



# Matrix Maker™

**The Formulation Engine  
for your High-Throughput  
Protein Crystallization  
Laboratory**

# Matrix Maker™ Summary

Break through your formulation bottlenecks with the unique liquid-handling capabilities of the Matrix Maker™:

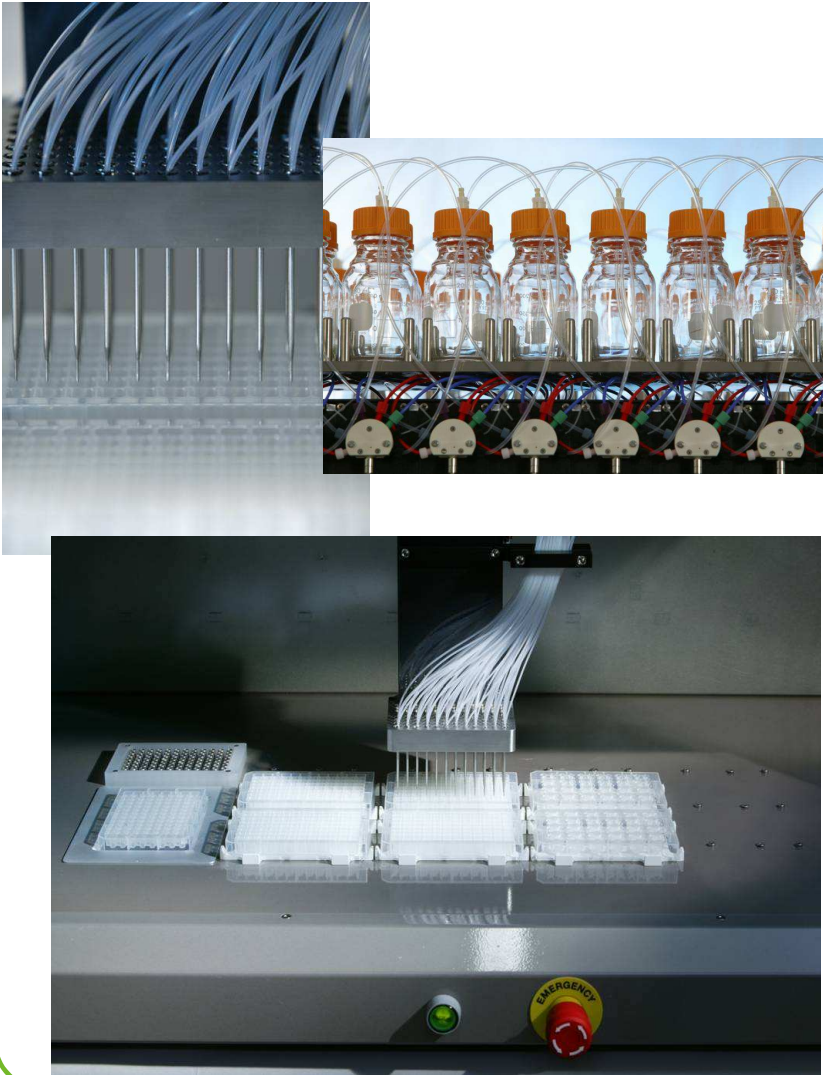
- Computer-aided formulation design and database tracking of formulation sets
- Automated formulation production: no more **time-consuming**, manual pipetting
- Robust, industrial-strength liquid dispensation technology



## FEATURES

- Dispense a 96-formulation matrix from up to 60 different liquids (any combination into any well)
- Fast processing time: less than 35 min for 96 cocktails
- Use any liquid: aqueous, organic, viscous and low surface tension liquids of varied pH
- Dispense into any container format (tubes, bottles, SBS-blocks etc.)
- Software support of formulation design

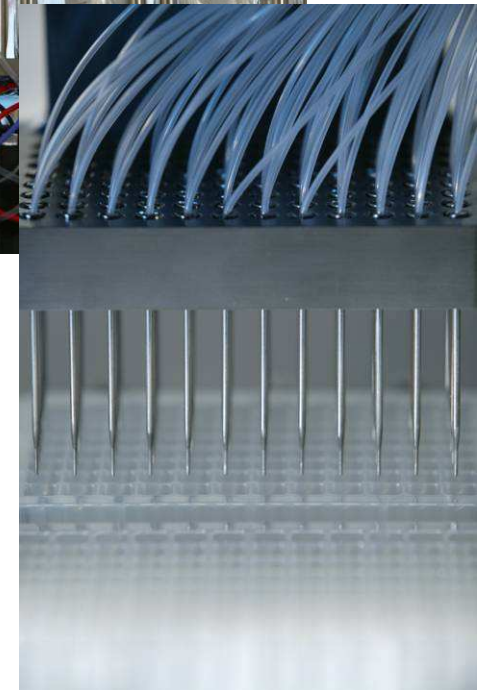
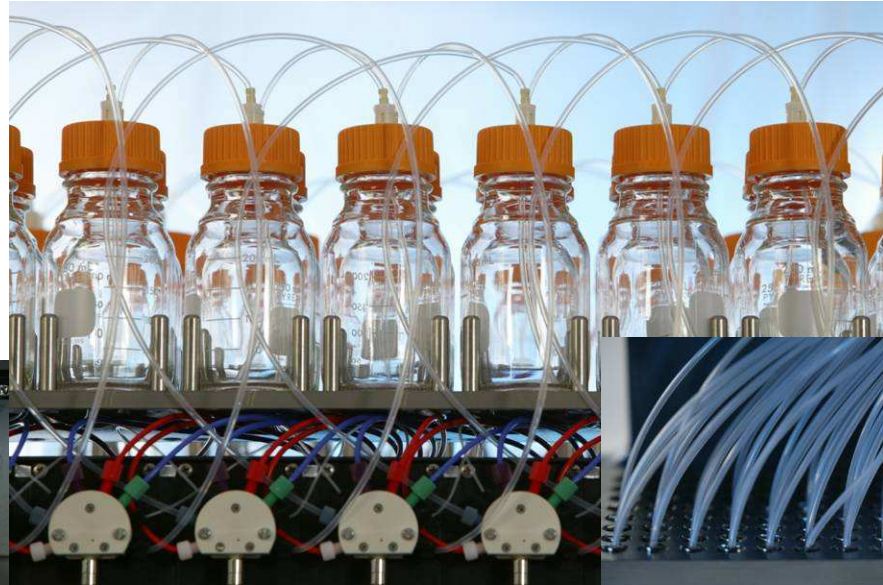
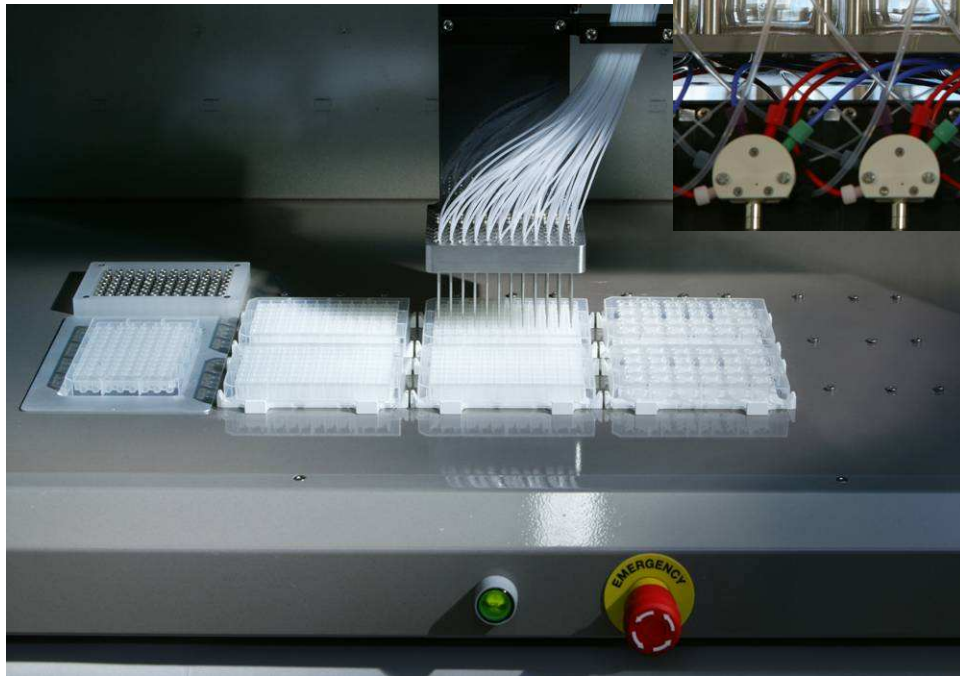
# The Matrix Maker™ Formulation Engine



