

***ProMax<sup>®</sup>***  
*with TSWEET<sup>®</sup>*

*Experience the Difference*



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## *Experience the Difference*

What makes Bryan Research & Engineering and ProMax different? This question is often asked by our prospective clients.

ProMax is built on over 35 years of continual research and development efforts. Our team of development engineers has consistently found ways to model processes so that the end results accurately and efficiently reflect the actual operating conditions of gas processing, refining and chemical facilities. We take pride in the fact that the focus of our development efforts has been strongly influenced by the needs of our clients. Members of our development team work directly with clients on specific process issues, attend training seminars and help resolve technical support issues on a regular basis. This helps ensure that the people who develop ProMax are in tune with the people who are using ProMax to simulate their facilities.

BR&E is committed to backing up our software with a level of service that is unmatched in our industry. Our passion as a company is for our engineers to work side by side with our clients. We find great satisfaction in working with our customers to help devise design alternatives or resolve process issues. To demonstrate our commitment to our clients, we provide an initial model of existing facilities for operating companies, free training sessions around the world and a team of technical support engineers who make every effort to ensure that all of your questions are resolved in a timely manner. For many of our clients, our technical support team has become an invaluable resource not only because of their knowledge of ProMax, but also because of their extensive experience and expertise with specific processes.

In an industry where volatility is the norm, our company has remained focused on our goal of providing the best available simulation software and service for our clients since 1974. Thousands of people in over 30 countries currently use ProMax to meet their simulation needs. Their satisfaction is demonstrated by the high retention rate of clients who continue to use ProMax year after year.

The technological merits of ProMax, the high level of service that accompanies ProMax, and the endurance of BR&E combine to create a unique resource. If you are in search of a process simulation software package that meets and exceeds your expectations, I firmly believe that you will be delighted with ProMax. It is one thing to read about all the features that make ProMax different. It is another thing all together to experience the difference.

Jerry A. Bullin  
President



For 35 years, Bryan Research & Engineering (BR&E) has been committed to providing the energy industry with process simulation software that accurately and efficiently predicts the performance of gas processing, refining and chemical processes.

Today, BR&E's ProMax simulator is used by engineers around the world to design and optimize processing facilities. Totally integrated with Microsoft Visio, Excel and Word, ProMax is a comprehensive tool that offers incomparable flexibility. A few of the commonly used features of ProMax include:

- Crude oil characterization
- Refining processes
- Gas and liquid sweetening
- Glycol dehydration / hydrate inhibition
- Sulfur recovery
- LPG recovery and fractionation
- Sour water stripping
- Chemical processes and general reactors
- Exchanger rating / sizing
- Exchanger network monitoring
- Pipeline systems
- Vessel sizing
- Parametric studies





*of today's engineers*

At BR&E, we view each of our clients as partners. Our success is based on your success. To ensure that every client receives optimal benefits from ProMax, we take customer support to another level by including valuable services with every ProMax license.

### *Free Training Sessions*

- BR&E provides over \$1,000,000 in free training each year.
- Last year, BR&E hosted 30 training sessions in 20 different locations around the world.
- Over 600 clients and prospective clients attended these sessions.
- Each session is instructed by members of BR&E's team of experienced and knowledgeable engineers.
- Participants are given the opportunity to model real process scenarios in an environment that encourages interaction between participants as well as with the instructors.
- Training sessions are designed to meet the individual needs of the attendees. Each session is centered around a specific process area and/or skill level. The course agendas currently offered include "Oil and Gas Focus," "Refining Focus," "Advanced Simulation Methods," and "Add-ins and Extensions."



### Free Technical Service

A knowledgeable and experienced team of chemical engineers is readily available to assist clients with questions regarding simulation issues and general process topics. We take pride in providing effective solutions for our clients in a timely manner.

### Free Initial Plant Models

To demonstrate our commitment to service, BR&E's technical support team will provide initial plant models for clients in operating companies.

*“The ProMax software provided by Bryan Research & Engineering has been used as a process tool by Gas Liquids Engineering for almost 20 years. BR&E continues to improve their software accuracy year after year in the areas we are concerned, giving us more confidence to effectively satisfy our clients’ needs. Perhaps the greatest tangible benefit is their excellent customer support. We can and do depend on them to quickly and effectively answer our simulation issues. I would not want to operate our business without this simulation tool and BR&E’s services in our arsenal.”*

-Jim Maddocks  
V.P., Engineering  
Gas Liquids Engineering Ltd.

