Cycad process

Design and simulation of metallurgical operations

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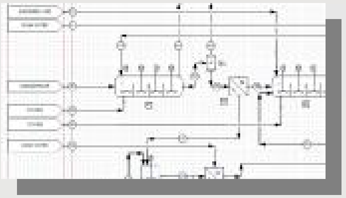
CM Solutions (Pty) Ltd

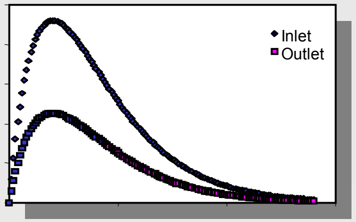
Simulation software for the metallurgical industry

This talk is divided into four topics:

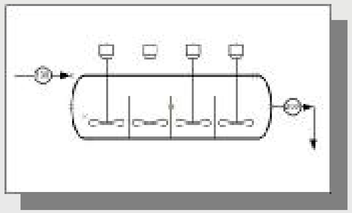


Drawing Environment and Outputs

Mass and Energy Balances

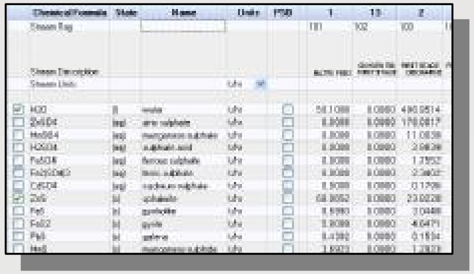


Particle Size Distributions and Population Balances

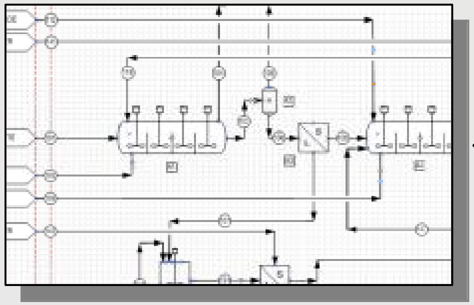


Dynamic Simulation

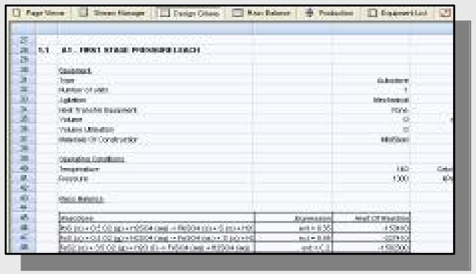
Cycad Process combines process simulation with sophisticated drawing capabilities to produce detailed reports