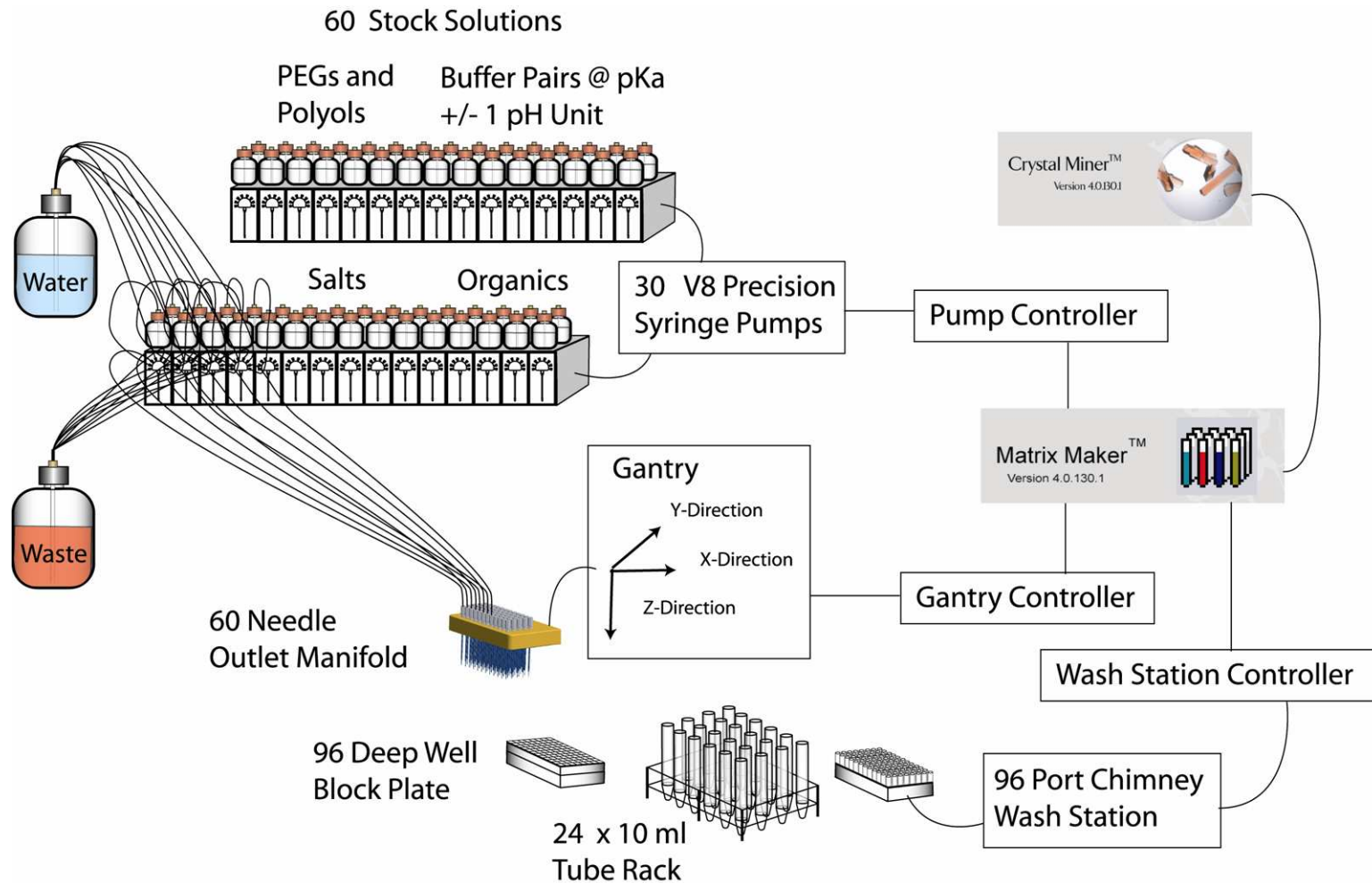
- Quality: High accuracy (2% cv) dispensation, even with highly viscous solutions (i.e. 100% Glycerol)
- Reliable & Robust
- Saves time and resources
- Easy to use and enables systematic variation of components and testing of more formulation variations
- Includes Crystal Miner™ optimization planning software application
- No surprise costs - no consumables needed for dispensation
- Adjustable for your throughput

