



Granulation plant modelling and design using SysCAD

CRU Phosphates 2022

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HATCH



Who is Hatch?



Roots over

65
YEARS



Experience in

150

Countries



65 Offices



Over

9,000

Great People

Project Delivery – Advisory – Digital – Operational Services

HATCH



Metals



Bringing the world's resources to market

Base Metals



Copper



Ferroalloys



Gold



Lithium & Rare Earths



Nickel



Precious Gems & Metals



Uranium



Bulk Metals



Alumina



Aluminum



Ironmaking



Magnesium



Steelmaking



Minerals



Coal



Iron Ore



Diamonds



Phosphates



Potash



Titanium Dioxide





Hatch Phosphate Engineers Have over a Century of Phosphate Industry Experience

- + Phosphate Mining and Beneficiation
- + Rock Receiving, Grinding and Storage
- + Sulfuric Acid
- + Phosphoric Acid
- + Ammoniated Phosphate Fertilizers
- + Ammonia and Related Processes
- + Water, Steam and Power Balances
- + Phosphate Chemical Plant Utilities
- + Equipment Specification and Design
- + Material Handling



+ Business Case



Granulation Plant Projects



The existing plant is old



The plant configuration is unique



The plant almost always has been modified



Client has a sense of urgency to expedite project implementation



Inaccurate design drawings and documentation



Mosaic New Wales DAP2 Granulation Plant MicroEssentials Conversion

+ Historical Approach & Challenges



Limitations



Time Intensive disconnected hand calculations

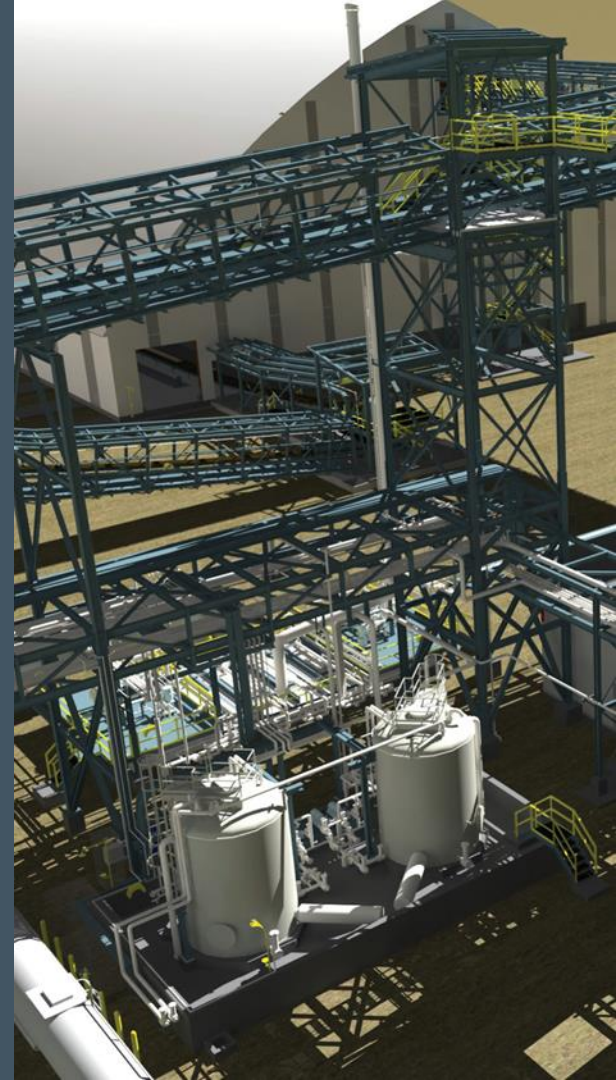


MICROSOFT EXCEL

Evolution of software and Microsoft Excel



Limitations, such as circular references, lack of chemical or thermodynamic databases, etc.



+ The Need for More Rigor



SysCAD Introduction



Thermodynamic Data



Chemical Data



Chemical Reactions



Speciation of Compounds



Iteration (number and speed)



Hatch Project Lifecycle



+ Power & Flexibility of SysCAD



SysCAD Introduction

- ▶ Age of the plant is irrelevant
- ▶ Plant configuration is irrelevant
- ▶ Availability and accuracy of design documentation is irrelevant
- ▶ SSP, TSP, MAP, DAP, micronutrient enhanced products, or any NPK fertilizer
- ▶ Iteration (number and speed)

Key Benefit

Overall, Hatch's tool significantly reduces the time required to produce a converged, comprehensive, and accurate heat and material balance for a granulation plant when compared to using other tools and software.