Process Simulator

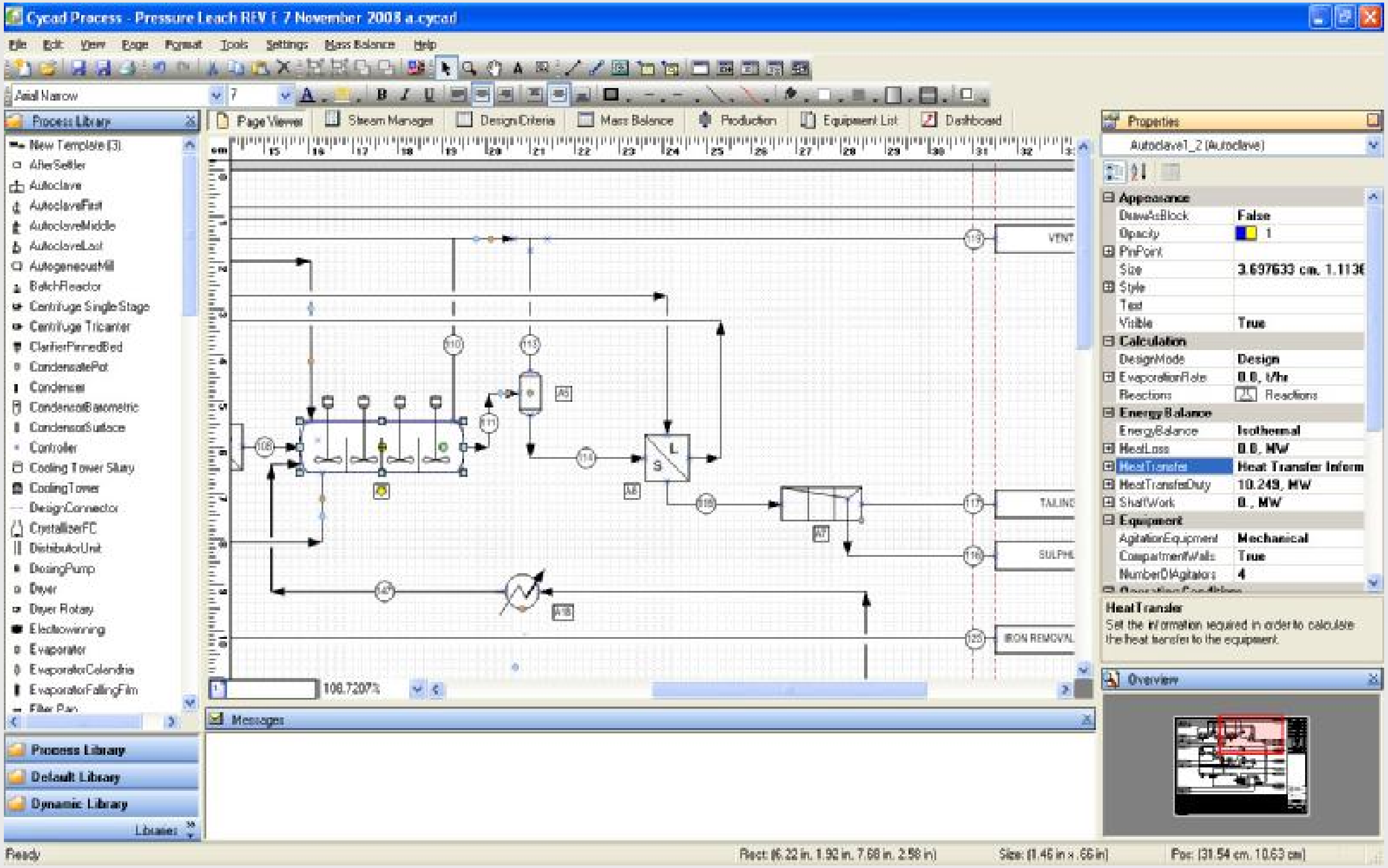


Engineering-quality Drawing



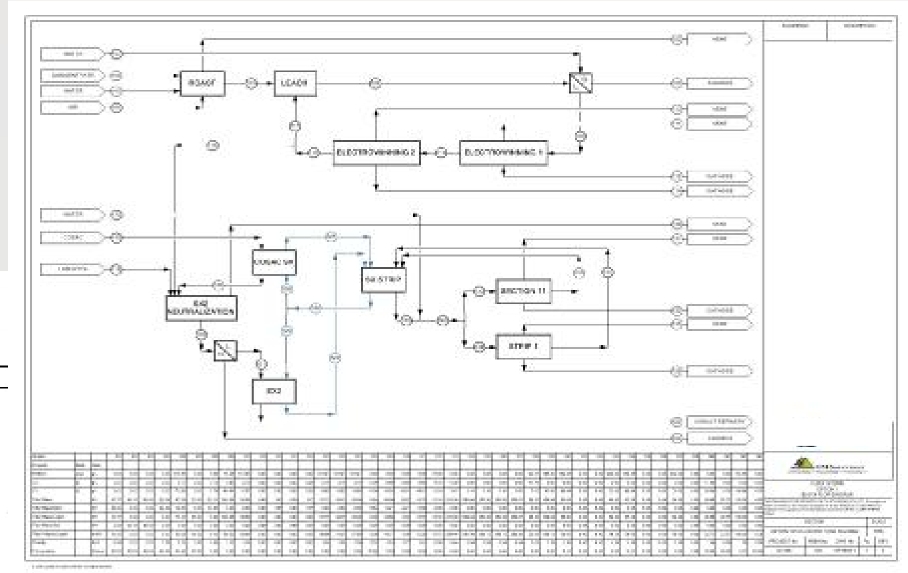
Detailed Reporting

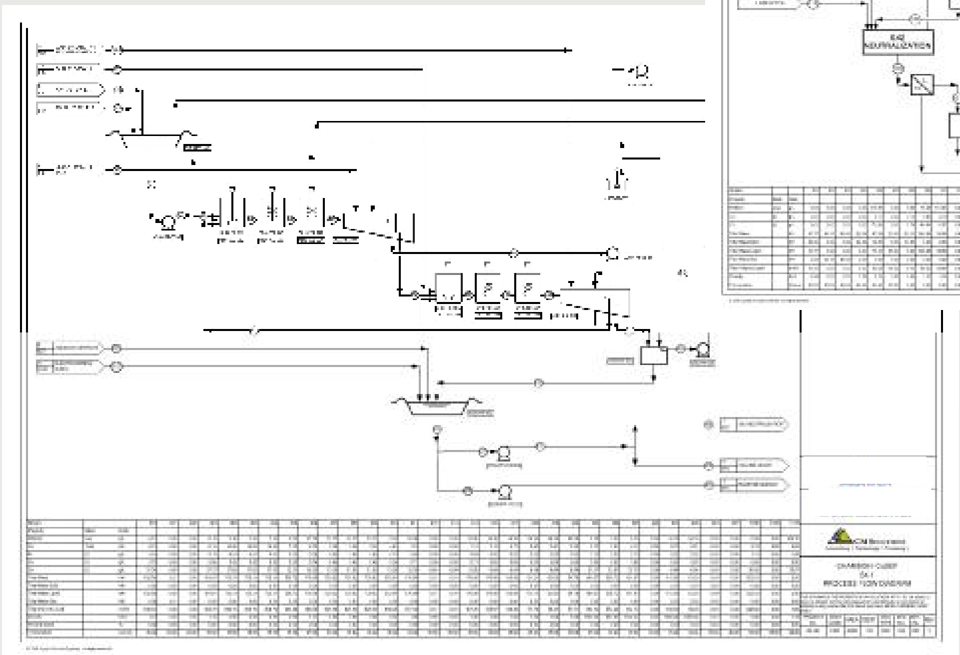
Cycad Process’ drawing interface follows familiar standards for graphical user interfaces



Cycad Process produces engineering-quality Block Flow Diagrams and Process Flow Diagrams

Block Flow Diagrams





Process Flow Diagrams

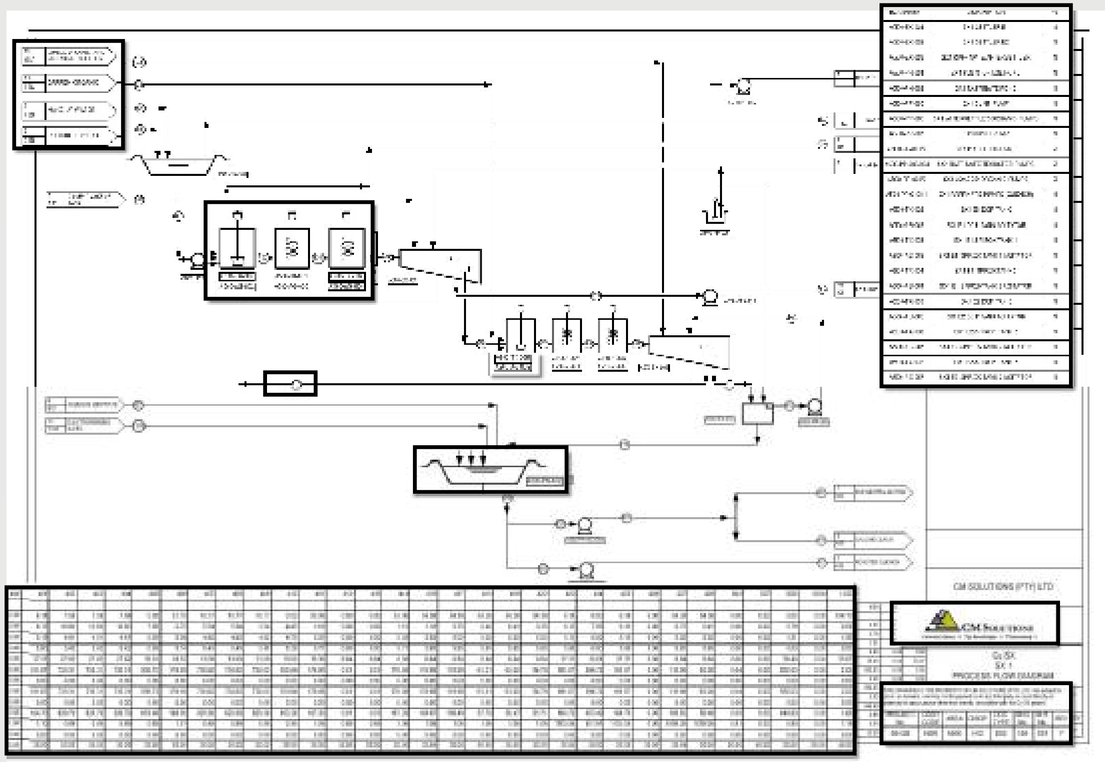
The main features of the Process Flow Diagrams drawn using Cycad Process are shown

