



# VMGSim™ 7.0

## Release Highlights

Speed. Substance. Style. The release of VMGSim 7.0 can be best characterized by these three qualities; we have worked on each of these areas to improve your total simulation experience. Regarding Speed, many large cases will have a twofold speed increase, expediting the time it takes to complete your simulations. We have added to the Substance of VMGSim 7.0 with an impressive array of new process modeling technology, ranging from new Fuel Cell and Pinch Utility Unit Operations to improvements in Oil Estimation Methods as well as a major enhancement to our Sulfur Recovery Unit modeling capabilities. The Style of VMGSim has also been enhanced with the addition of many more of those little features that quickly become an integral part of your day to day use of VMGSim.

VMGSim 7.0 is a major milestone in our objective of continuing to develop the best process simulation software. Use VMGSim 7.0 and experience its Speed, Substance and Style for yourself.

### Best-in-Class Sulfur Recovery Modeling Capabilities

The partnership between Sulfur Recovery Engineering (SRE) and VMG provides the best-in-class sulfur modeling solution.



SRU Reliability, Performance and Protection

VMGSim 7.0 includes multiple correlations for different plant configurations. These correlations include prediction of formation of COS, CS<sub>2</sub>, H<sub>2</sub>, and CO, in a reaction furnace.

### Heavy Oil Characterization Enhancements

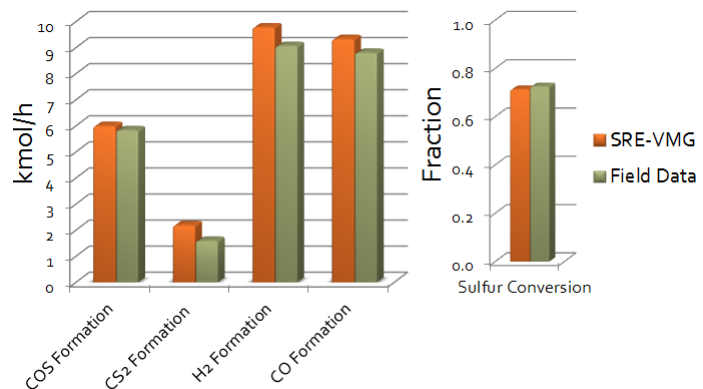
The powerful and flexible oil environment includes new characterization methods and additional estimation methods for physical and critical properties.

- New characterization method based on Carbon Number Compositional Analysis and plus fraction.
- Enhanced Gamma Distribution, now suitable for Molecular Weight distribution as well as for characterizing heavy fluids.

### Unit Operations Additions and Enhancements

- Pinch Utility - New utility for helping to evaluate the energy utilization of processes.
- Tower - Revamped interface to streamline the workflow and general convergence improvements.
- HX (Heat Exchanger) Rating - Includes all the TEMA types and the calculation of shell stream fraction flows.
- Envelope - New multiphase envelope mode with support for multiple liquid phases.

### Exceptional Predictions Out of the Box



SRE-VMG correlations in action predicting sulfur conversion and formation of COS, CS<sub>2</sub>, H<sub>2</sub>, and CO, in a reaction furnace of a Gas Plant with a High-Efficiency Main Burner

### New Fuel Cell Unit Operation

The Fuel Cell joins the suite of unit operations in VMGSim focused on modeling alternative energy processes. The rigorous Fuel Cell unit operation predicts internal and overall trends of key process variables, including temperatures and conversions.

### Dynamics

Dynamics in VMGSim 7.0 features full Sulfur Recovery modeling capabilities. Unprecedented studies for transient behavior of operations and studies of control strategies are now possible.

### Speed Up

VMGSim 7.0 speed improvements for increased productivity.

- Steady State features a 2X speed up for large simulation cases.
- Increased speed in APRNG.
- General speed up in Dynamics.