# Chemically Resistant Materials

- Stainless Steel
- Teflon
- Glass

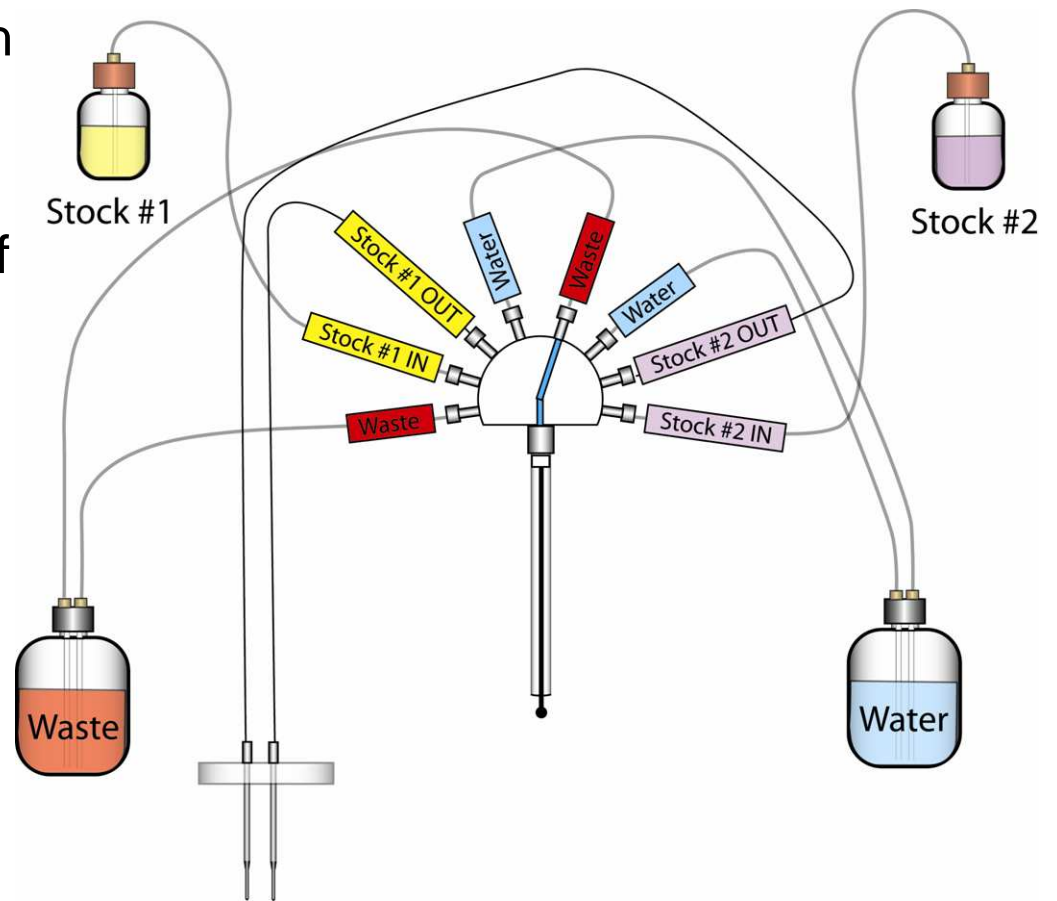
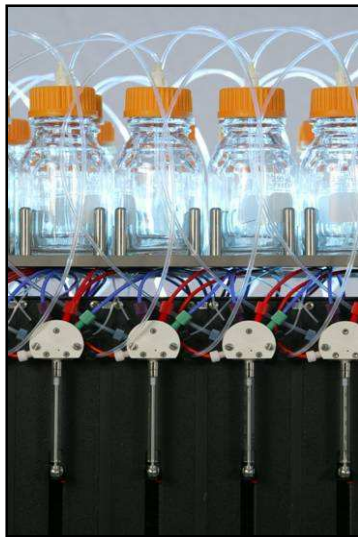


