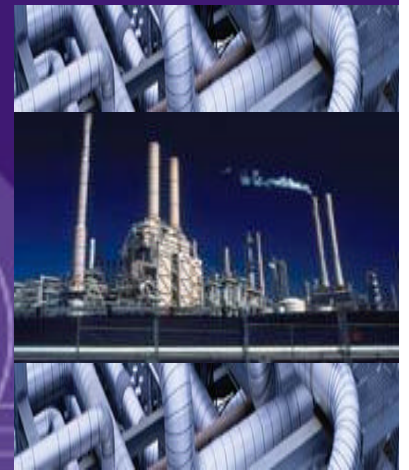


PROSIMPLUS HNO₃

NITRIC ACID PLANT AND NITROUS
VAPORS ABSORPTION SIMULATOR



ProSim

A unique software

ProSim HNO₃ is the only process simulator specifically dedicated to processes involving nitrous vapors absorption. The complexity of the physical and chemical phenomena involved (nitrogen monoxide oxidation reactions, nitrogen dioxide dimerization reaction, nitrogen oxides absorption in nitric acid aqueous solutions, ...) justify this specificity



Applications

Existing units efficiency improvement

from an operating parameter change to a complete revamping, ProSim HNO₃ allows to optimize a unit operating, to improve its profitability, to limit its energy cost, or to face new regulations in particular in matter of gas emissions

New process design

from preliminary studies to detailed design, ProSimPlus HNO₃ is a powerful tool which insures rigour, efficiency, consistency so that process engineers can concentrate on process engineering instead of computer operations, and then significantly increase their productivity

Operator training

ProSimPlus HNO₃ is also very useful for the operators training in order to analyze and understand the physical and chemical phenomena which take place in their units.



Thermodynamics

ProSimPlus HNO₃ includes a properties data base for components involved in such processes (H₂O, NO, NO₂, N₂O₄, N₂, O₂, HNO₃, NH₃, N₂O, N₂O₃, HNO₂). Properties have been selected for their accuracy but it's possible to modify them thanks to the interactive program Component Plus supplied simultaneously. The thermodynamic model used in ProSimPlus HNO₃ is specifically fitted for nitrous vapors-water-nitric acid mixtures, as much for the fluid phase equilibria calculations, as for thermodynamic, physical or transport properties calculation. For example the density of a nitric acid solution is calculated using a specific correlation (model of NOVOTY and SOHNEL).



Calculations

- to perform complete and rigorous heat and mass balance calculations in a nitric acid and/or nitrous vapors absorption process
- to supply all process streams characteristics (flowrate, temperature, pressure, composition, physical properties, .)
- to perform calculations of process data required for equipment sizing and design
- to perform rigorous simulation of nitrous vapors oxido-absorption.



Chemical reactions

All the chemical reactions susceptible of taking place in nitric acid production or in nitrous vapors absorption have been taken into account when developing the models used in ProSimPlus HNO₃. The description of a process became then very easy and user is sure of the quality of calculations performed. Systematic calculation of nitrogen dioxide dimerization is the most obvious example. Furthermore taking into account these chemical reactions when setting the equations of the models insures robust and efficient calculations which cannot be reached with a standard process simulator.



Unit operations

MIXERS AND SEPARATORS

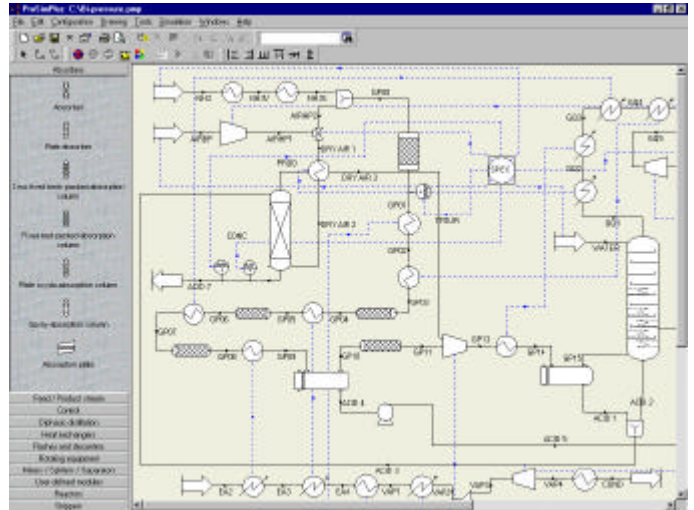
HEAT EXCHANGERS : nitrous vapors condenser which produces nitric acid by absorption of nitrogen dioxide and tetraoxide in the condensed water. Using a rate based approach, this model can simulate vertical as well as horizontal condensers;