Intelligent Flags

Detailed Equipment Options

Flexible Stream Tags

Mass balance Table



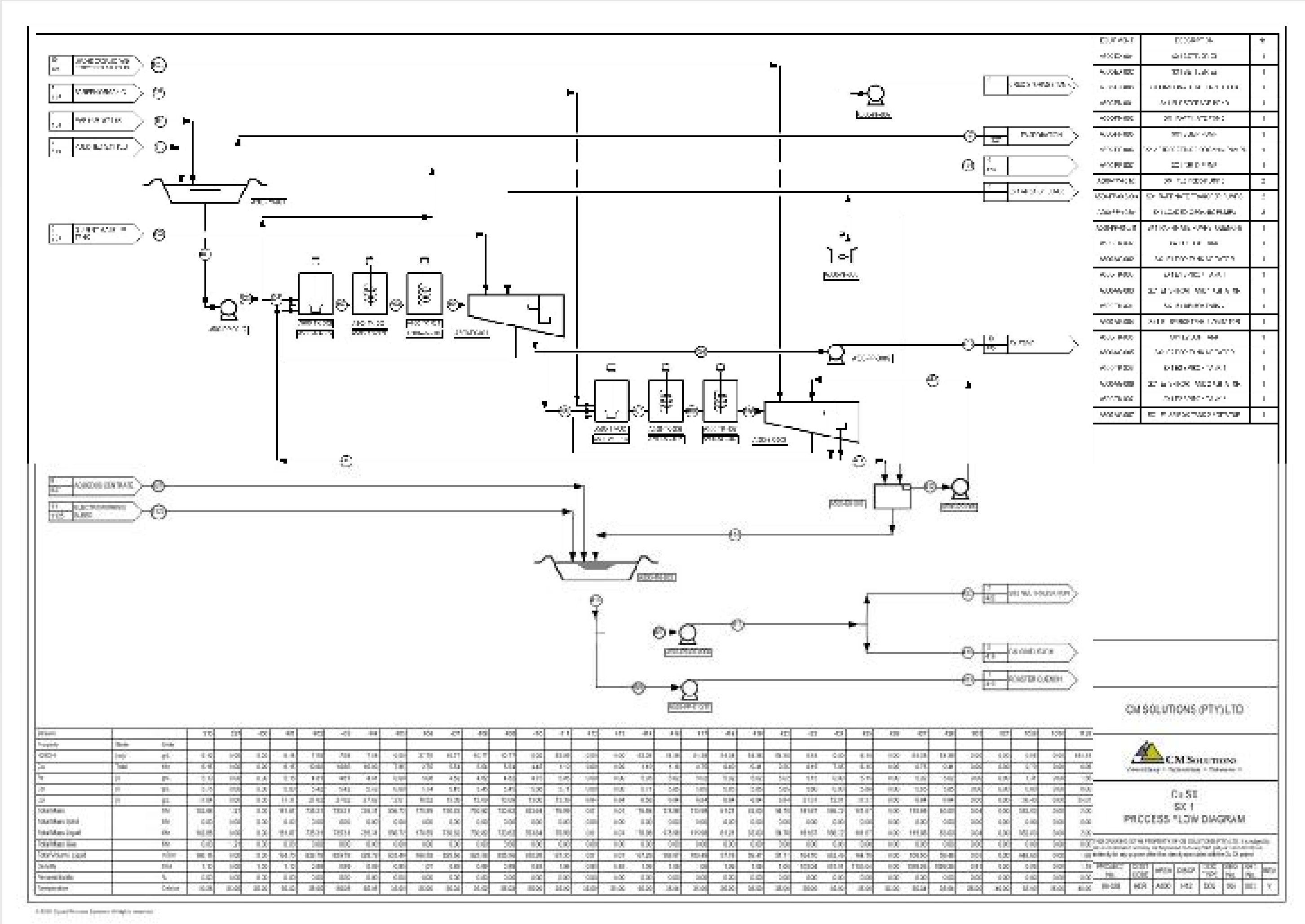
Equipment List

Equipment Tags, Including Agitators

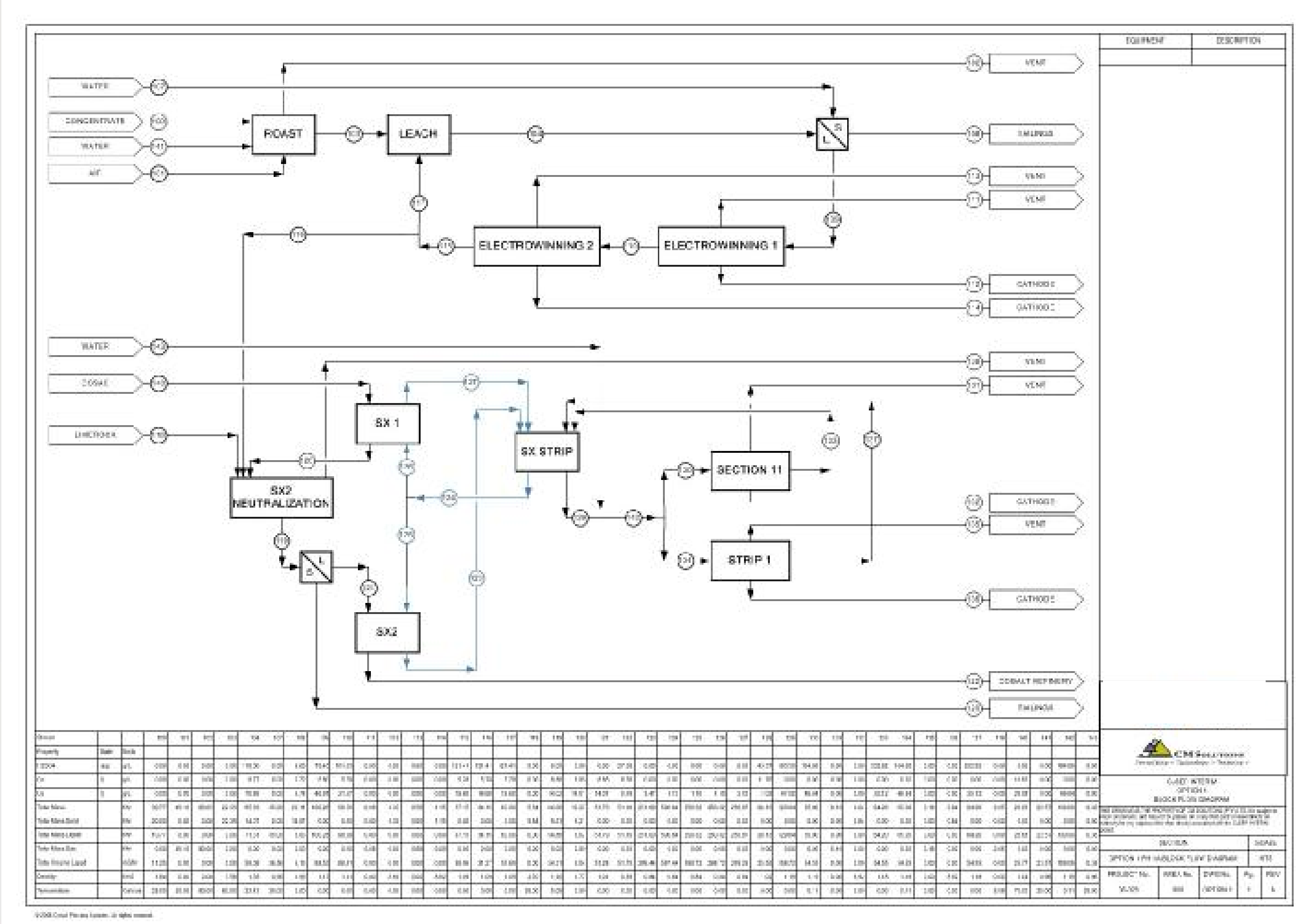
Company Logo

Drawing Details

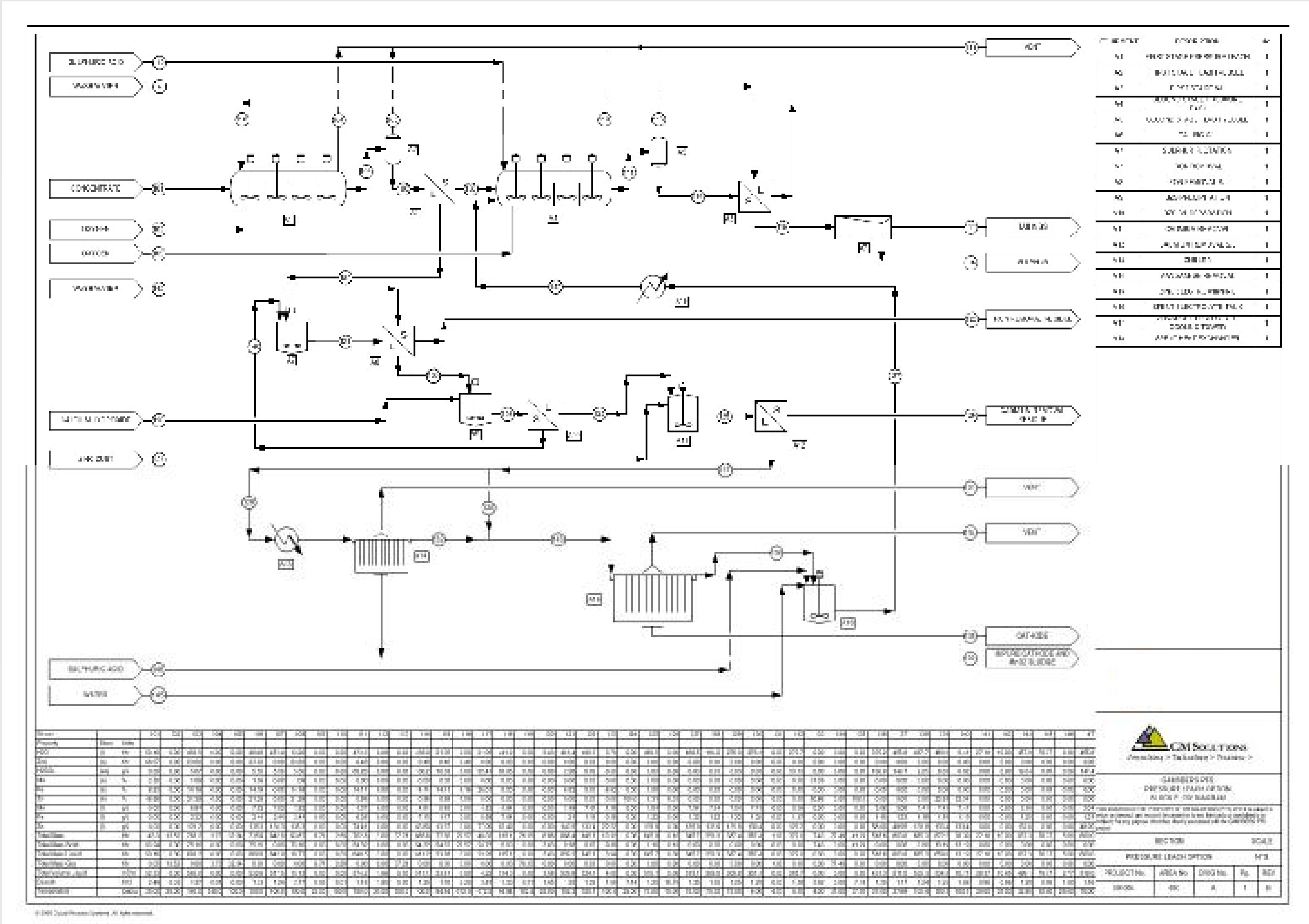
An example of a typical Process Flow Diagrams produced using Cycad Process



