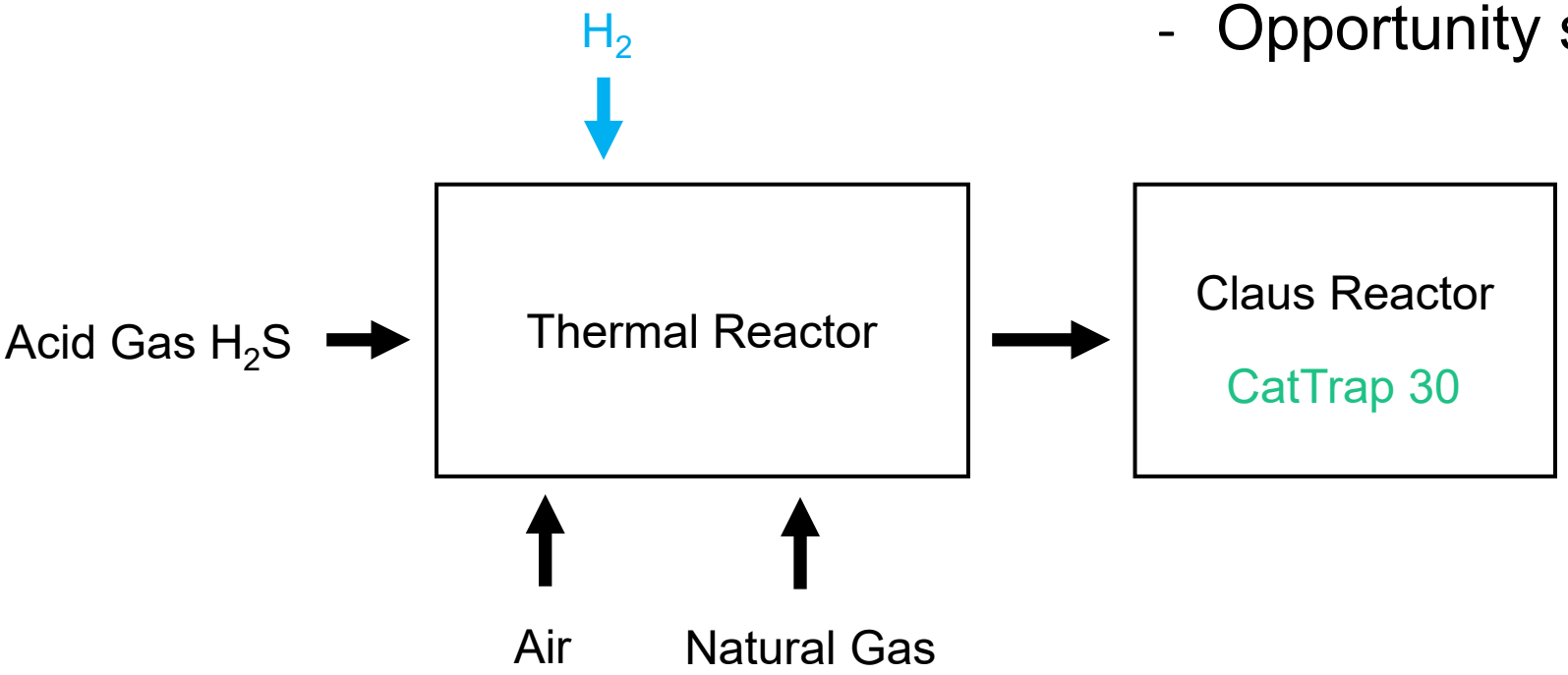
Optimizing for dP control & activity



Small US refinery

Using tools to address dP problem

- 3 years into the cycle, refinery-wide upset. Lost hydrogen
- Co-firing with natural gas for two weeks
- dP remained stable
- Opportunity shutdown one year later



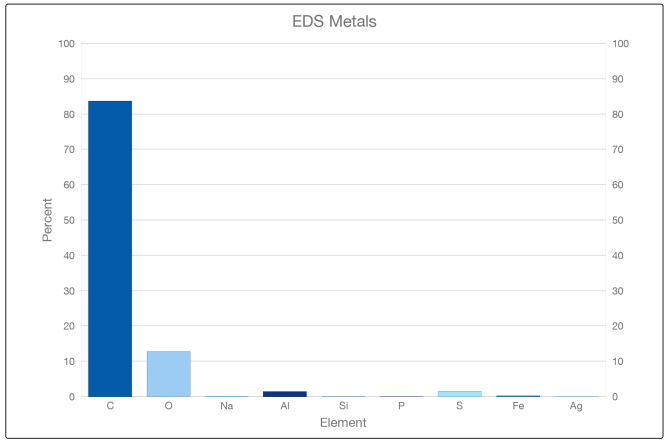
Learning through sample analysis of SRUs