## Gas Processing

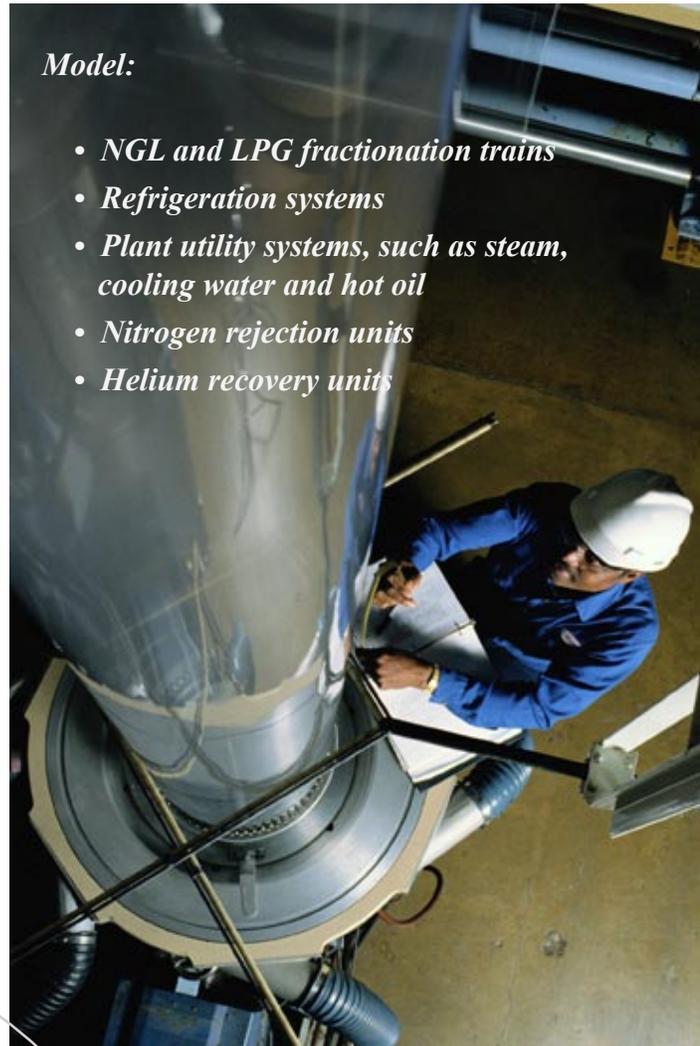
ProMax may be used to model virtually any NGL, LNG or LPG recovery and fractionation process or nitrogen rejection unit (NRU). Because of its ability to simulate an entire processing facility in one project, ProMax continues to be the preferred simulation resource at gas processing facilities throughout the world.

- Rate heat exchangers including brazed aluminum
- Predict optimal exchanger performance with active rating during simulation
- Determine hydrate formation and CO<sub>2</sub> freeze-out temperatures
- Size two and three phase separators
- Use Excel to perform parametric studies and economic analyses
- Calculate hydrate inhibitor requirements
- Model amine treating, dehydration, cryogenic and fractionation facilities in a single project

*Currently, thousands of clients in 32 countries use ProMax to meet their process simulation needs.*

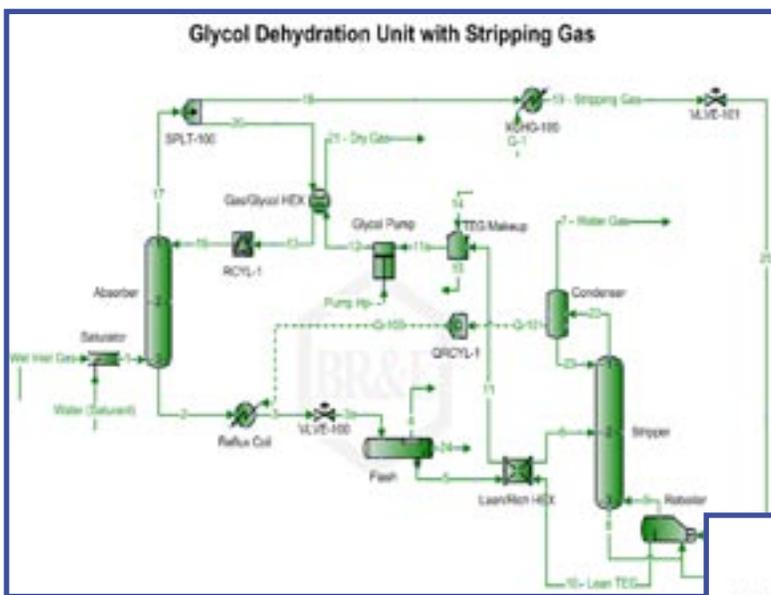
### *Model:*

- *NGL and LPG fractionation trains*
- *Refrigeration systems*
- *Plant utility systems, such as steam, cooling water and hot oil*
- *Nitrogen rejection units*
- *Helium recovery units*