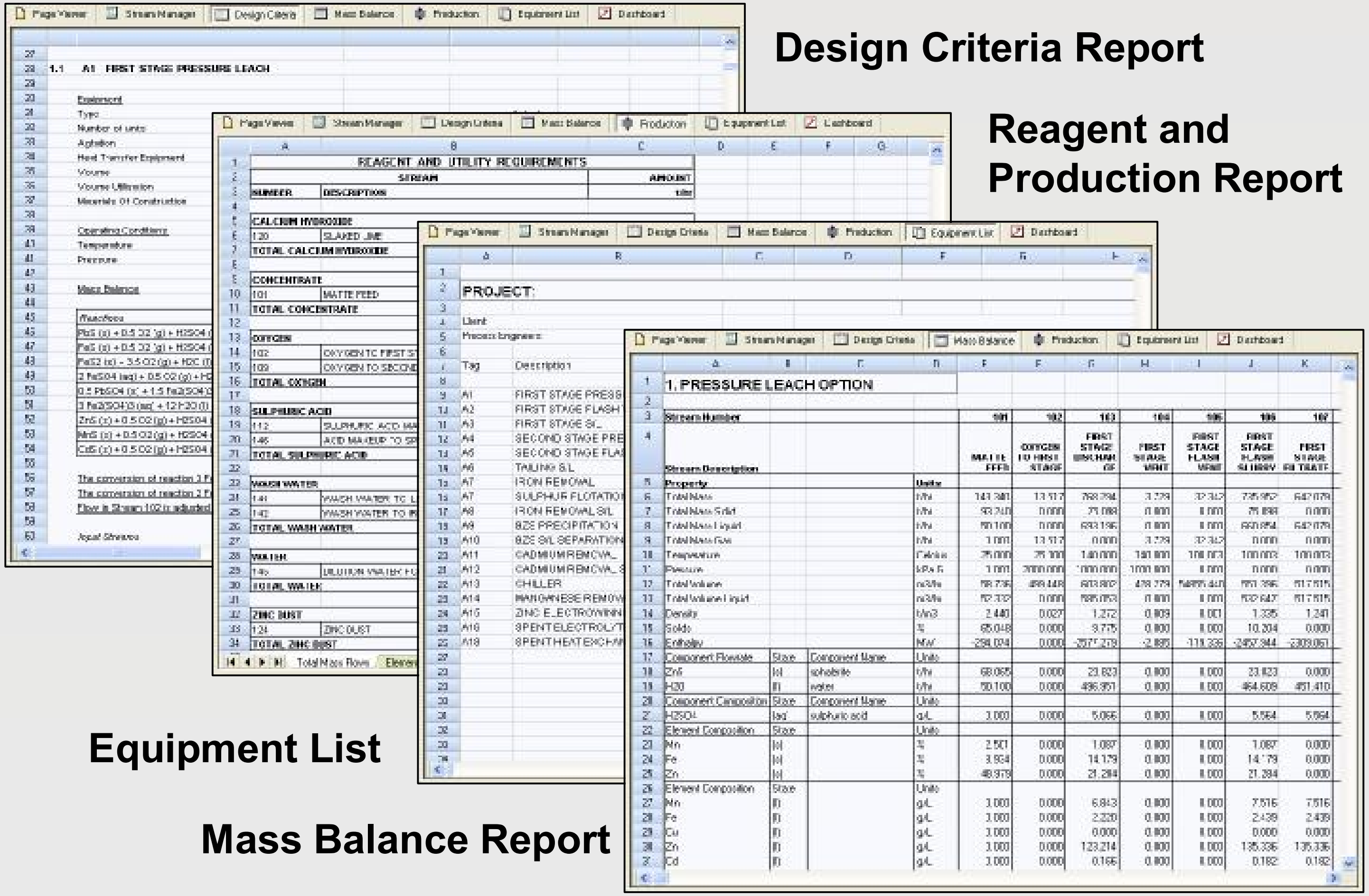
An example of a typical Block Flow Diagram produced using Cycad Process



Of course, Block Flow Diagrams can also be produced using equipment symbols



Cycad Process produces four standard reports for each flow sheet



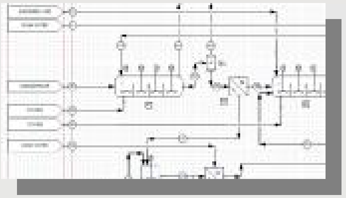
Design Criteria Report

Reagent and Production Report

Equipment List

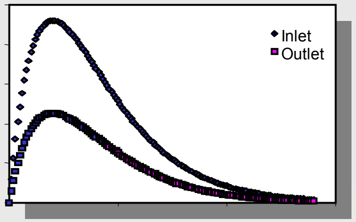
Mass Balance Report

The second topic of this presentation concerns the calculation of the mass and energy balance