+ SysCAD Granulation Plant Model

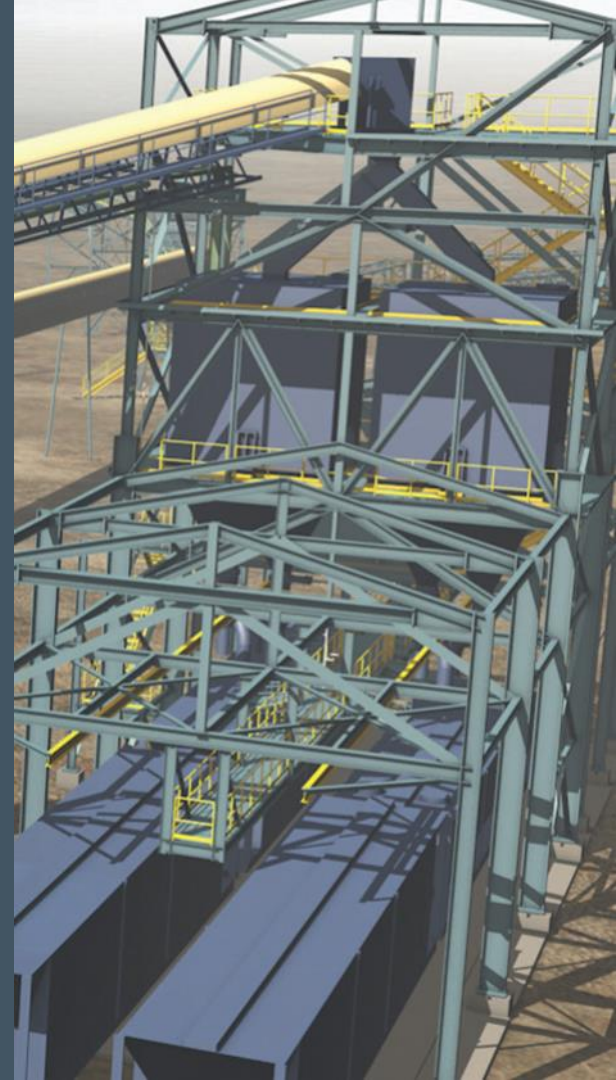


Key Benefits

- ▶ Powerful, Predictive and insightful information that drives informed decision-making
- ▶ Improved plant operation performance on plant optimization and debottlenecking studies
- ▶ Cost saving; both CAPEX and OPEX
- ▶ More efficient and knowledgeable operators if used as a training aid for production personnel
- ▶ Iteration (number and speed)