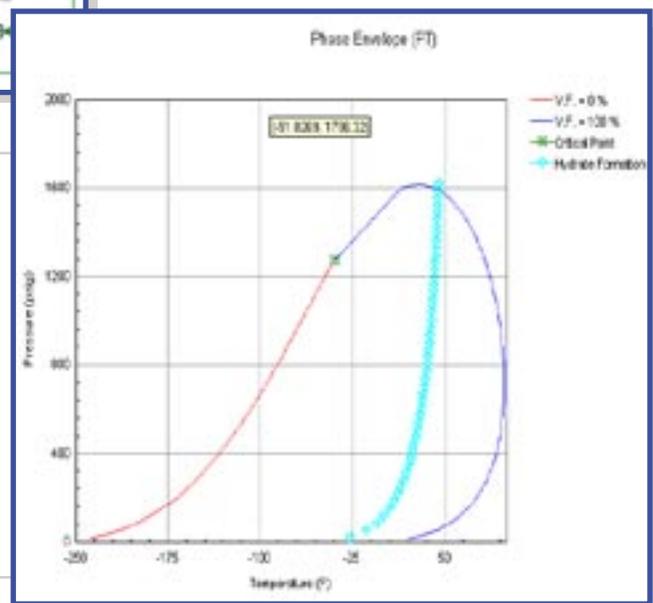
## Glycol Dehydration & Hydrate Prediction / Inhibition

ProMax is renowned as the leading resource for predicting the performance of both glycol dehydration and hydrate suppression systems. ProMax can perform dehydration simulations using the common glycols Ethylene Glycol (EG), Diethylene Glycol (DEG), and Triethylene Glycol (TEG) or other solvents such as Methanol and DEPG. Injection systems using Methanol, EG, or other hydrate inhibitors can be modeled as well. Almost any dehydration unit flow scheme may be simulated, including stripping gas, stripping gas with dryer column, solvent enhanced stripping, and enhanced stripping with vapor recovery. ProMax is also well known for its ability to accurately predict BTEX and VOC emissions.



- Plot hydrate curve on phase diagram
- Perform integrated exchanger rating/sizing
- Calculate the water content of gas
- Optimize glycol flow rate

- Calculate hydrate, ice and solid CO<sub>2</sub> formation temperatures
- Evaluate process variations including Drizo®, IFPEXOL®, Coldfinger®, Stripping gas, Sparge gas, and BTEX stripping column
- Calculate hydrate inhibitor requirements



## Acid Gas Removal

Given the wide variety of gas treating options available today, a process simulator that can accurately predict sweetening results is a necessity when attempting to determine the best option. ProMax has been proven to accurately predict results for numerous process schemes.

ProMax can model virtually any flow process or configuration including multiple columns, liquid hydrocarbon treating, and split flow processes. In addition, ProMax can accurately model caustic treating applications as well as physical solvent sweetening with solvents such as Coastal AGR®, methanol, and NMP. All of these features combine to make ProMax the leading simulator in the gas treating field.

- Access the advanced electrolytic property package
- Model virtually any process configuration
- Model selective absorption of H<sub>2</sub>S using an amine/CO<sub>2</sub> kinetic model
- Analyze the effects of enhanced stripping by the addition of acid
- Optimize the type of amine, amine flow rate and reboiler duty
- Model gas, liquid hydrocarbon and oil treating
- Predict hydrocarbon/BTEX and mercaptan solubility in amines
- Model MEA, DEA, TEA, DGA®, MDEA, DIPA, piperazine and mixtures
- Model caustic treating units
- Predict the performance of physical solvents such as DEPG (Coastal AGR), NMP or N-Methyl-2-Pyrrolidone (formerly Purisol), methanol (Rectisol), and others