# Matrix Maker™ Schematic

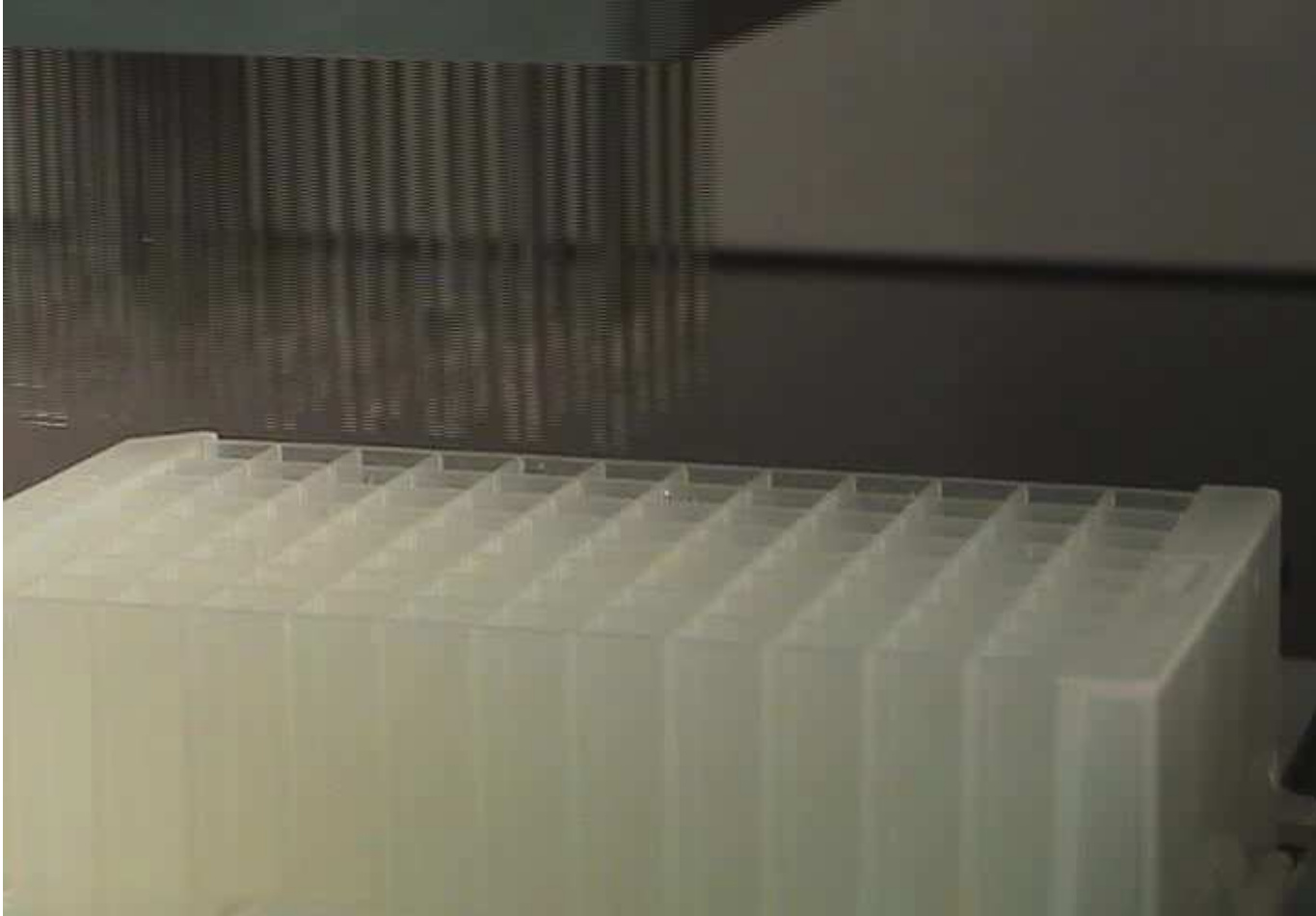


# 8-Port Valve Plumbing Configuration

- 2 Stocks Solutions on each V8 Syringe Pump
- No Cross Contamination of Stocks



# Matrix Maker™ Video



1-888-780-8535

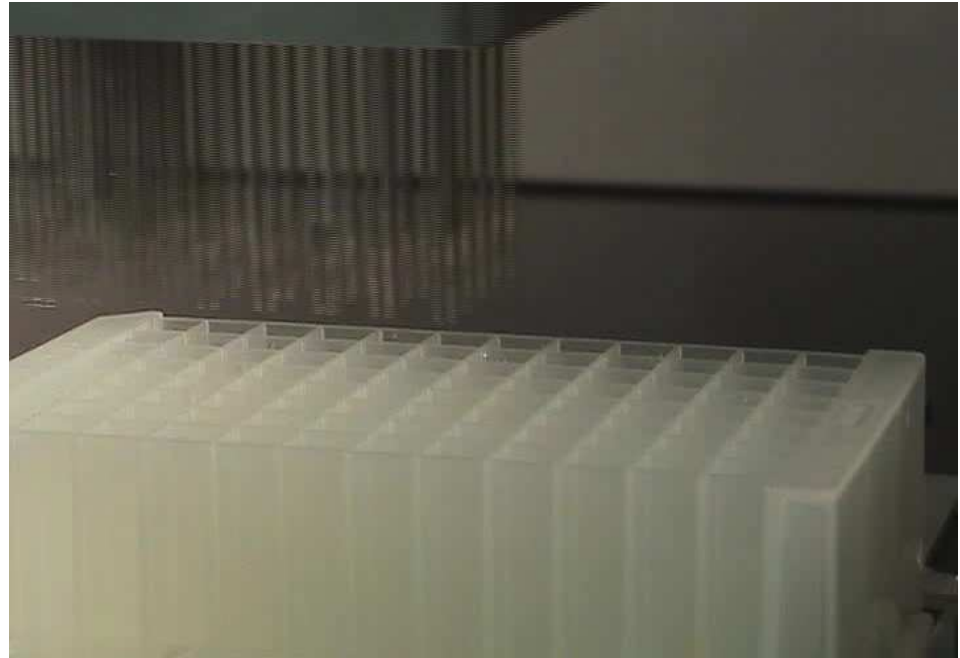
Emerald BioSystems © 2009

# Positive Pressure Shots of Viscous vs. Non-Viscous Solutions

Viscous  
Solutions



Non - Viscous  
Solutions

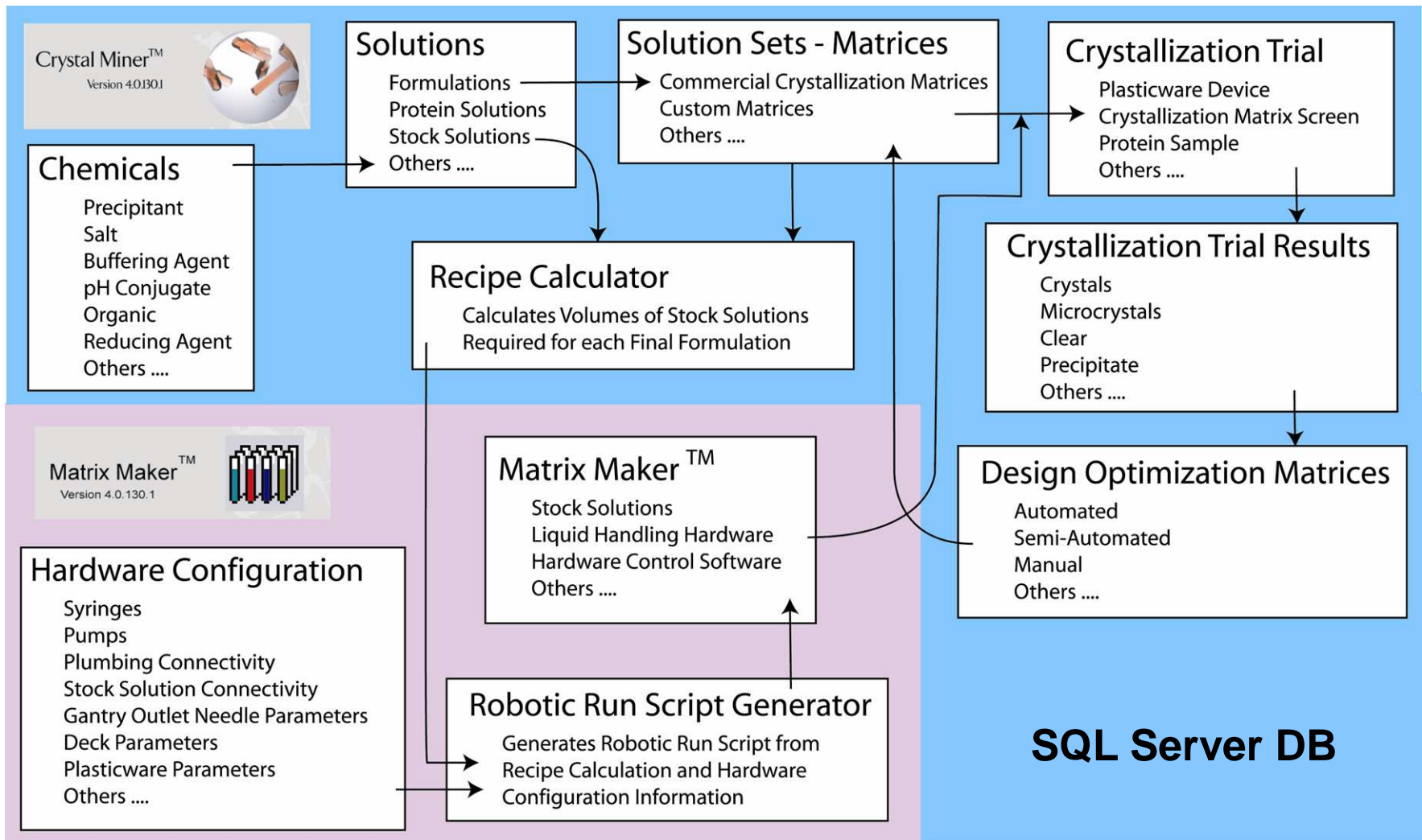


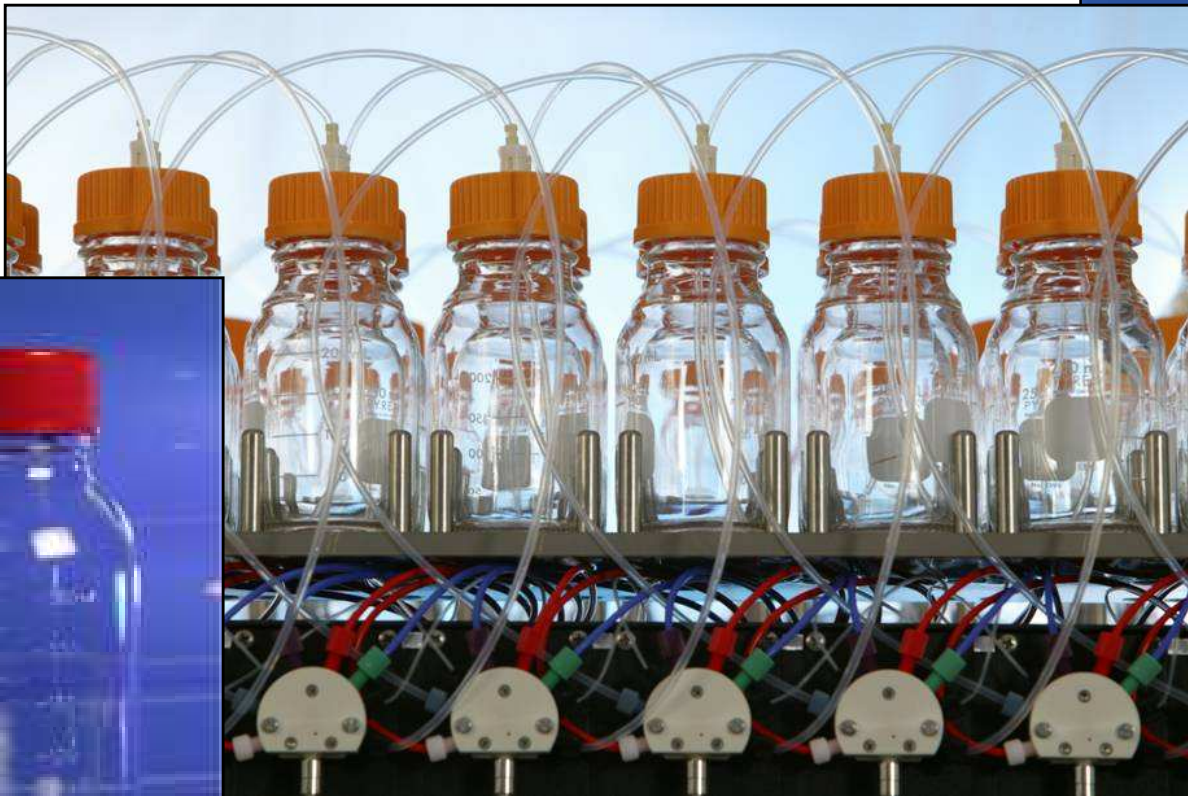
- ◆ **Viscous Solutions (i.e. 50% w/v PEG 8K)**
- ◆ **Low Viscosity Solutions (Water to 5M NaCl)**

# Crystal Miner™ Relational Database and Software Application

- Simple to use Matrix Design Tool
  - for new matrices from scratch
  - for systematic optimization (Screen Design Wizard)
- Matrix Maker control software
- Starter library with predefined Stock Solutions and Solution Sets – Matrices and standard formulations
- Integrated Recipe Calculation (including pH buffer concept)
- Networkability and data security with SQL Server or Oracle 9i database