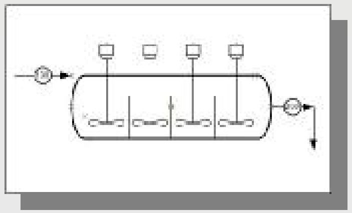


Drawing Environment and Outputs

Mass and Energy Balances

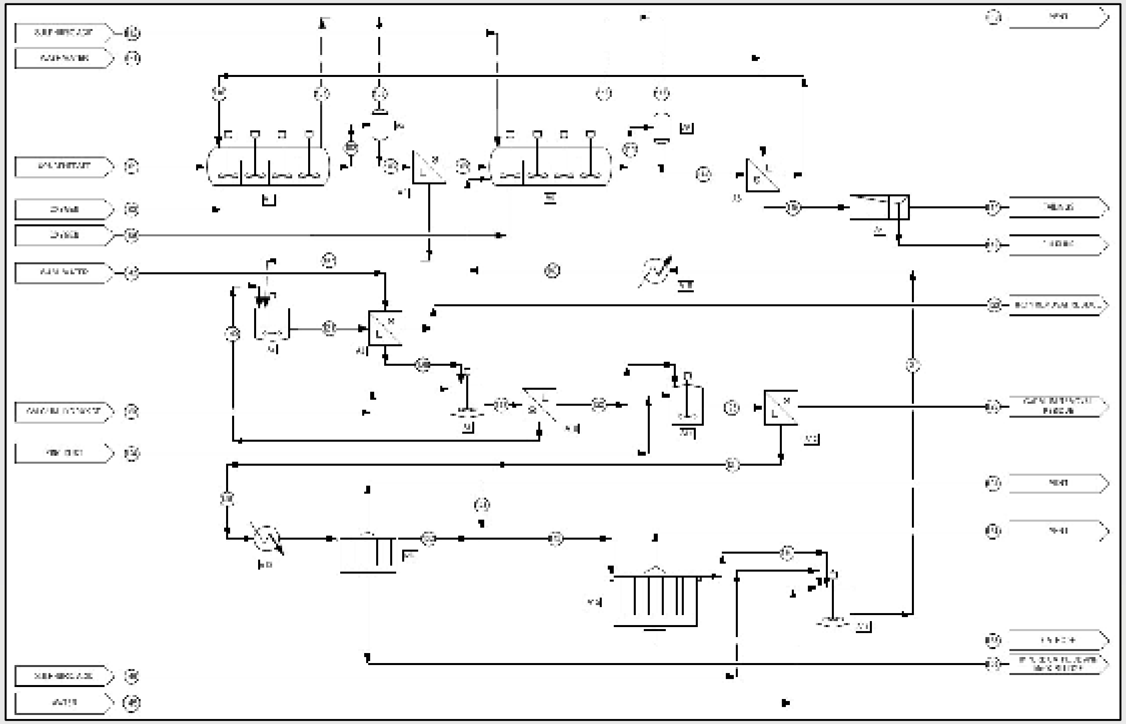


Particle Size Distributions and Population Balances



Dynamic Simulation

The calculation of mass and energy balances is based on well-known methods

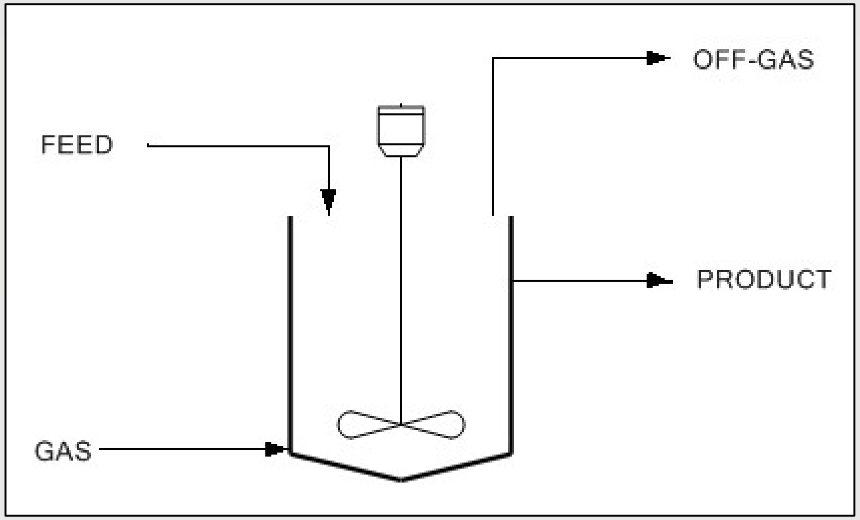


Cycad automatically determines recycle set

Cycad optimizes the order of calculation of the units

No need for user to order unit operations, to number units, or to specify recycle streams

Each unit has a hierarchy of rules that describe its calculation



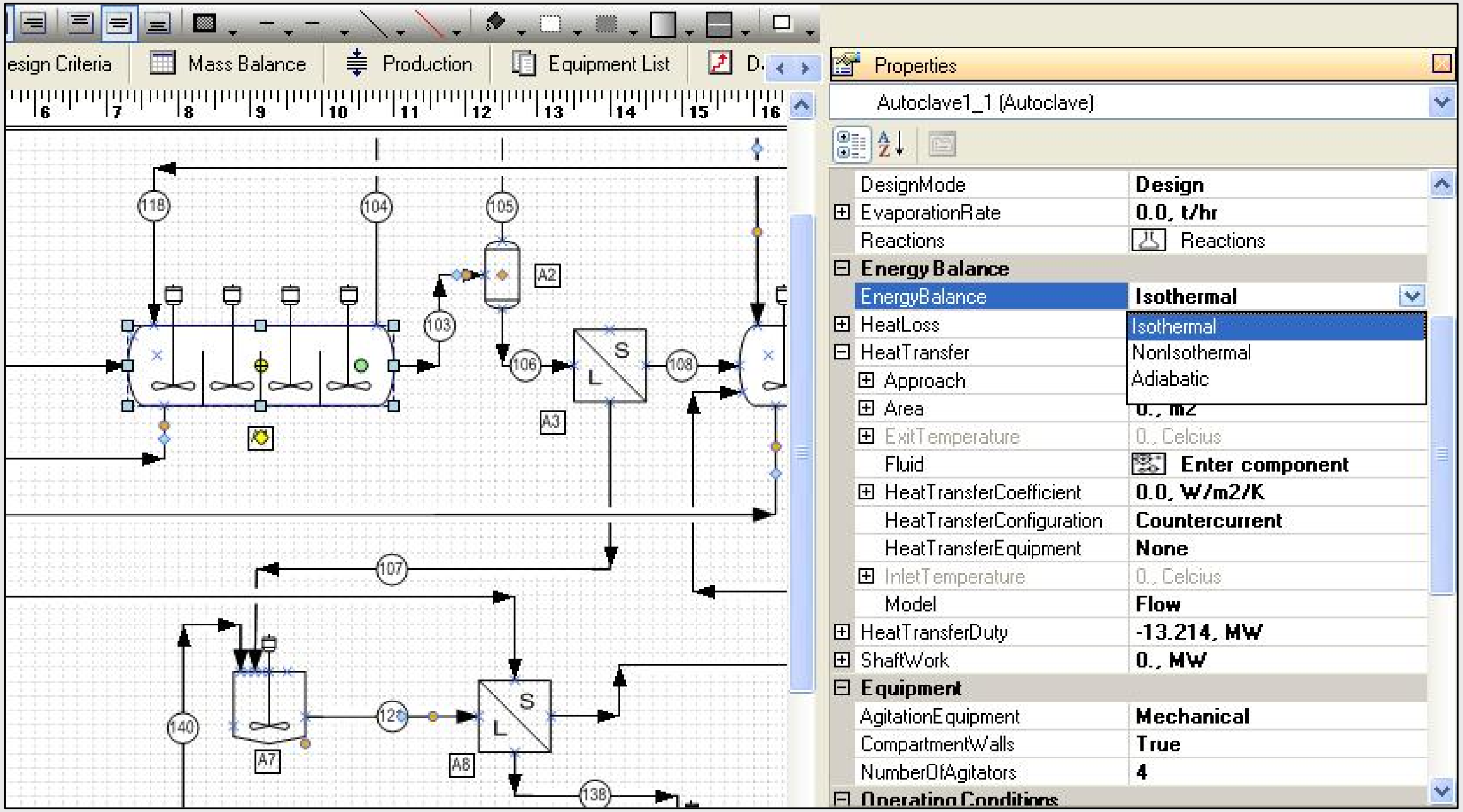
Example 1:

All gases will be vented if there is a vent stream.

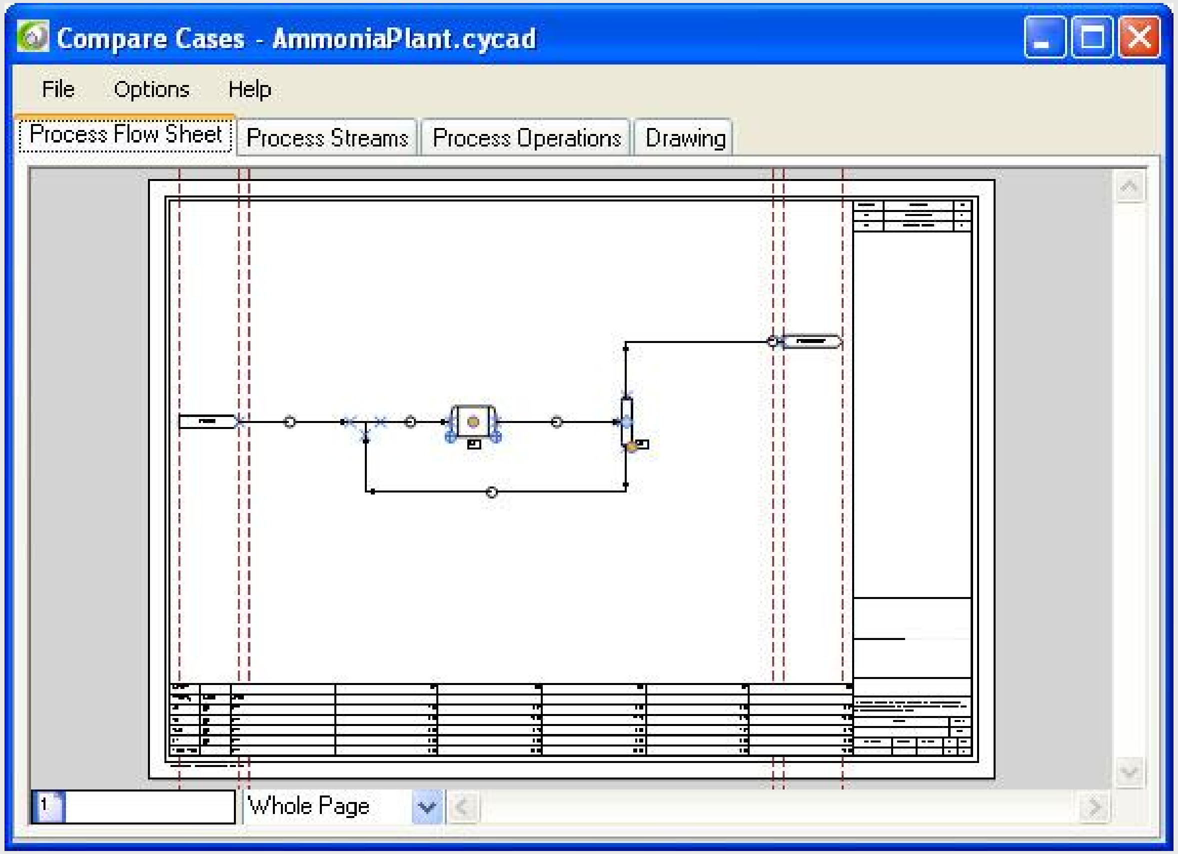
Example 2:

Vent will be saturated in water vapour if there is water in the product stream.