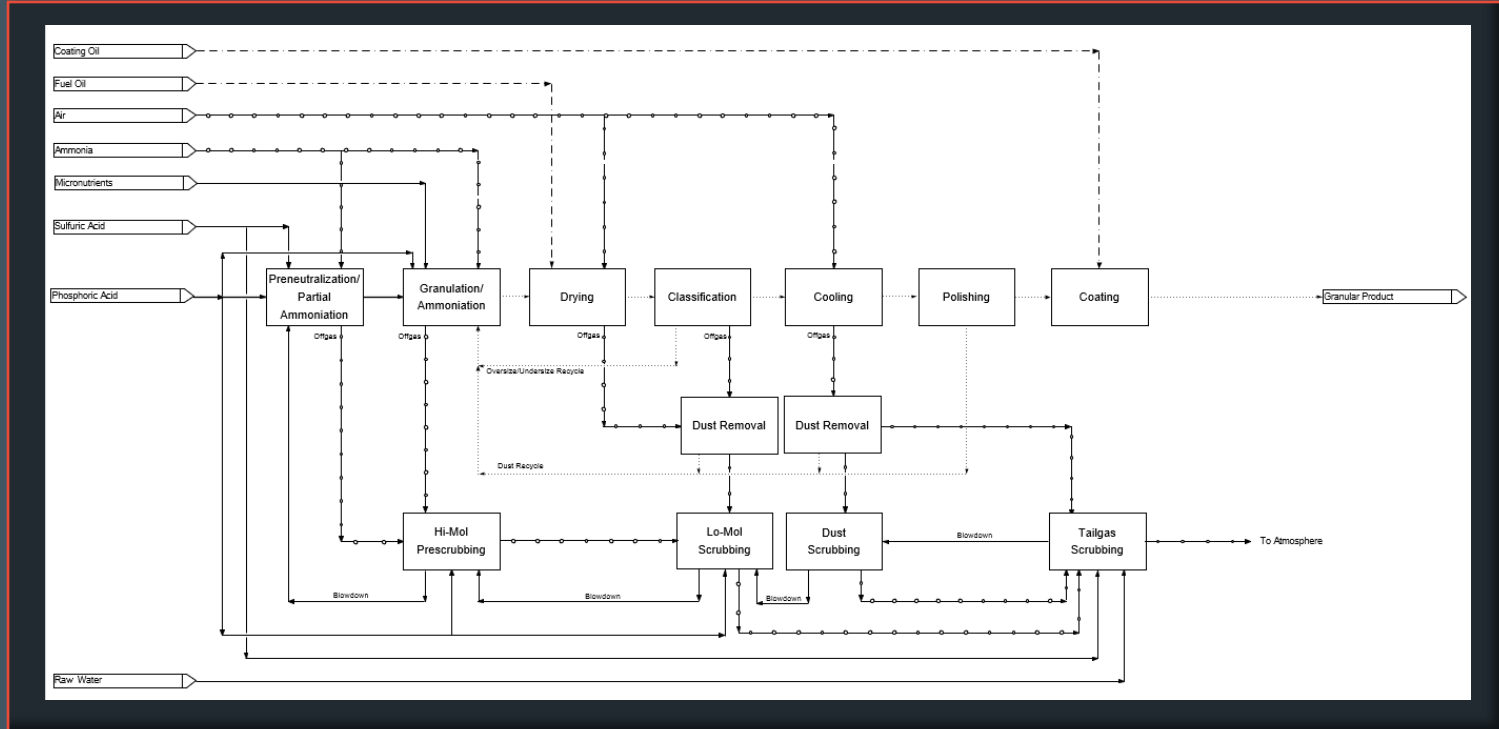
Types of Granulation Projects

- | | |
|--|--------------------------------------|
| Debottlenecking studies | Unit operation modification projects |
| Capacity increase and plant optimization studies | Plant capability studies |
| Micronutrient enhances fertilizer plant upgrades | Scrubber revamps |