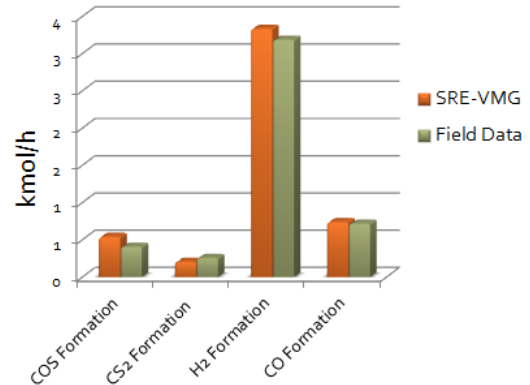
# VMGSim™ 7.0 Release Highlights

## Best-in-Class Sulfur Recovery Modeling Capabilities

The partnership between Sulfur Recovery Engineering(SRE) and VMG has made VMGSim 7.0 the best available Sulfur Recovery Unit modeling/simulation tool. SRE's years of experience and thousands of individual performance test runs combined with VMGSim's simulation framework has resulted in VMGSim 7.0 having the most up to date and accurate performance correlations with the most flexible SRU modeling tool. In the future, SRE and VMG will continue to work together to endeavour to push the boundaries of what is possible to do in SRU process modeling.

### Highlights

- SRE-VMG Correlations available in Claus Reaction Furnace for more realistic predictions of outlet compositions of Sulfur vapor, COS, CS<sub>2</sub>, CO and H<sub>2</sub>.
- Supported Plant Configurations:
  - Gas Plant or Refinery.
  - High-efficiency or old-style burners.
  - Straight-through or front-side split.
  - Oxygen enriched or natural gas co-fired.
- SRE-VMG COS and CS<sub>2</sub> hydrolysis correlations now available for regular alumina, promoted Titania and full Titania catalysts.
- New option to estimate Heat Loss in Claus Reaction Furnace.



Comparison of SRE-VMG correlations for predicting the formation of COS, CS<sub>2</sub>, H<sub>2</sub>, and CO, in a reaction furnace of a Refinery Straight through Claus plant with - Low Efficiency burners.

## Heavy Oil Characterization Enhancements

- Improved API-VMG viscosity estimation method. This method provides better estimation for viscosities of heavy oils compared to the standard API method.
- More estimation methods for physical and critical properties. VMGSim 7.0 includes most common methods used in the industry as well as newly developed ones.
- New custom sets of physical properties estimation methods for heavy oils, resins and asphaltenes.

## Thermodynamics Additions

- Use default physical property estimation methods from the Oil Characterization when creating hypos with the Oil family, including the new API-VMG viscosity estimation method.
- New multiphase envelope, includes advanced slice plot to visualize the behavior of physical properties in the different phases.
- New configurable options for transport properties estimation methods for specific property packages.
- Updated component database for C<sub>20</sub> - C<sub>100</sub> paraffins.
- Gasification package includes new option to estimate Heating Values.

**Oil\_1. Assay\_1**

Experimental Information | Gamma Distribution | **Cn Compositional Analysis**

Assay Information

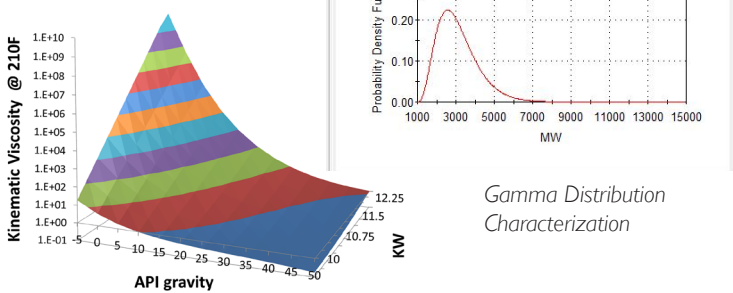
Light Ends | Liquid Properties | Content Curves

Oil Bulk vs. Temperature | Cn Compositional Analysis

Starting Cn	10	Cn+ Pseudo Components	165
Cn+ Composition [%]	25.17	Basis	Mole %
Cn+ MW	1038.10	Liquid Density @ 60 F [kg/m <sup>3</sup> ]	955.4176
Cn+ LD @ 60 F [kg/m <sup>3</sup> ]	1014.000		

Component	[%]	MW	LD @ 60 F [kg/m <sup>3</sup> ]	NBP
C10	0.9000	134.00	778.000	
C11	1.45	147.00	789.000	
C12	1.97	161.00	800.000	
C13	2.50	175.00	811.000	
C14	2.57	190.00	822.000	
C15	2.86	206.00	832.000	
C16	2.91	222.00	839.000	
C17	2.96	237.00	870.000	
C18	2.99	251.00	852.000	
C19	3.07	263.00	857.000	
C20	2.72	275.00	862.000	
C21	2.90	291.00	867.000	
C22	2.20	305.00	872.000	
C23	2.26	318.00	877.000	
C24	2.14	331.00	881.000	
C25+	25.17	1038.10	1014.000	