## CO<sub>2</sub> Capture, Compression and Sequestration

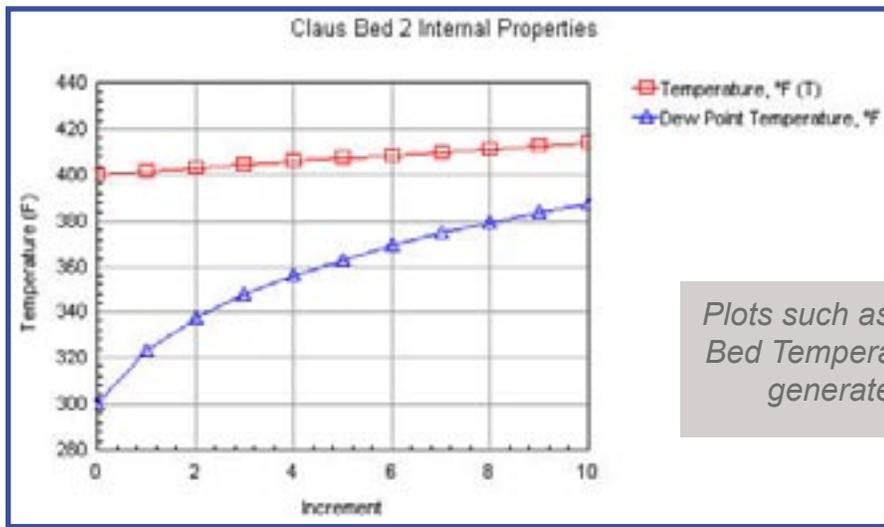
Model all possible configurations of CO<sub>2</sub> capture processes including:

- Pre-combustion processing
- Post-combustion treating
- CO<sub>2</sub> removal using single amines, mixed amines or physical solvents
- Integrated dehydration and compression facilities for sequestration employing a new, more accurate equation of state for pure CO<sub>2</sub>

## Sulfur Recovery / Tail Gas Cleanup

With increasing environmental concerns, sulfur recovery has become one of the leading issues in emissions reduction. The latest version of ProMax contains a complete reactor suite for modeling kinetic (plug flow and stirred tank), equilibrium, conversion, and Gibbs minimization schemes. This suite of options allows the ProMax user to model a variety of sulfur recovery and tail gas cleanup processes such as

- Claus (including acid gas bypass, hot gas bypass, enhanced oxygen, catalytic burners and more)
- Selectox/Recycle Selectox<sup>®</sup>
- COPE<sup>™</sup>
- Ultra<sup>®</sup>
- Sulfreen<sup>®</sup>
- SCOT<sup>®</sup>
- SUPERCLAUS<sup>®</sup>
- MODOP<sup>®</sup>
- CBA<sup>®</sup>



*Plots such as Dew Point vs. Bed Temperature are easily generated with ProMax*

## Sour Water Stripping

Model virtually any flow configuration of a sour water stripping facility with ProMax. Recently enhanced electrolytic property packages give ProMax users access to the best available component interaction data, thus creating models that accurately predict operating conditions.

- Optimize steam rate
- Evaluate different stripping methods
- Model refluxed or non-refluxed systems
- Simulate acid addition for pH control

Model amine, sulfur and tail gas units in a single project

Optimize plant performance through custom solver routines

Automatically determine overall plant sulfur recovery

Calculate steam generation and consumption quantities

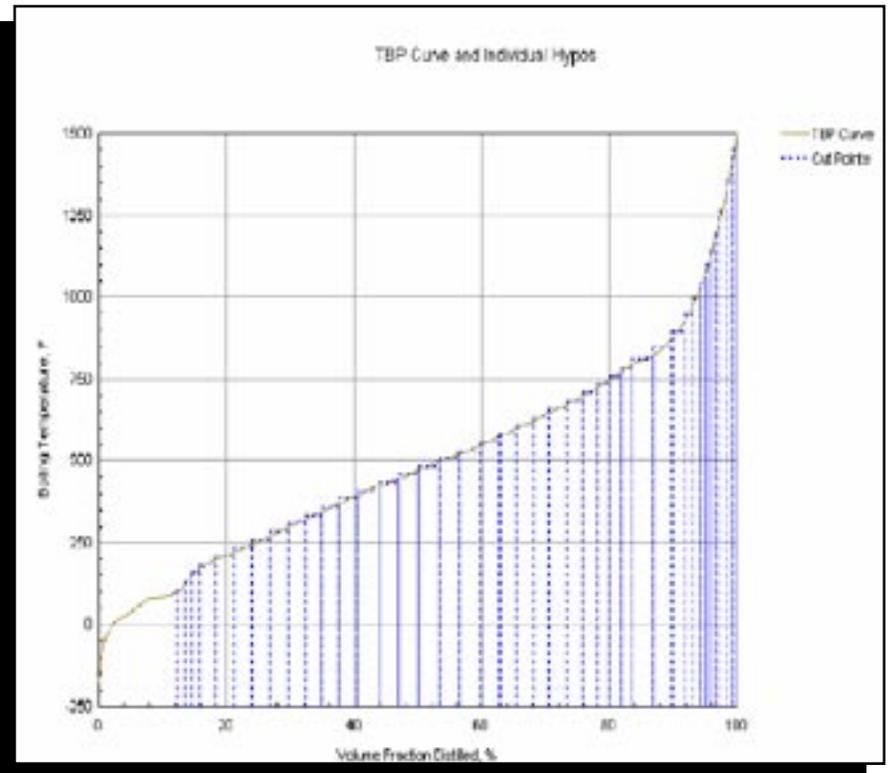
Integrate the complete steam system into a simulation

Easily determine the sulfur dew point

## Refining

Use ProMax to characterize single or multi-component oils and blends for use in common refining applications.