The energy balance is integrated within the specifications for each unit operation

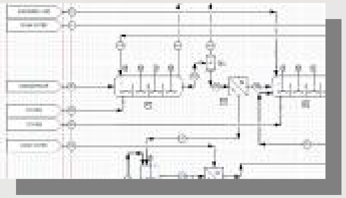


A “Compare Cases” function allows an automated comparison between different revisions



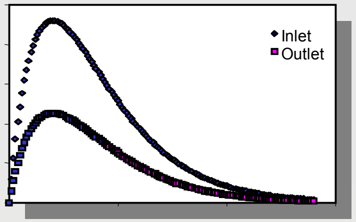
An extremely useful function when working on flowsheets of hundreds of streams and units

The third topic of this presentation is the capability of Cycad Process to describe particulate processes

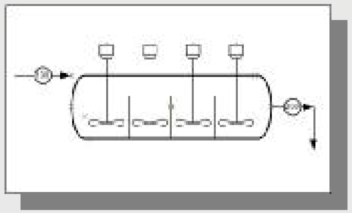


Drawing Environment and Outputs

Mass and Energy Balances

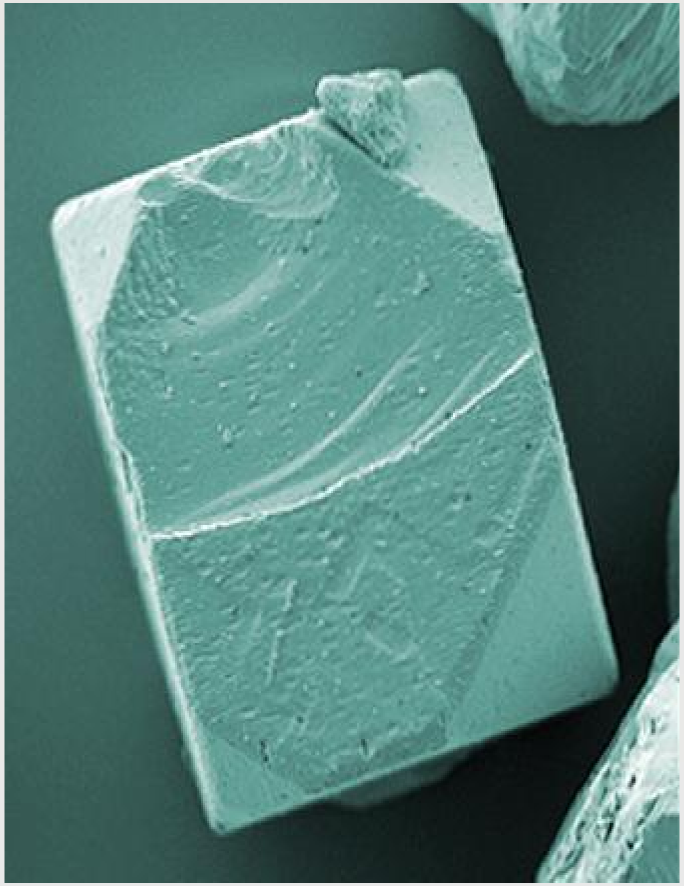


Particle Size Distributions and Population Balances



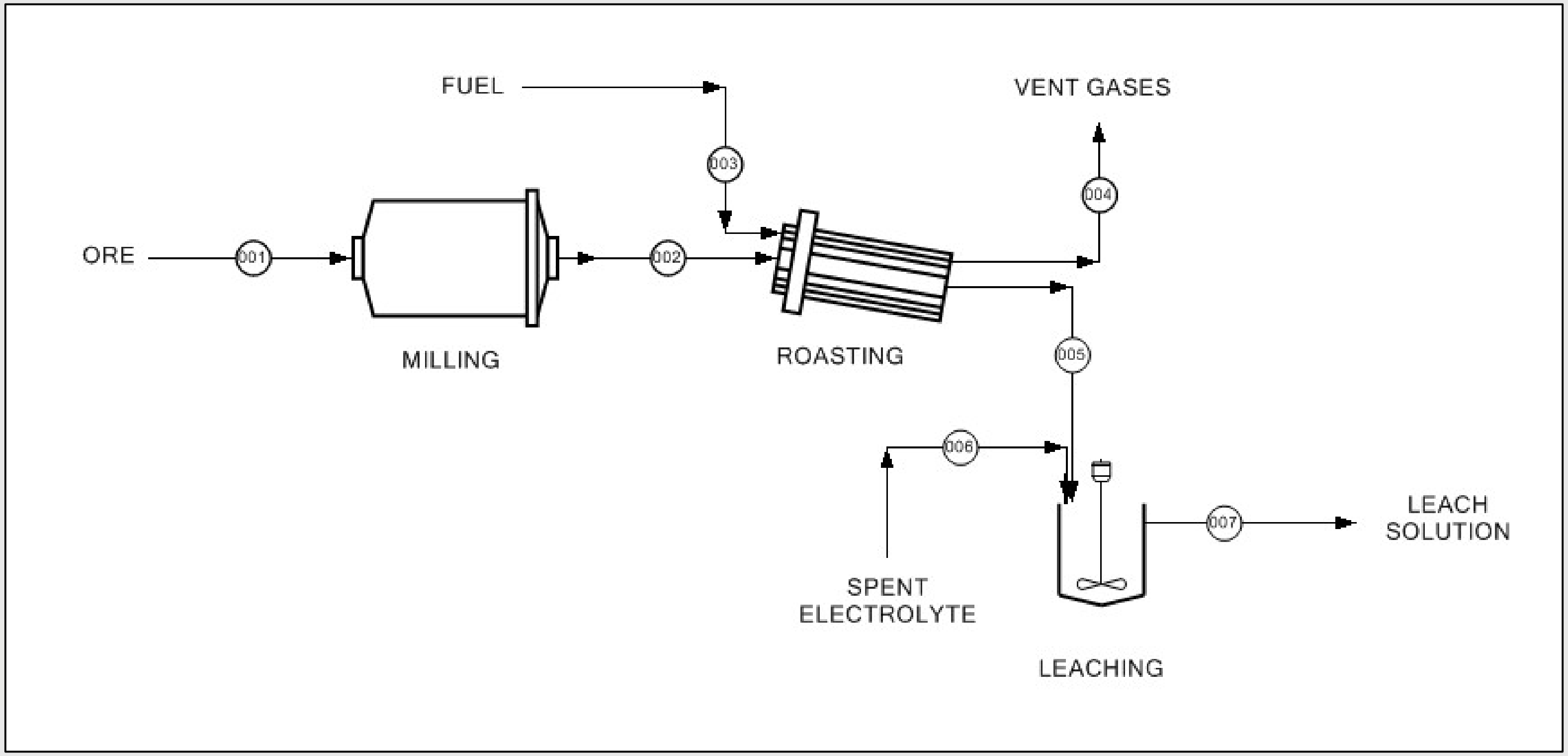
Dynamic Simulation

Most metallurgical and more than 40% of chemical processes treat solids in which particle size is important