Carbon Number Compositional Analysis

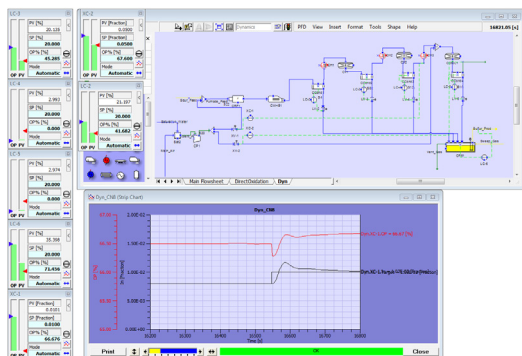


Gamma Distribution Characterization

Kinematic viscosities from the API-VMG correlation cover a broad range of different oils, from light to heavy.

## Dynamics

VMGSim 7.0 features the capability to build drag and drop sulfur recovery processes models in Dynamics. The full suite of Claus unit operations and utility operations are now supported in dynamics.



Dynamics Claus plant model

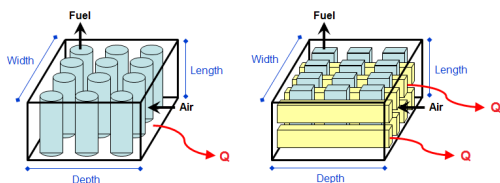
### Additions to Dynamics

- New Miller method for calculating pressure drop in tees.
- New Support for line sizing.
- Compressor – New curve correction using either molecular weight or sonic velocity.
- Controller - New feedforward control functionality.
- Expander - New option to estimate nozzle/guide vane area from design point. Used to determine flow through machine.

## New Fuel Cell Unit Operation

The rigorous Fuel Cell unit operation allows for internal and overall predictive trending of key process variables, including temperatures and conversions. The model is suitable for conceptual design and for optimization of modern processes using different types of fuel cell technologies.

- Multiple fuel cells:
  - Solid oxide fuel cell (SOFC)
  - Proton exchange membrane (PEM)
  - Solid oxide electrolysis cell (SOEC)
- Built-in Kinetic and Gibbs free energy minimization based reactions.
- Multiple configuration options available, including geometry and materials.

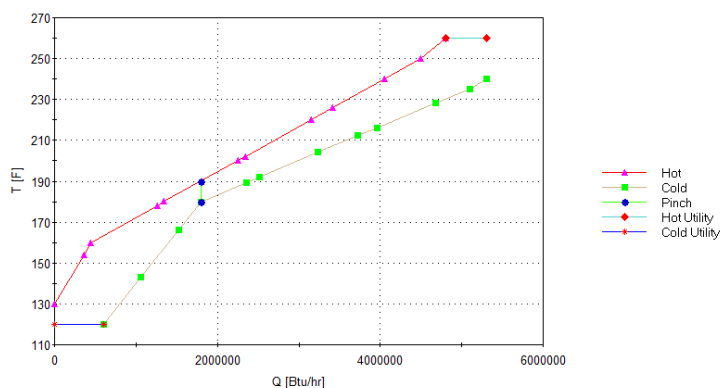


Tubular or channel configuration options

## New Pinch Utility Tool

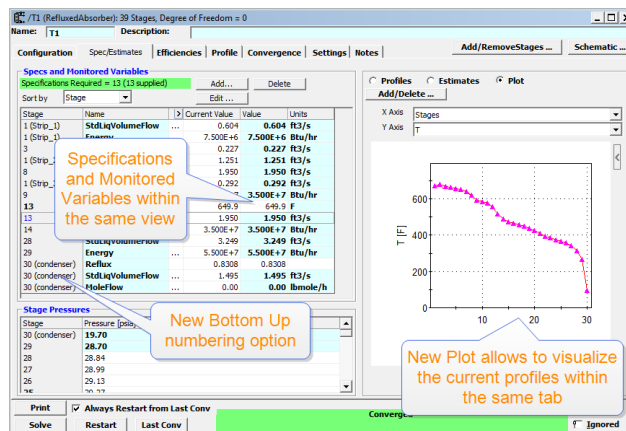
The pinch utility tool makes it easier to evaluate the energy-efficiency of different process designs. Overall composite curve for a group of unit operations is calculated and heating curve automatically determined.