- Model atmospheric and vacuum towers
- Simulate complex petroleum fractionators
- Investigate crude preheat exchange and fouling
- Divide large processes into multiple linked flowsheets
- Simulate caustic treaters
- Predict optimal exchanger performance with active rating during simulation
- Study the impact of refinery changes on sour LPG, gas, and water systems



Choose from assay types:

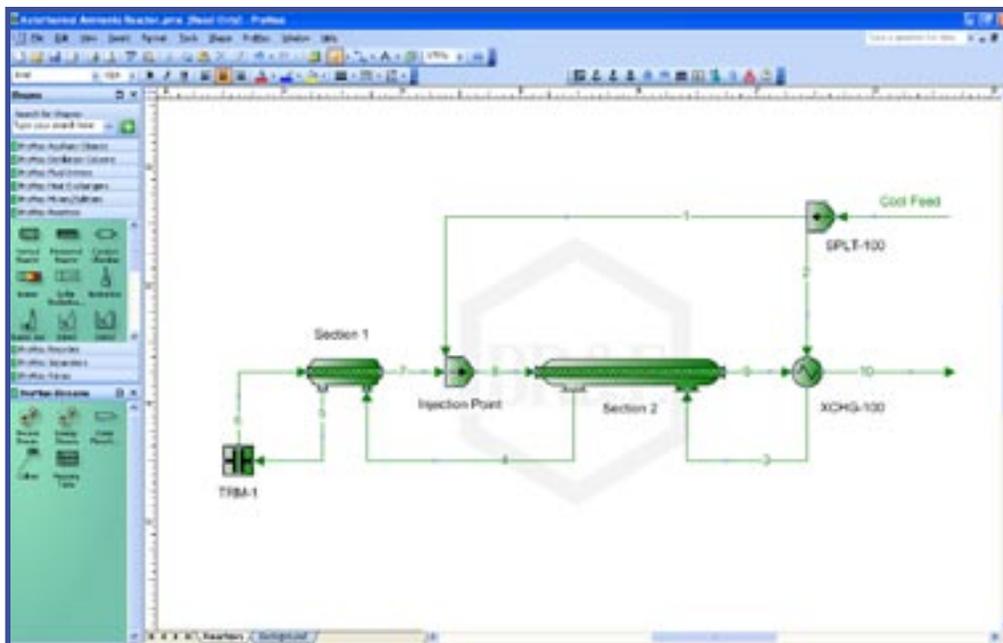
- TBP
- ASTM D86
- ASTM D1160
- ASTM D2887/SD
- EFV



## Chemical Processes and General Reactors

ProMax offers a powerful yet flexible set of reactors used in making a variety of chemical processes. User defined reaction sets containing either single or multiple simultaneous reactions can be created to give the user precise control over stoichiometry, equilibrium conditions, reaction rates and much more. Examples include:

- $\text{NH}_3$  production
- Nitric acid
- Steam reforming of methane
- Alkylation of toluene
- Styrene production
- Others



### Reactor Types

- Plug Flow
- CSTR
- Conversion
- Equilibrium
- Gibbs minimization

### Reactor Configurations

- Single sided
- Reactive separators
- Cross flow reactors with exchanger rating

*“The model helped us to make a final project decision and we were able to remove the proposed new amine column completely. We were able to predict the real impact on mercaptans carry-over into our sales gas more confidently using ProMax. The total project savings amounted to approximately \$24 million. With your help we were able to complete three months of engineering work in half the time.*”

*...I am proficient with [a number of process simulators], but I never receive the technical assistance like I have experienced with BR&E. In most cases I am satisfied if they can simply solve my technical problem, but with BR&E I experience something extra and we at WorleyParsons Kazakhstan appreciate it.”*

-Vernon Adams  
Sr. Process Engineer  
WorleyParsons  
Kazakhstan LLP

## ***Equipment Rating and Sizing***

To accurately and efficiently determine if a piece of equipment will perform under a given set of conditions, ProMax offers a number of equipment rating and sizing resources.

## ***Pipelines and Gathering Systems***

- Specify ambient conditions or overall heat transfer coefficient
- Calculate pressure drop for horizontal, vertical and inclined flow
- Obtain results for one, two and three phase flow
- Choose from a number of multiphase flow correlations
- Perform reverse calculations



## ***Vessels***

ProMax is capable of sizing both horizontal and vertical separation vessels containing either two or three-phase flow configurations including liquid/liquid sizing.