More tools in the toolbox

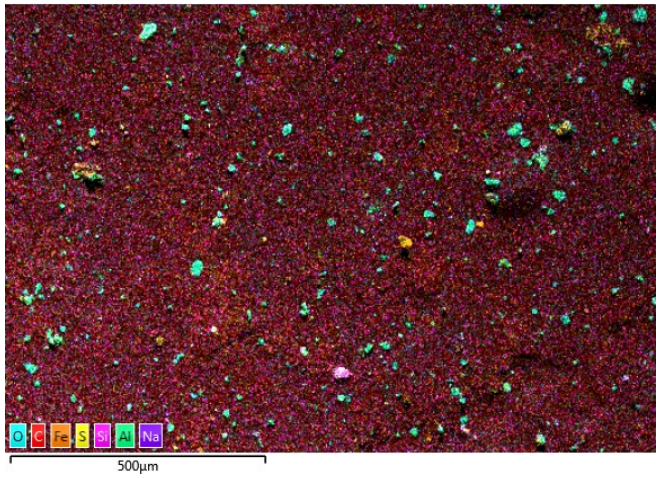
Volume Utilization

35%

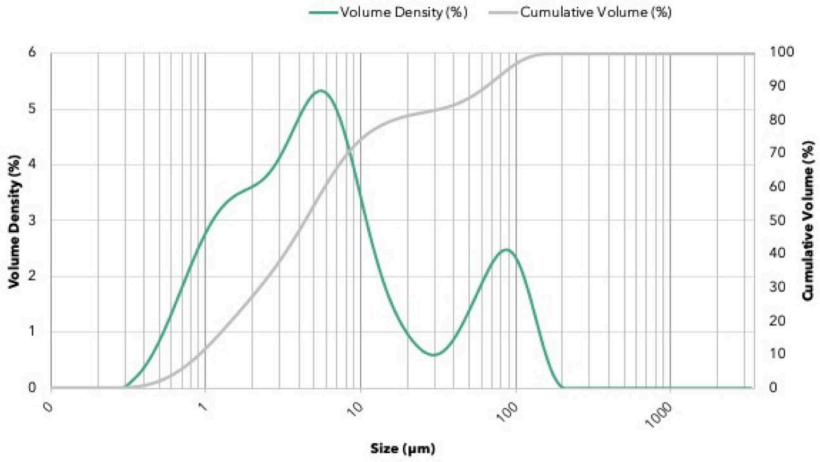
EDS Analysis



SEM Imaging



Particle Size Distribution



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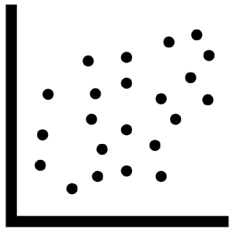
CatTrap held foulant equivalent to a

1/2-inch crust layer

with no noticeable rise in pressure drop.

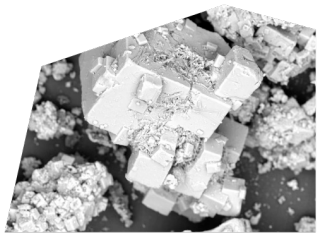

“There is great satisfaction in building tools for other people to use.”
-Freeman Dyson

How Crystaphase supports refiners



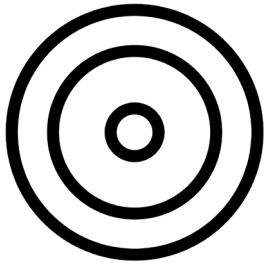
Learn

Understanding past performance / experience and obtain samples



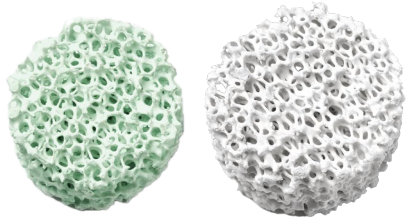
Analyze

In-depth foulant analysis, distribution analysis, and timely reporting



Goal Set

Target setting for run-length, feed types, and foulant load



Design

Quantitative design of Crystaphase systems to meet cycle goals

Monitor

Track unit performance, evaluate trends, and predict constraints