- The pinch utility analysis includes:
  - Grand Composite Curve
  - LMTD and Delta T
  - Hot Composite versus Cold Sides
  - Cold Composite versus Hot Sides



Composite Curve Plot with pinch point

## User Interface Enhancements



View of redesigned Specifications and Estimates Tab in Tower Interface

### Tower Interface

- Specifications and Estimates section redesigned to streamline the configuration process.
- New ability to edit existing specs.

### PFD

- New information and border shapes for easy PFD formatting.
- New right-click menu to add variables to the PFD Datasheets.

### Plots

- New global user preferences.
- Individual plot configuration is now stored with the unit operation.

### Units

- Redesigned units sets form for easier customization.
- Streamlined process to customize unit conversion tooltips.
- New static unit conversion window.

### Unit Operations

- Claus Furnace – Provide default values when changing kinetic correction methods.
- Claus Condenser and Claus Sulfur Pit– New variable to define sulfur entrainment.
- Claus Direct Fired Heater – Now supports specification of O<sub>2</sub> fraction.
- Ethylene Cracking Unit – Support for inner MERT Type. New serrated fin option for tube coils. New automatic Steam97 utility package for improved accuracy in convection section.
- FTR – New Selectivity model to include more product distribution components.
- Heat Exchanger – VMGSim Rating now supports all TEMA types of HX rating, new types include G-type, H-type, and J-type split flow.
- Heat Exchanger – Added calculation of shell stream fraction flows in VMGSim heat exchanger rating.
- Line Sizing – Now allows for inclination specification.
- Multisided HX – Improved convergence for large UA values that result in pinched approach temperatures.
- Pipe Segment – New profiles, includes Mach number, volume, cumulative length and vertical/horizontal distance.
- Process Calculator and Selector Block – AND and OR logical functions now supported.
- Reactors (CSTR, PFR, Eq Reactor) – Reactions can be copied between reactors. Specific reactions can be ignored.
- Special Properties – New hydrocarbon dew point property available. New Heat of Vaporization at constant T or P in mass basis.

### Flowsheeting and Graphical User Interface (GUI)

- Equilibrium Results – New properties available. Gas specific gravity, Atom count.
- Equilibrium Results – Bulk liquid properties now available for material streams.
- PFD – New feature to import borders from Visio® files.
- PFD – Re-enabled short cut Ctrl + W to zoom whole PFD window with Visio® 2010.
- Plant Examples – New interface to open or import existing plant examples.
- Property Package – Settings tab reorganized.
- Summary Sets – New ability to insert blank rows.
- Tower Interface – Re-designed dialog box to add specifications results in fewer clicks.

### Dynamics

- Amine Detail – Now supported in dynamics.
- Control Valves – New options to calculate vapor and liquid choke.
- Event Scheduler – New functionality to start/stop sequences.
- Heat Exchanger – Auto mode for side model to handle effects such as boiling and condensing.
- Integrator – Allows to set Control Layer Frequency, PFS Frequency and Composition Frequency.
- Multi Sided HX – Ability to specify fin geometry for individual layers.
- Multi Sided HX – Ability to tune heat transfer coefficient and dP correlation predictions.
- Pipe Segment – New profiles Mach number and Is-choked.
- Pipe Segment – New Max Mach number parameter.
- Pipe Segment – Dukler pressure drop correlation is now supported.
- Relief Valve – Reports Mass Flux.

### Thermodynamics

- CO<sub>2</sub> Freezing model – Improved to handle 3 phases (VLL) plus an incipient solid CO<sub>2</sub> phase.
- Gasification – Updated and expanded Gibbs energy of formation data base.
- Gasification – Added an option to estimate Heating Values.
- Improved Solubility of Hg and Alcohols in H<sub>2</sub>O in APR and APRNG property packages.
- Improved undefined hydrocarbon heat of formation estimation.
- Oil Characterization – Calculation of net heating values (NHV) for oil bulk and pseudo-components is now available.
- Oil Characterization – New options to calculate chemical formulas of oil pseudo components based on physical properties, elemental content curves and chemical family.
- VMG-RefProp property package – Now uses REFPROP version 9.0. \*REFPROP is the standard for high precision pure component and simple mixtures physical property calculations produced by NIST/TRC.

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