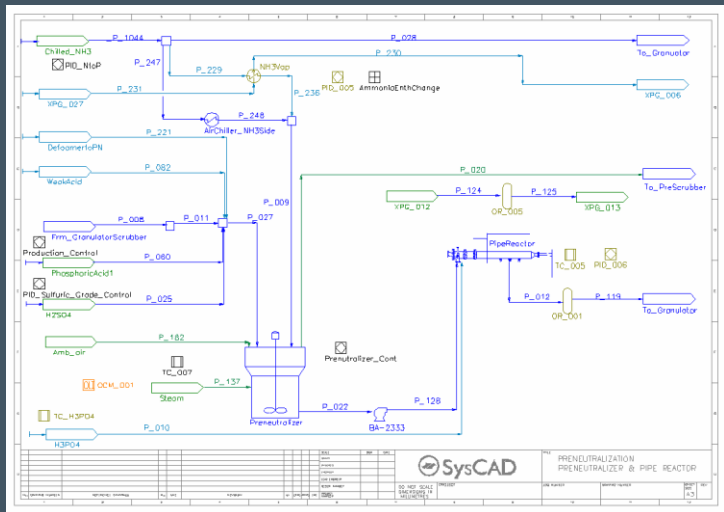
Block Flow Diagram



+ Granulation Graphical Model Interface

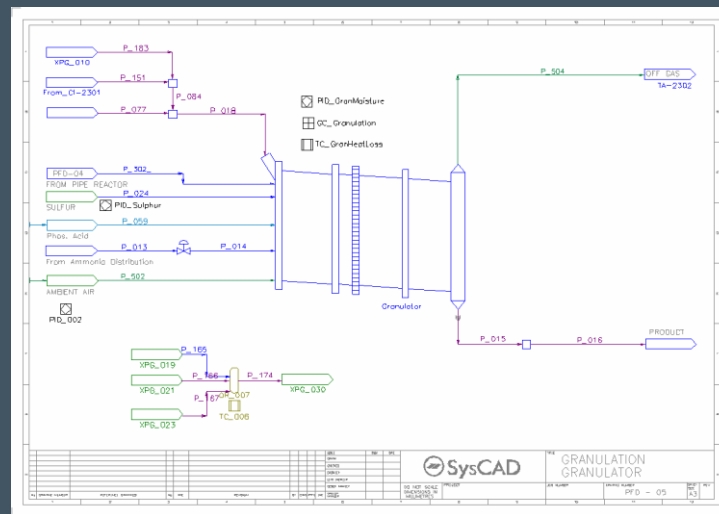


Flowsheet Graphic Examples

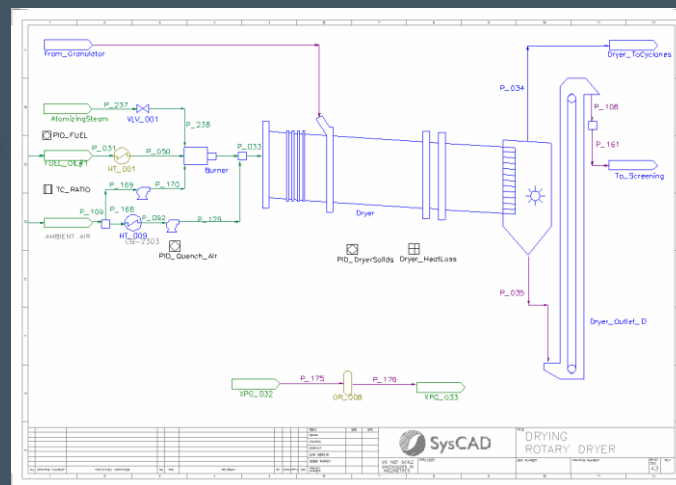


1

2



3



+ Chemical Granulation Model



“Under the Hood”



Process Chemistry



Process Design Basis & Criteria



Pure Component species
thermodynamic database

Species: SulphuricAcid

Long Name: SulphuricAcid

Short Name: H2SO4

Component: H2SO4

Definition: H2S1O4

Phase: Liquid

Individual Phase: aq

Properties:

H25 (J/mol) Dilution: H2O(l): TSpline(1, -813989; 0.844827586, -841791; 0.784, -849688; 0.731343284, -855440; 0.681343284, -861000)

S25 (J/mol.K) 1 Equations. Total Range 10C to 200C

Cp (J/mol.K) Const(88.0) : Range(C, 10, 200)

Density (kg/m³) Correction: H2O(l): Poly_MF(1, 0.5394, 1.4827, -4.6384, 7.2207, -3.7737) : Limit(1, 1830.5, Off)

PhaseChange Curve1 = MassFraction: H2O(l): H2SO4(l) : 0.983

BPE (C) H2O(l): VantHoffConst(2.8)

Ka/b Ka(1000, 0.0102)

Viscosity (Ns/m²)

Thermal Cond (W/m.K)

Administration:

Warning:

Reference: NBS Tables(H2S and Ka)

Reviewed: SysCAD Modified: Peter M 14:59:48 05/08/2016

Species: Add Copy Delete Update Undo Cleanup Done

+ Chemical Granulation Model



Convergence



Model runs in a sequential modular approach.



Recycle streams are torn and compose tear blocks that are converged by using either direct substitution or adaptive direct substitution depending on how settings are configured.



Controllers react and change process variables as model is run.