## ***Column Hydraulics***

Distillation columns containing trays, random packing, structured packing, or any combination of these may be sized or rated in ProMax. Detailed stage data is presented on both a phase and component basis. ProMax automatically displays component recoveries for every product stream, which allows the user to easily maintain column performance.

## Heat Exchangers

- Calculate complete exchanger details
- Choose from over 30 heat transfer fluids
- Generate TEMA datasheets
- Rate and/or size shell and tube, plate-frame, fin fan, double pipe and compact exchangers
- Determine fouling and subsequent cost benefit for cleaning

Name:  Execute ↑ ↓

Connections | Process Data | **Rating** | Streams | Tables | Plots | Notes

**Overall**

Results

Shell

Tubes

Fins

Baffles

Notes

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**Inline Excha...**

Side Pipes

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**Inline Excha...**

Side Pipes

Solve

Export...

**Overall Results**

Fraction Over Design	5.00019	%
Area Available	4909.56	ft <sup>2</sup>
Area Required	4675.76	ft <sup>2</sup>
Overall U	59.1801	Btu/(h <sup>2</sup> ft <sup>2</sup> °F)
Clean U	73.2791	Btu/(h <sup>2</sup> ft <sup>2</sup> °F)
Bare U	59.1001	Btu/(h <sup>2</sup> ft <sup>2</sup> °F)
Service U	56.3619	Btu/(h <sup>2</sup> ft <sup>2</sup> °F)
Effective Overall UA	290548	Btu/(h°F)
End Point UA	291370	Btu/(h°F)
Duty	1.85966e+007	Btu/h
Corrected MTD	67.2055	°F
Effective MTD	67.2055	°F
F Correction Factor	1	
Exchanger Volume	147.262	ft <sup>3</sup>

Increment	Incremental Duty Btu/h	Metal Temperature °F	Delta Temperature °F	Metal Thermal Conductivity Btu/(h <sup>2</sup> ft <sup>2</sup> °F)	Incremental U Btu/(h <sup>2</sup> ft <sup>2</sup> °F)
0	0	98.3276	59.6742	34.7038	55.446
1	1.85966e+006	105.609	61.3008	34.6565	56.2940
2	3.71931e+006	112.971	62.9169	34.6098	57.1231
3	5.57897e+006	120.176	64.4905	34.5635	57.9317
4	7.43863e+006	127.308	66.0576	34.4905	58.721
5	9.29828e+006	134.364	67.592	34.4089	59.4921
6	1.11579e+007	141.352	69.1036	34.3282	60.2458
7	1.30178e+007	148.272	70.5931	34.2482	60.9829
8	1.48773e+007	155.125	72.0613	34.169	61.7039
9	1.67369e+007	161.915	73.5009	34.0906	62.4094
10	1.85966e+007	168.641	74.9384	34.0128	63.0999

## ***Drawing flowsheets using Microsoft Visio***

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ProMax uses Visio as its drawing package. Visio's functionality and flexibility allow ProMax users to quickly set up and edit flowsheets. Using Visio, a flowsheet may be completely customized and easily automated using VB, VBA, etc. Customized stream material balances are displayed directly on the drawing and data may be imported or exported directly to/from Excel. By working in tandem, ProMax and Visio can significantly improve workflow efficiency.



## ***Multiple flowsheets in ProMax***

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In ProMax, the independent processes within a given facility can be modeled in a single project. ProMax users are given the flexibility to choose the best property package for each process while sharing data between flowsheets, which increases accuracy and efficiency.