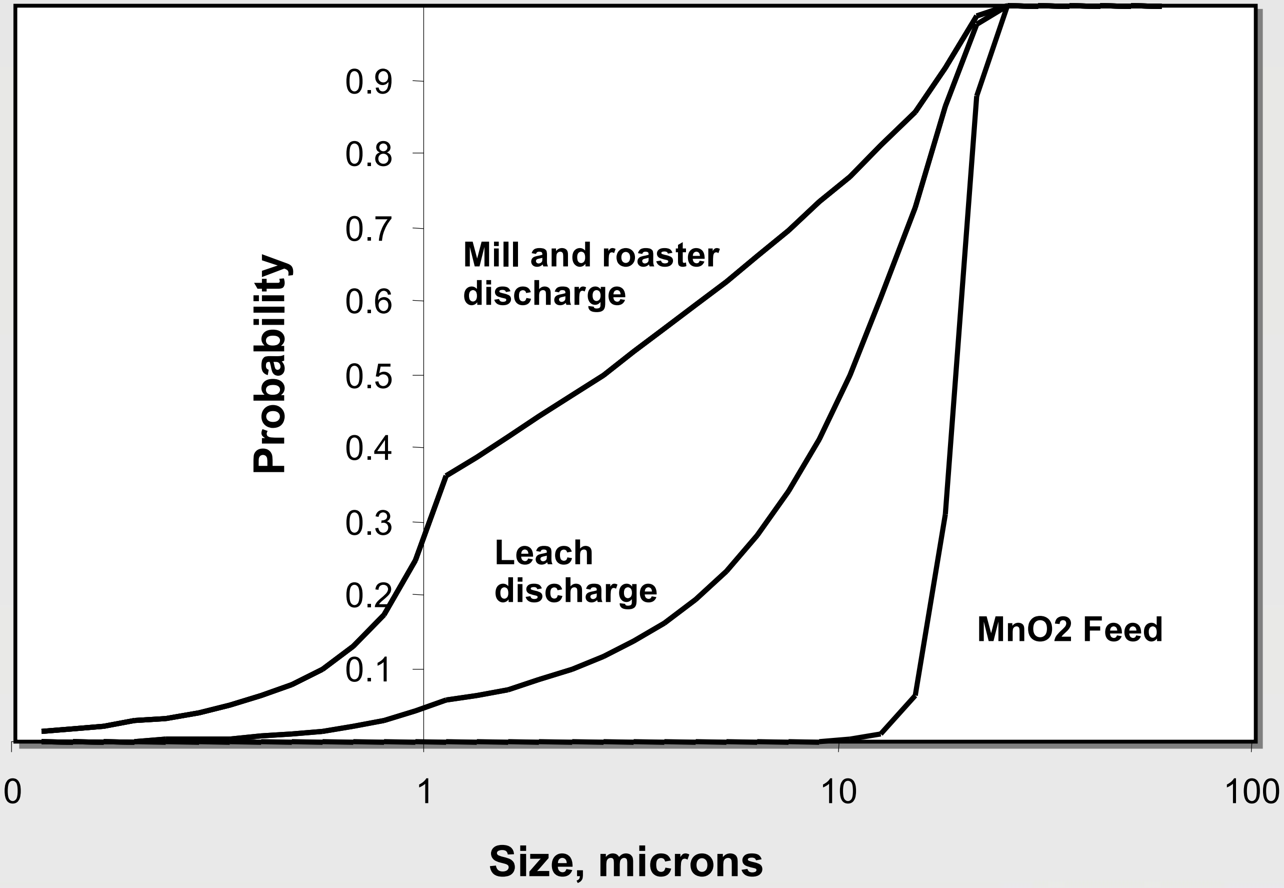


- Roasting
- Leaching
- Precipitation
- Crystallisation
- Agglomeration
- Flotation
- Crushing
- Grinding
- Screening
- Filtration
- Thickening

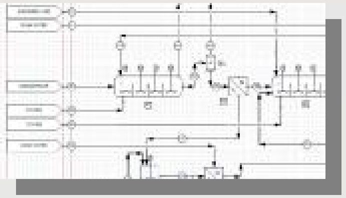
Consider a process with a front end of milling roasting and leaching



A trade-off between milling and leaching exists, which can be more rigorously evaluated

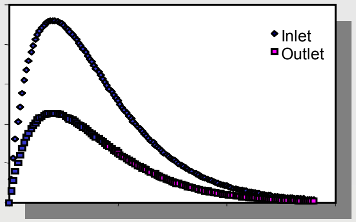


The fourth and final topic of this presentation is the use of Cycad Process to describe dynamic processes

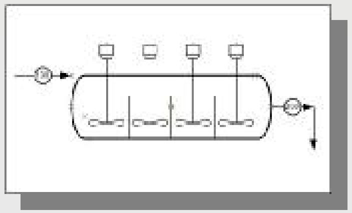


Drawing Environment and Outputs

Mass and Energy Balances

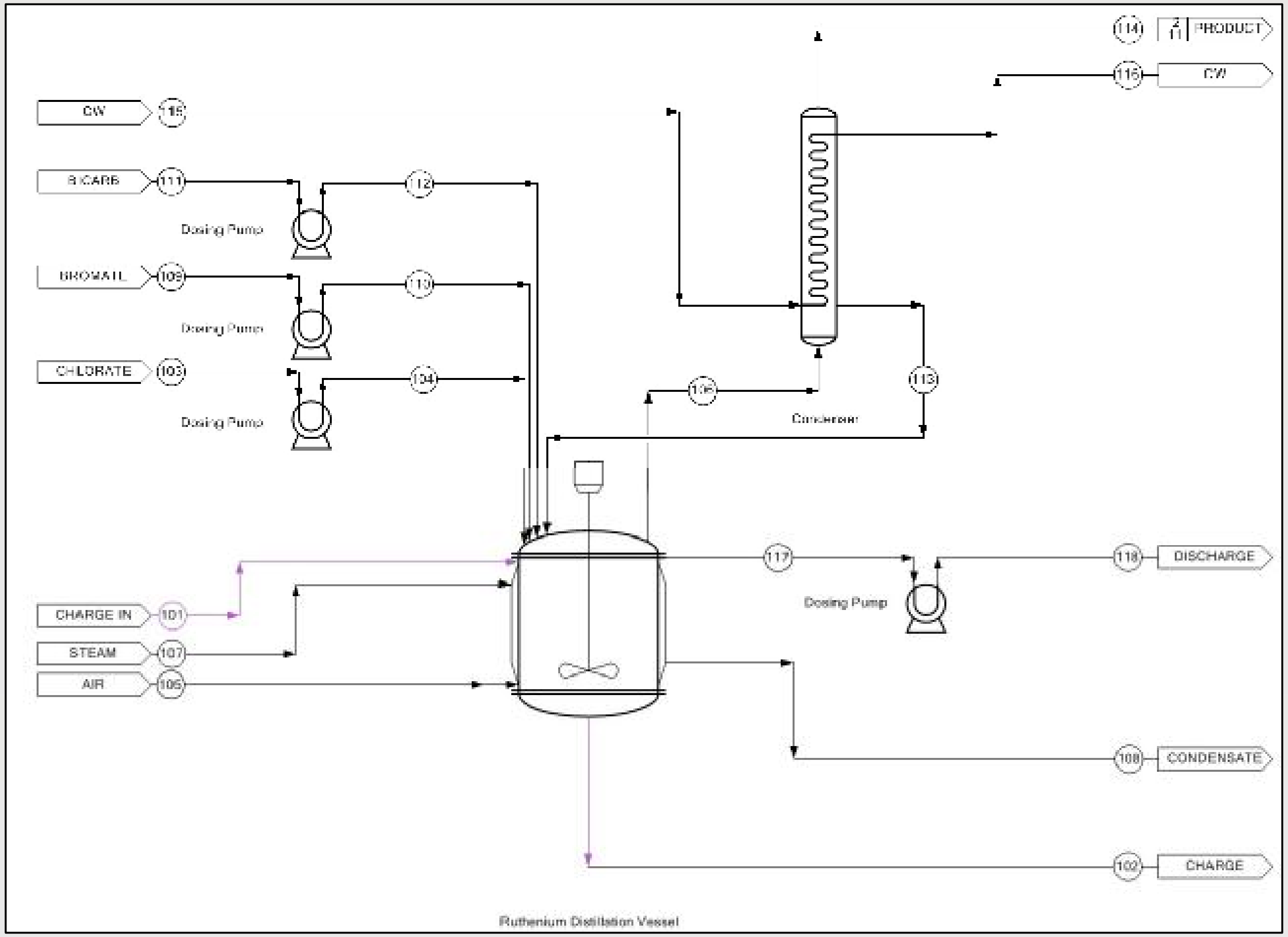


Particle Size Distributions and Population Balances



Dynamic Simulation

Consider the distillation of ruthenium, which occurs in batch with reagents dosed in at different times