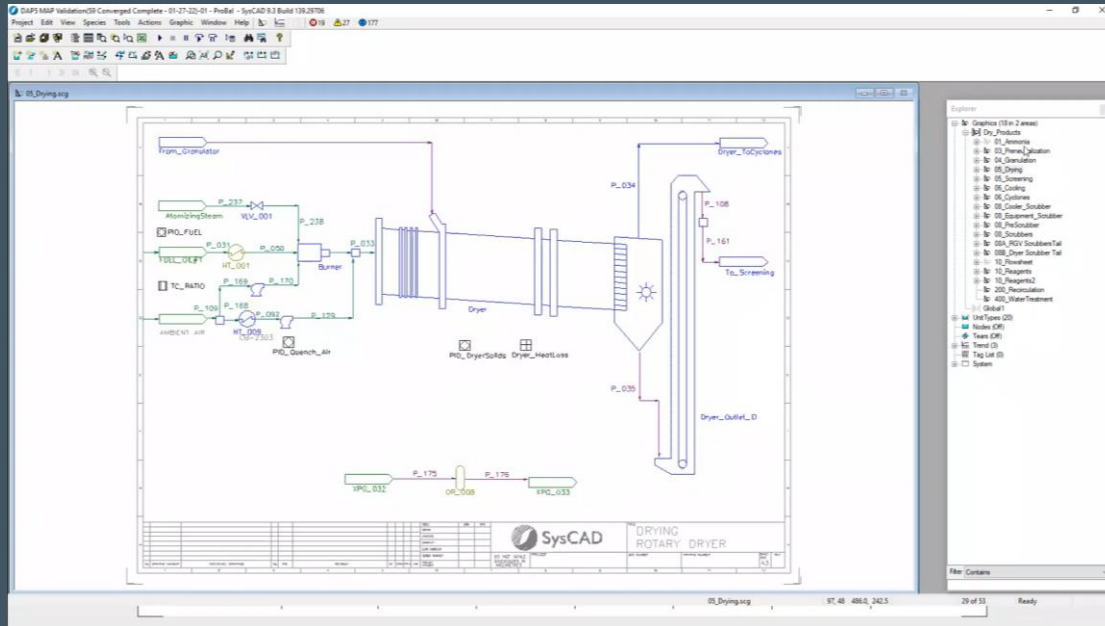
+ Chemical Granulation Model



Model Run Demo



830 iterations in 30 seconds!





Validation effort after building the model



Dryer Burner

- ▶ Burner modeled as Free Energy Minimization reactor.
- ▶ Combustion air set to an Air to Fuel Ratio and quench air controlled by a PID loop to control dryer inlet gas temperatures.
- ▶ Model solved for temperature profile across drier and product moisture content.
- ▶ Historical MEB and fan curves of previous project confirms unit operation performance is valid.



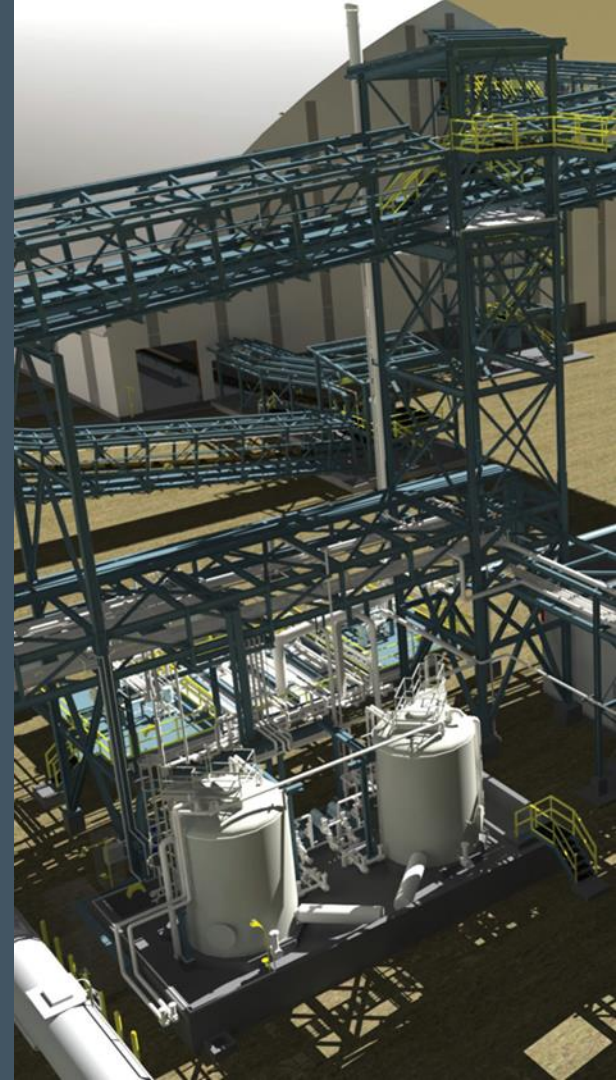


Validation examples during building our model



Water Balance

- ▶ Key Model Moisture Parameters to evaluate freshwater make up is granulator moisture and reactor slurry SG.
- ▶ Model controls freshwater make up by using a feedback controller varying freshwater addition to the Tailgas seal tank to meet a target reactor slurry SG.
- ▶ Water and air balance is highly interdependent.



Thank you.

For more information,
please visit www.hatch.com