## ***Import Projects***

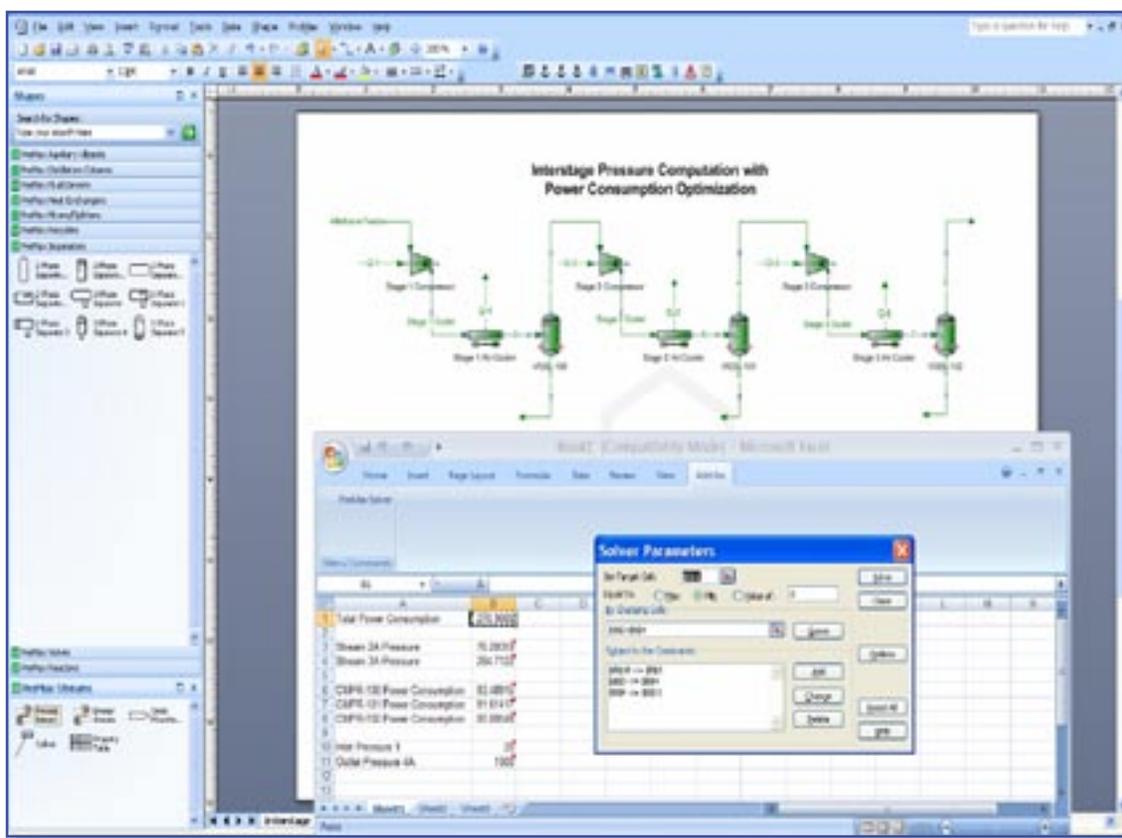
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Import any previously saved ProMax project into a current simulation.

With relative ease, ProMax can export or import individual values to and from an embedded Microsoft Excel workbook. This allows the Excel Solver and other macros in Excel to control values within a ProMax project. The possibilities of this feature include:

**Excel**

- Using Excel to create a simple user interface to ProMax
- Performing calculations in Excel while referencing ProMax data
- Using the Excel Solver to optimize process variables
- Moving data in bulk to and from ProMax
- Generating user defined data sheets



The programming language VBA can be used to automate ProMax. Automation of ProMax via this feature allows a vast amount of customization but does require some knowledge of Visual Basic and the ProMax object model. A few applications of this advanced ProMax feature are:

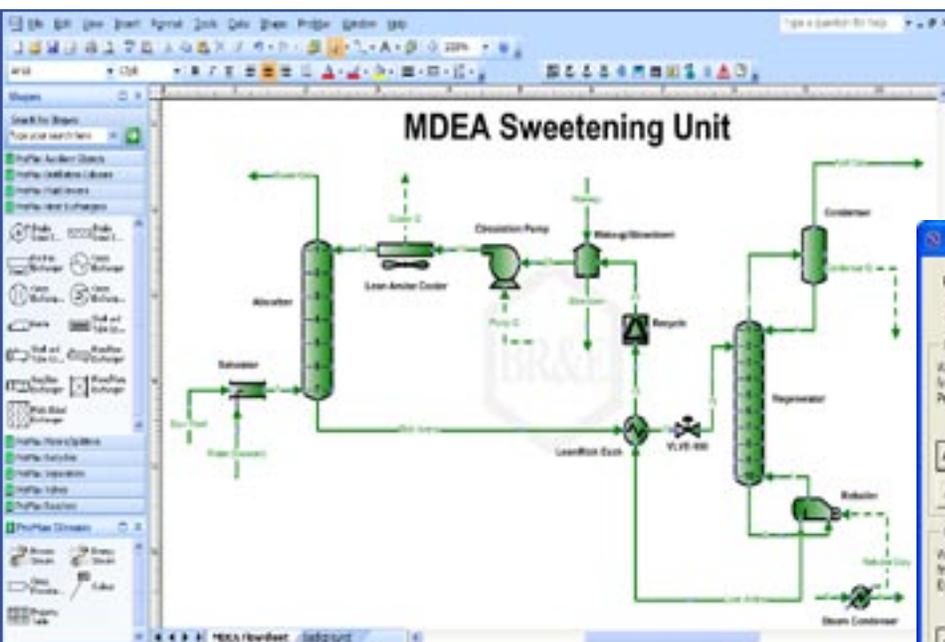
**VBA Tie-ins**

- Convert ProMax units inside another program
- Automate Excel workbooks using ProMax to handle complex calculations
- Automate simulations using text file inputs
- Simulate facilities based on real-time data provided from controls