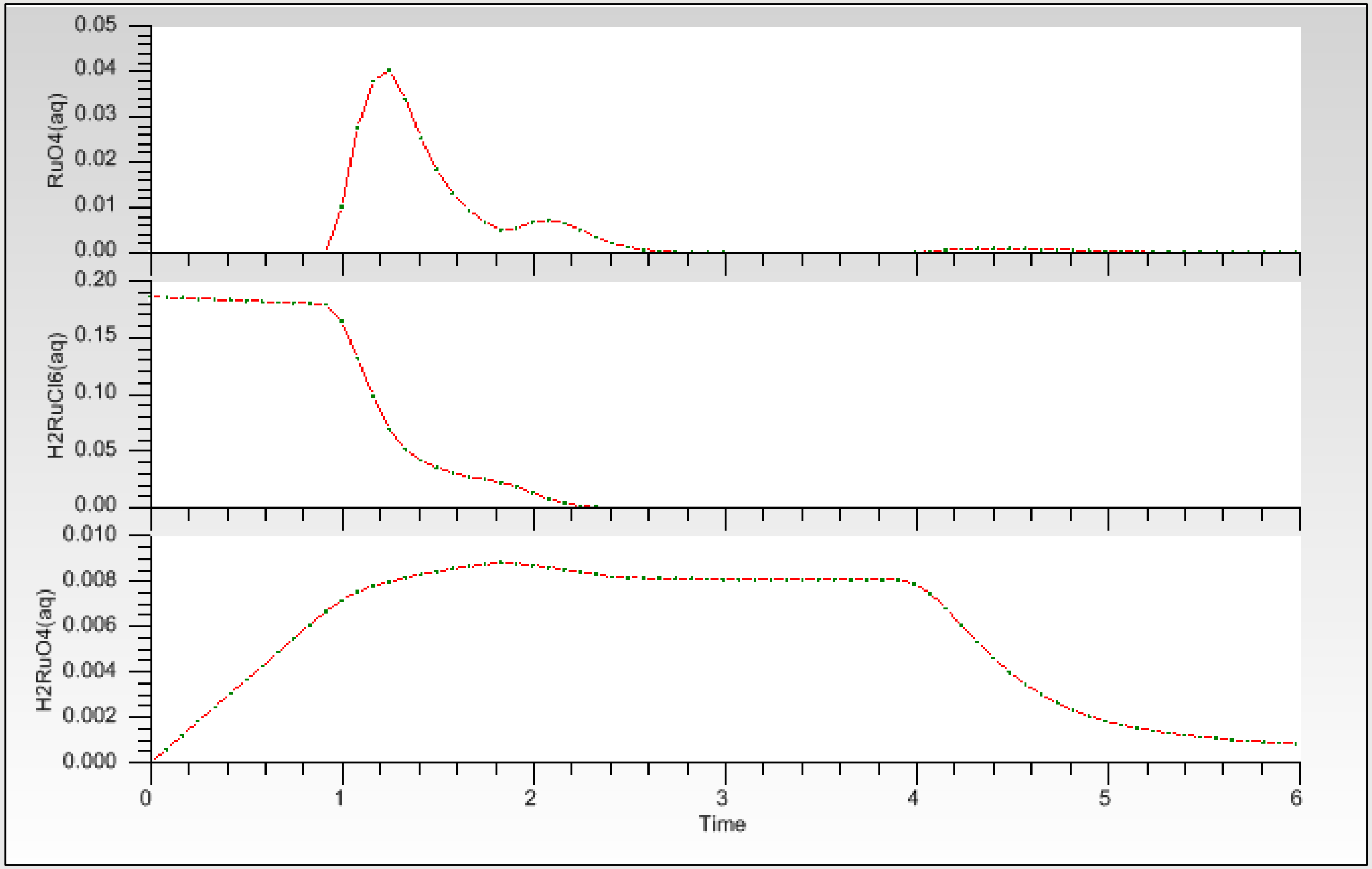


Cycad process

Rates of reaction are entered to model the batch operation

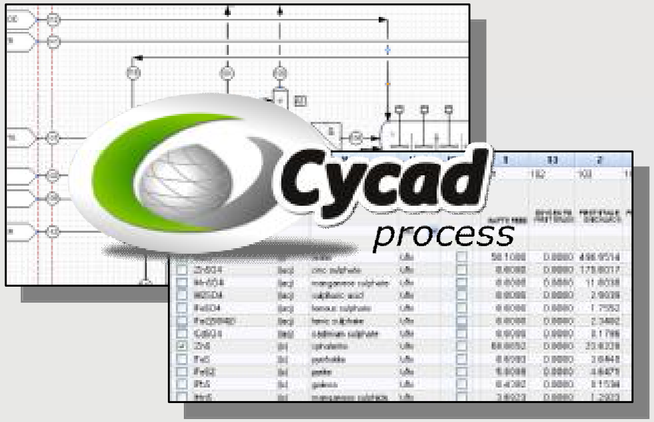
	Reaction	Expression
1	3 H2RuCl6 (aq) + 4 H2O (l) + 4 NaClO2 (aq) -> 3 RuO4 (aq) + 12 HCl (aq	rate = 1e1*[H2RuCl6 (aq)]*[NaClO2 (aq)]
2	NaClO3 (aq) + 6 HCl (aq) -> 3 Cl2 (aq) + 3 H2O (l) + NaCl (aq)	rate = 1.3e1*[NaClO3 (aq)]*[HCl (aq)]
3	RuO4 (aq) -> RuO4 (g)	rate = 7.5
4	H2RuCl6 (aq) -> H2RuO4 (aq)	rate = 0.4e-1*[H2RuCl6 (aq)] - 0.*[H2RuO4 (aq)]
5	3 NaClO3 (aq) + Cl2 (aq) + H2O (l) + 2 NaCl (aq) -> 5 NaClO2 (aq) + 2 H(	rate = 1.1e1*[Cl2 (aq)]*[NaClO3 (aq)]*[NaCl (aq)]
6	5 H2RuCl6 (aq) + 8 H2O (l) + 4 NaClO3 (aq) -> 5 RuO4 (aq) + 26 HCl (ac	rate = 3e1*[H2RuCl6 (aq)]*[NaClO3 (aq)]
7	5 H2RuO4 (aq) + 8 H2O (l) + 4 NaBrO3 (aq) -> 5 RuO4 (aq) + 26 HCl (aq	rate = 1e4*[H2RuO4 (aq)]^2*[NaBrO3 (aq)]
8	H2O (l) -> H2O (g)	rate = 1e-4
9	Cl2 (aq) -> Cl2 (g)	rate = 1e-2
10	NaClO3 (aq) + 6 HCl (aq) -> 3 Cl2 (g) + 3 H2O (l) + NaCl (aq)	rate = 1e-3*[NaClO3 (aq)]*[HCl (aq)]
11	2 NaClO3 (aq) + 4 HCl (aq) -> 2 ClO2 (g) + Cl2 (aq) + 2 H2O (l) + 2 NaCl	rate = 1e-3*[NaClO3 (aq)]*[HCl]

The model of this complex batch process using Cycad Process agrees with lab and plant data



Cycad process

Conclusions



- Cycad Process is intuitive and easy to use
- Outputs are directly matched with metallurgical requirements
- Calculations based on well-known methods
- Population balance methods are integrated with equipment models
- Simulate batch lab and plant results
- Cycad Process is a powerful tool for the design and simulation of process engineering plants

Questions?