# Crystal Miner™

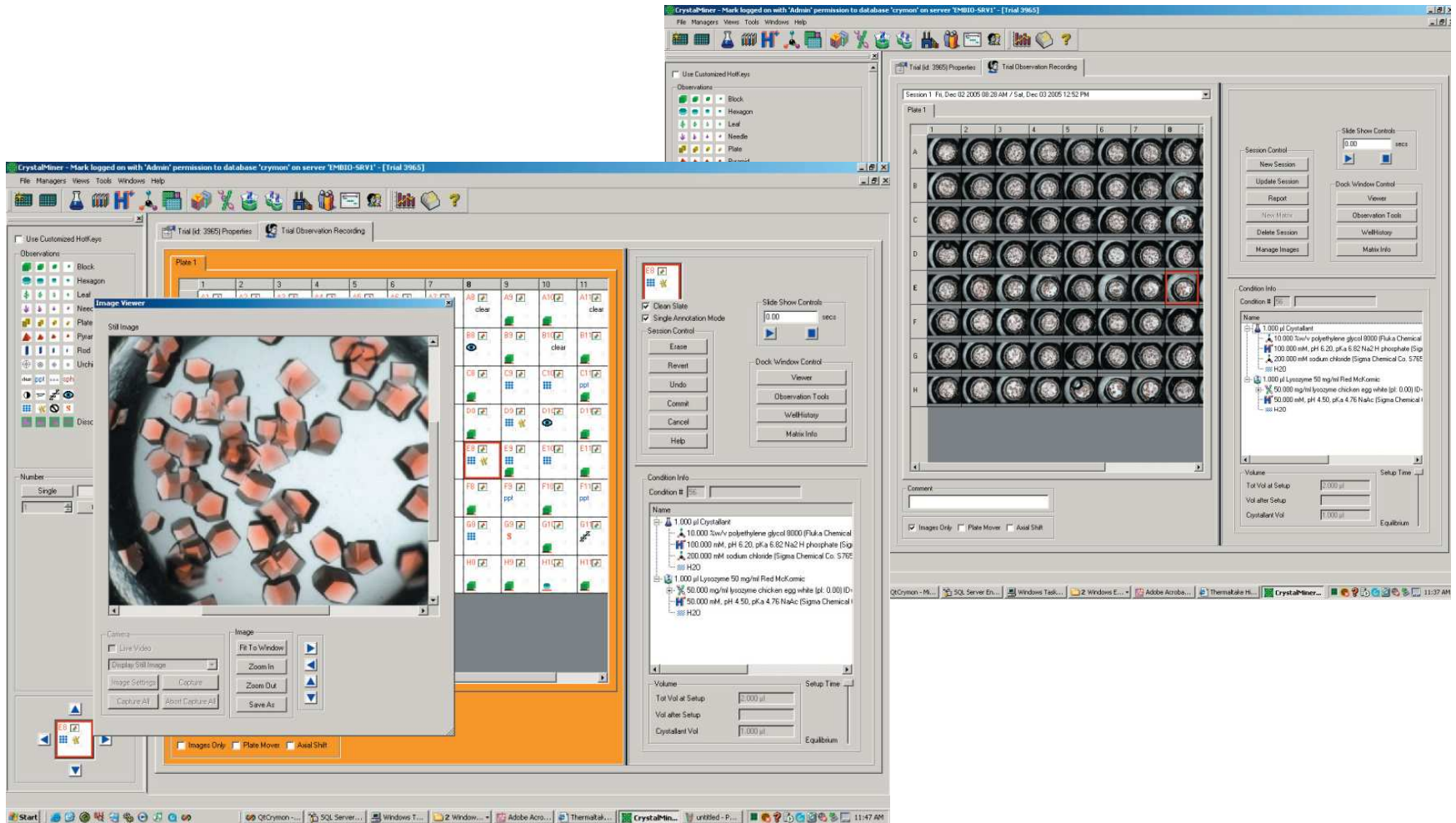




1-888-780-8535

Emerald BioSystems © 2009

# Crystal Miner Screen Shots



1-888-780-8535

Emerald BioSystems © 2009

# Component Variation Optimization

- Vary individual components in any condition, such as pH or concentration.
- Integrated pKa feature calculates pH and useful pH ranges.
- Substitute, remove, or add components to any condition(s).
- Choose Axis to vary each component.

**ex.**



# Crystal Miner™ New Matrix Tool

The screenshot displays the Crystal Miner software interface. The main window is titled "Matrix Viewer" and shows a grid of wells with pH values. A "Matrix Wizard - Opti96 (Reichert screen)" dialog box is open, prompting the user to enter limits for Quad I and Quad IV. The dialog box includes a grid diagram and input fields for Buffer Conc., Salt Conc., PPT Conc., and PPT Limit (Y-axis) for both quads.

**Matrix Viewer Data:**

Well	pH
1 (2)	pH 9.50
2 (3)	pH 7.50
3 (2)	pH 9.50
4 (3)	pH 8.00
5 (2)	pH 10.50
6 (2)	pH 5.50
7 (3)	pH 6.00
8	pH
13 (2)	pH 6.50
14	pH
19 (2)	pH 7.00
20	pH
25 (3)	pH 8.50
26	pH
31 (3)	pH 4.20
32	pH
37 (2)	pH 8.00
38	pH