**and flexibility**

## Scenario Tool

ProMax Scenario Tool is an add-in for Excel that facilitates the solving of ProMax projects with various conditions. The scenario tool may be used in any simulation or plant to systematically vary selected parameters in an effort to determine the optimum operating conditions and the appropriate solvent. For example, these studies can determine rich loading, reboiler duty, acid gas content of the sweet gas, amine losses, required circulation rate, type of amine or physical solvent, weight percent of amine, and other parameters.



ProMax Scenario Tool - Worksheet in ProMaxBook1

ProMax Project: ProMax1 Scenario Tester - Standalone Absorber.pmx

Scenario Name: Amine Flow Scenario

ProMax Input

Variable Name	Excel Range
Amine Flow Rate	[Worksheet in ProMaxBook1]Sheet1!\$A\$2:\$A\$3

ProMax Output

Variable Name	Excel Range
H <sub>2</sub> S ppm	[Worksheet in ProMaxBook1]Sheet1!\$E\$2:\$E\$12
CO <sub>2</sub> %	[Worksheet in ProMaxBook1]Sheet1!\$C\$2:\$C\$3
Rich Loading	[Worksheet in ProMaxBook1]Sheet1!\$D\$2:\$D\$12
Lean Loading	[Worksheet in ProMaxBook1]Sheet1!\$E\$2:\$E\$12
H <sub>2</sub> S Rich Approach	[Worksheet in ProMaxBook1]Sheet1!\$F\$2:\$F\$12
H <sub>2</sub> S Lean Approach	[Worksheet in ProMaxBook1]Sheet1!\$G\$2:\$G\$12

Starting Scenario #1 (1/14/2009 11:00:56 AM)  
 Scenario #2 Finished (1/16/2009 11:02:09 AM)  
 Starting Scenario #3 (1/16/2009 11:03:09 AM)  
 Scenario #4 Finished (1/16/2009 11:03:21 AM)  
 Starting Scenario #10 (1/16/2009 11:03:21 AM)  
 Scenario #10 Finished (1/16/2009 11:03:33 AM)  
 Starting Scenario #11 (1/16/2009 11:03:33 AM)  
 Scenario #11 Finished (1/16/2009 11:03:44 AM)

Log to worksheet Log Warnings  Stop on error  Reset initial guess  
 Log Scenario Selections  Add Cell Comments  Single run dynamic input.

Run from 1 to 11 Run

Amine Flow Rate Scenario.xlsx - Microsoft Excel

	A	B	C	D	E	F	G
	Amine Flow	H <sub>2</sub> S ppm	CO <sub>2</sub> %	Rich Loading	Lean Loading	H <sub>2</sub> S Rich Approach	H <sub>2</sub> S Lean Approach
1	50	221.92	2.21	0.21	0.0043	85.60	4.66
2	60	74.24	2.13	0.18	0.0042	77.28	12.89
3	70	45.38	2.08	0.16	0.0042	69.23	19.78
4	80	37.20	2.04	0.15	0.0041	62.26	23.35
5	90	33.75	2.01	0.13	0.0041	56.42	25.62
6	100	31.98	1.99	0.12	0.0041	51.53	27.39
7	110	30.92	1.97	0.11	0.0041	47.42	28.91
8	120	30.11	1.95	0.10	0.0041	43.93	30.37
9	130	29.54	1.93	0.10	0.0041	40.93	31.53
10	140	29.06	1.92	0.09	0.0041	38.34	32.80
11	150	28.63	1.90	0.09	0.0041	36.06	33.91



*“I would like to compliment your company on the excellent software package you developed. I’ve experienced other process simulation software in the past and have yet to find one that equals the accuracy and user friendliness of ProMax. This software has literally rejuvenated my love for engineering. This software, used in conjunction with a solid understanding of basic engineering principles, is a very effective tool. I’ve simulated most all of the processes within our company and continue to be amazed at how closely I’m able to match actual plant conditions. The facilities that are using my simulation information to operate their Cryo process are seeing significant recovery improvements and are amazed by the accuracy. I actually have plant operators (30 year vets) that are running outside their normal operating parameters and are achieving recoveries that were once thought unachievable. This software is literally affecting our bottom line and is worth every penny.”*

-Guy Gage  
Process Engineer  
Southern Union Company



# ProMax<sup>®</sup>

with TSWEET<sup>®</sup>

*Process Simulation Software*

*by*

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