CHEMICAL REACTORS : oxidation of nitrogen monoxide in vapor phase and dimerization of dioxide in peroxide with tube flow or CSTR option. Adiabatic, isotherm or output temperature specified general reactor (possibility to specify conversion rates or selectivities) which can be used to simulate for example NOx reduction by ammoniac;

COMPRESSORS, PIPES AND PUMPS : monostage or multistage isentropic or polytropic compressor (possibility to specify the design curves), monostage or multistage expander turbine (condensation possibility), volumetric or isentropic pump, pipe pressure drop;

OXYDO-ABSORPTION COLUMN: nitrous vapors oxido-absorption by aqueous nitric acid solutions column (rigorous model) with possibility of several feeds or nitric acid side streams, oxidation available volumes and efficiencies of nitrogen monoxide oxidation consideration. Several models available for absorption efficiencies on each stage as functions of the plates geometry, temperature profile fixed or calculated from the characteristics of the cooling device. Several correlations available for nitrogen monoxide oxidation rate, nitrogen dimerization equilibrium constant or nitrogen oxides - water-nitric acid system equilibrium constant calculations.

DISTILLATION COLUMNS, ABSORBERS, STRIPPERS.



Graphical User Interface

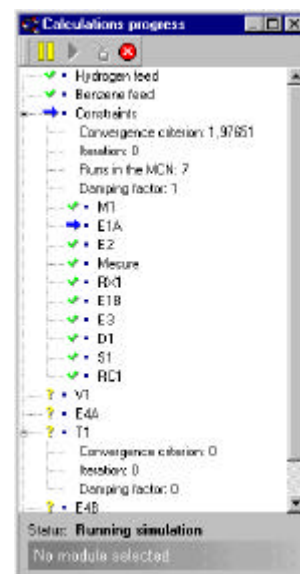
- Windows 32 bit application
- Drag and drop functions
- Advanced reporting and export capabilities (Excel, Word, Lotus,...)
- On-line help
- Color conventions for input guidance
- Stream characteristics displayed on the PFD
- Units predefined systems
- Unit conversion module
- Results in HTML format
- PFD export (EMF format)
- English or French input and output



Performances

ProSimPlus HNO3 is a simulator that proves to be extremely efficient in complex simulations: numerous recyclings, large scale flowsheets, etc...For recyclings and/or operating specifications or constraints problems, ProSimPlus HNO3 provides the user with the most effective and most robust algorithms. A rapid convergence is insured thanks to the proprietary simultaneous modular approach.

Multistage separation model (nitrous vapors oxido-absorption or nitric acid distillation) is solved with a unique efficiency. Algorithm is based on a global approach solved with a Newton based method. A large choice of operating specifications is always available (purity, recovery ratio, flowrate, ...) and allows to find the right operating parameters of a column at the first try, without providing adjusted starting values. Use of analytical derivatives in the convergence method increase drastically the efficiency of the algorithm.



Associated services

- technical assistance provided by modeling experts dedicated to user support
- standard off-the-shelf as well as specific on-site training course
- user requirements are always the first consideration when deciding new developments
- customized consulting services to solve difficulties encountered in complex problems
- a complete range of simulation software: batch processes, calculations of thermodynamic properties and fluid phase equilibria, energy optimization, dynamic real-time simulation,...
- specific customized developments on request
- unparalleled reactivity of a highly motivated team



ProSim

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