**Matrix Wizard - Opti96 (Reichert screen) Parameters:**

Please enter the limits for Quad I and Quad IV

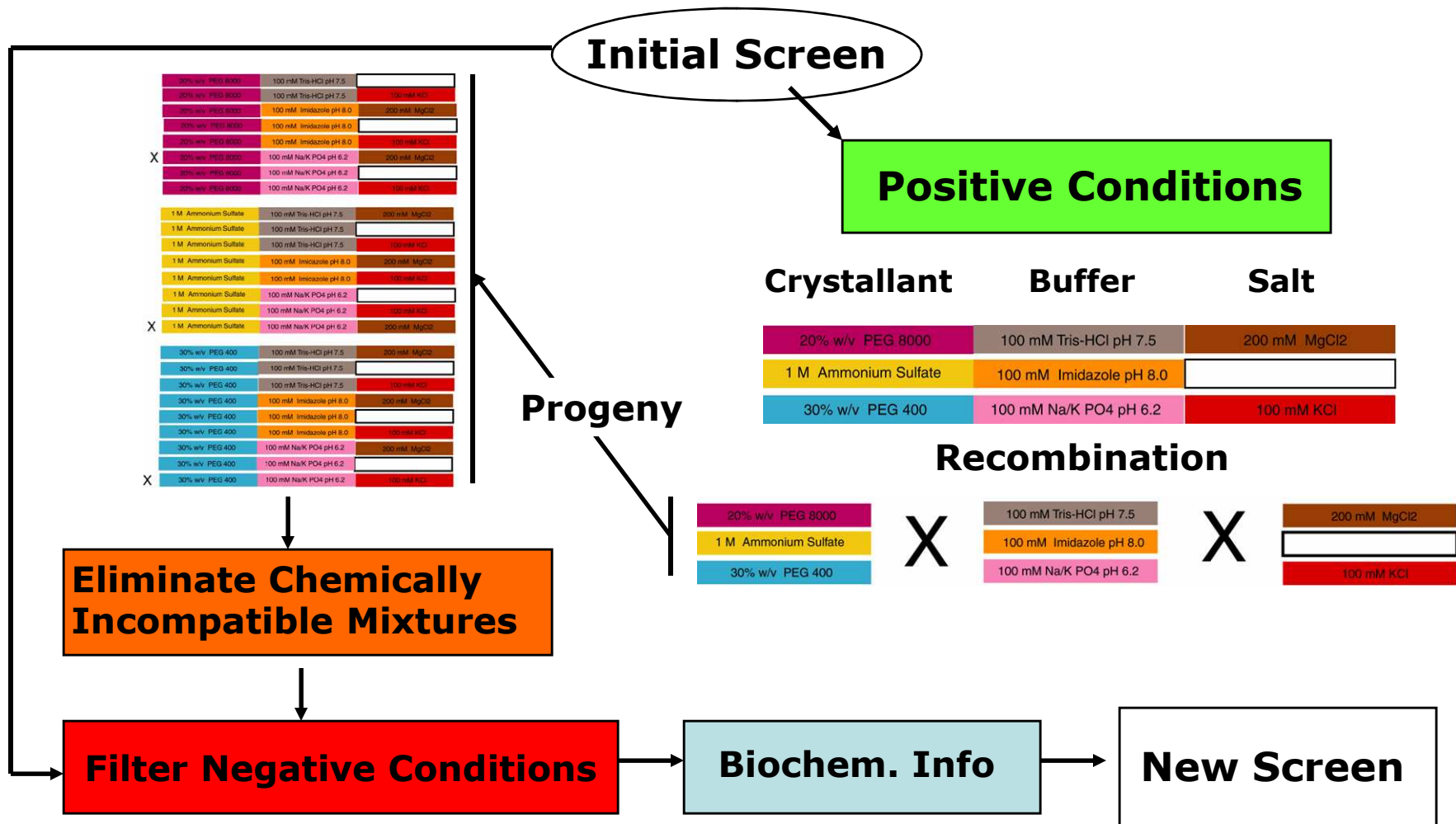
**Quad I (8x3)**

- Buffer Conc.: 100. mM const.
- Salt Conc.: 200. mM const.
- PPT Conc.: 10.000 %v/v
- PPT Limit (Y-axis): 20

**Quad IV (8x3)**

- Buffer Conc.: 100. mM const.
- Salt Inc.: 200. mM const.
- Buffer pH: 7.5
- pH Limit (X-axis): 8.2
- PPT Conc.: 10.000 %v/v
- PPT Limit (Y-axis): 20

# PBS Cross Optimization Strategy



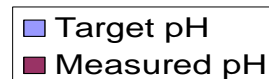
# Henderson-Hasselbach Buffer Recipe Calculation for Matrix Maker™

- Proper mixtures of buffer stocks @ pKa +/- 1 pH unit calculated for dispensing by Matrix Maker™
- $\text{pH} = \text{pK}_a + \log\left[\frac{[\text{A}^-]}{[\text{HA}]}\right]$
- pH depends on ratio of conjugate base / conjugate acid
- Example; HEPES/NaOH pH 6.48 and pH 8.48 Stocks.

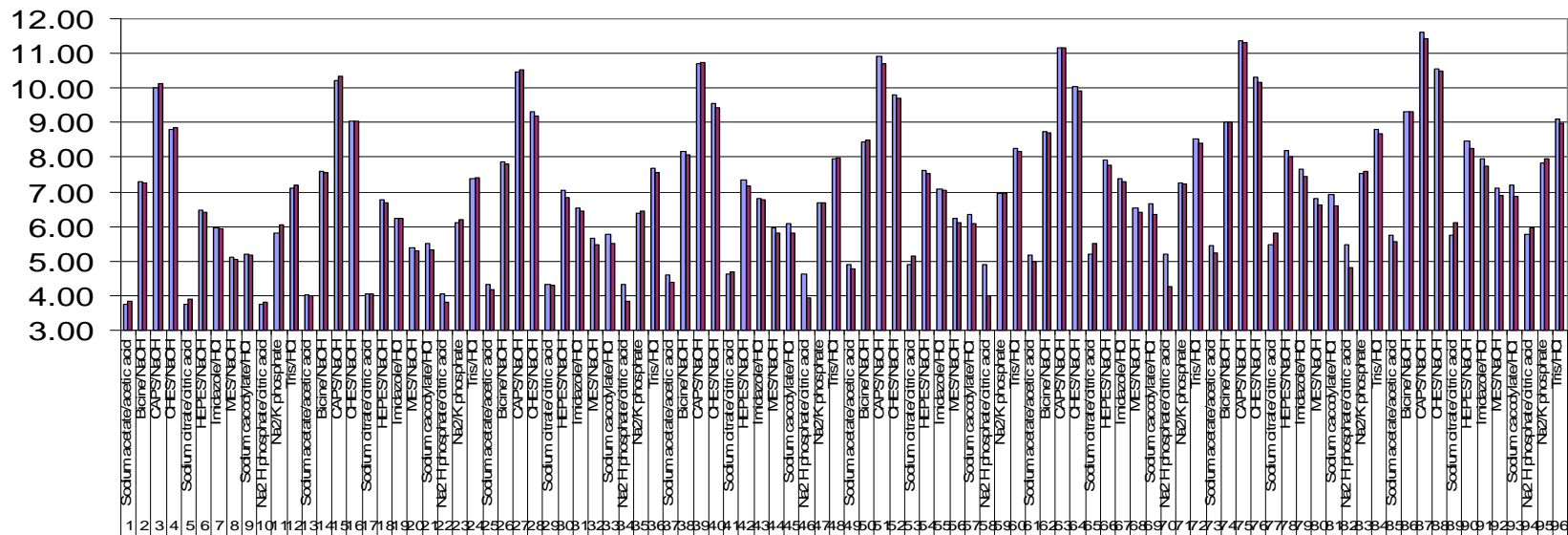
WellID	Volume	Stock Name	Stock Conc.	Chemical Name
H 1	0.086 ml	HEPES pH6.48	1000.000 mM	pH 6.480 (pKa 7.48 HEPE...
H 1	0.014 ml	1M HEPES pH 8.48	1000.000 mM	pH 8.480 (pKa 7.48 HEPE...
≡ 1	0.900 ml		n/a	H2O
H 2	0.079 ml	HEPES pH6.48	1000.000 mM	pH 6.480 (pKa 7.48 HEPE...
H 2	0.021 ml	1M HEPES pH 8.48	1000.000 mM	pH 8.480 (pKa 7.48 HEPE...
≡ 2	0.900 ml		n/a	H2O
H 3	0.070 ml	HEPES pH6.48	1000.000 mM	pH 6.480 (pKa 7.48 HEPE...
H 3	0.030 ml	1M HEPES pH 8.48	1000.000 mM	pH 8.480 (pKa 7.48 HEPE...
≡ 3	0.900 ml		n/a	H2O
H 4	0.061 ml	HEPES pH6.48	1000.000 mM	pH 6.480 (pKa 7.48 HEPE...
H 4	0.039 ml	1M HEPES pH 8.48	1000.000 mM	pH 8.480 (pKa 7.48 HEPE...
≡ 4	0.900 ml		n/a	H2O
H 5	0.051 ml	HEPES pH6.48	1000.000 mM	pH 6.480 (pKa 7.48 HEPE...
H 5	0.049 ml	1M HEPES pH 8.48	1000.000 mM	pH 8.480 (pKa 7.48 HEPE...
≡ 5	0.900 ml		n/a	H2O

# Buffer pH Accuracy

- 1.5 ml final volume prepared with 1 M Buffer Stocks @ pKa +/- 1 pH unit.
- +/- ~0.09 pH unit for Target pH vs. Measured pH using 11 different single buffer systems ranging from pH 3.8 to pH 11.6 .
- Accuracy of measurement is ~0.02 pH units.
- Conclusion: Highly Accurate pH Delivery



**Matrix Maker pH Test Results**



# Matrix Manager

- Database Management of Matrices / Screens within Crystal Miner

Matrix Name: WzrdF  
 Condition Count: 96  
 Preparator: Emerald BioStructures, Inc.  
 Prep Date: Sat, Jul 31 1999 12:00 AM  
 Comment: Emerald's Full Wizard I&II Matrices. A random sparse matrix of crystallants (1-96).

Well	Compound Buffer	Precipitant	Salt
1	100.000 mM CHES/NaOH pH: 9.5	20.000 %w/v PEG-8000	
2	100.000 mM HEPES/NaOH pH: 7.5	10.000 %v/v isopropanol	200.000 mM sodium chloride
3	100.000 mM CHES/NaOH pH: 9.5	15.000 %v/v EtOH	
4	100.000 mM imidazole/HCl pH: 8.	35.000 %v/v MPD	200.000 mM MgCl2
5	100.000 mM CAPS/NaOH pH: 10.5	30.000 %v/v PEG-400	
6	100.000 mM Na3 citrate/citric acid pH: 5.5	20.000 %w/v PEG-3000	
7	100.000 mM MES/NaOH pH: 6.	10.000 %w/v PEG-8000	200.000 mM ZnAc2
8	100.000 mM Na3 citrate/citric acid pH: 5.5		
9	100.000 mM acetic acid/NaAc pH: 4.5		
10	100.000 mM Tris base/HCl pH: 7.		
11	100.000 mM MES/NaOH pH: 6.		
12	100.000 mM imidazole/HCl pH: 8.		
13	100.000 mM Na cacodylate/HCl pH: 6.5		
14	100.000 mM Na cacodylate/HCl pH: 6.5		
15	100.000 mM imidazole/HCl pH: 8.		
16	100.000 mM Na2 H phosphate/K H2 phosphate pH: 6.2		
17	100.000 mM acetic acid/NaAc pH: 4.5		
18	100.000 mM imidazole/HCl pH: 8.		
19	100.000 mM Tris base/HCl pH: 7.		
20	100.000 mM imidazole/HCl pH: 8.		
21	100.000 mM HEPES/NaOH pH: 7.5		
22	100.000 mM Tris base/HCl pH: 8.5		
23	100.000 mM imidazole/HCl pH: 8.		
24	100.000 mM Tris base/HCl pH: 7.		

**Matrix Manager**  
 Emerald BioStructures, Inc.

Name	Type	Preparator	Num...	Comment
Wzrd1	Random	Emerald...	48	Emerald's Wizard I Crystal Growth Matrix. A ran...
Wzrd2	Random	Emerald...	48	Emerald's Wizard II Crystal Growth Matrix. A ra...
Cryo1	Random	Emerald...	48	Emerald's Cryo I Crystal Growth Matrix. All crys...
Cryo2	Random	Emerald...	48	Emerald's Cryo II Crystal Growth Matrix. All crys...
CryoF	Random	Emerald...	96	Emerald's Full Cryo I&II Crystal Growth Matrix. ...
WzrdF	Random	Emerald...	96	Emerald's Full Wizard I&II Matrices. A random...

Usage:  
 ProjectName: test  
 Comment:

# Automatic Stock Recipe Calculation

- Read directly by Matrix Maker™

Stock Solution Calculator - Matrix Recipe

Minimum dispense volume: 1.00 µl

Final crystallant volume: 1 ml

Calculate! Make Matrix..

WellID	Volume	Stock Name	Stock Conc.	Chemical Name
1	0.050 ml	2-propanol stock	100.000 %v/v	isopropanol (A464-4 Fis
1	0.040 ml	sodium chloride 5 M stock	5000.000 mM	sodium chloride (S7653
1	0.173 ml	HEPES pH 6.2 500 mM Sigma H3...	500.000 mM	pH 6.200 (pKa 7.48 HE
1	0.027 ml	HEPES pH 8.8 500 mM Sigma H3...	500.000 mM	pH 8.800 (pKa 7.48 HE
1	0.710 ml		n/a	H2O
2	0.050 ml	2-propanol stock	100.000 %v/v	isopropanol (A464-4 Fis
2	0.040 ml	sodium chloride 5 M stock	5000.000 mM	sodium chloride (S7653
2	0.163 ml	HEPES pH 6.2 500 mM Sigma H3...	500.000 mM	pH 6.200 (pKa 7.48 HE
2	0.037 ml	HEPES pH 8.8 500 mM Sigma H3...	500.000 mM	pH 8.800 (pKa 7.48 HE
2	0.710 ml		n/a	H2O
3	0.050 ml	2-propanol stock	100.000 %v/v	isopropanol (A464-4 Fis
3	0.040 ml	sodium chloride 5 M stock	5000.000 mM	sodium chloride (S7653
3	0.151 ml	HEPES pH 6.2 500 mM Sigma H3...	500.000 mM	pH 6.200 (pKa 7.48 HE
3	0.049 ml	HEPES pH 8.8 500 mM Sigma H3...	500.000 mM	pH 8.800 (pKa 7.48 HE
3	0.710 ml		n/a	H2O

View in Browser... Save to HTML...

< Back Finish Cancel Help

# Matrix Maker™ Liquid Formulation Robot

**96 new cocktails in less than 35 minutes from 60 chemical stocks**



Patented

- ◆ 30 or 60 V8 Syringe Pumps
- ◆ Water + 59 Stocks
- ◆ Wash station
- ◆ No tip waste
- ◆ Sterile liquid path
- ◆ Stock volume tracking
- ◆ 100 ul to 25 ml Syringes
- ◆ Weight 475lb (215kg)
- ◆ Height 49" (125cm), Depth 31" (79cm), Length 44" (112cm)
- ◆ Operating Range: 4 – 20 C
- ◆ CE Certified
- ◆ 110/220 VAC, 60/50hz, 880VA max
- ◆ Emergency Stop Button
- ◆ Safety sash with safety Stop Feature



# Emerald BioSystems

*Integrated Solutions for Biotechnology*

Emerald BioSystems, Inc.

7869 NE Day Road West Bainbridge Island, WA 98110

[www.emeraldbiosystems.com](http://www.emeraldbiosystems.com)

(888)780 8535