



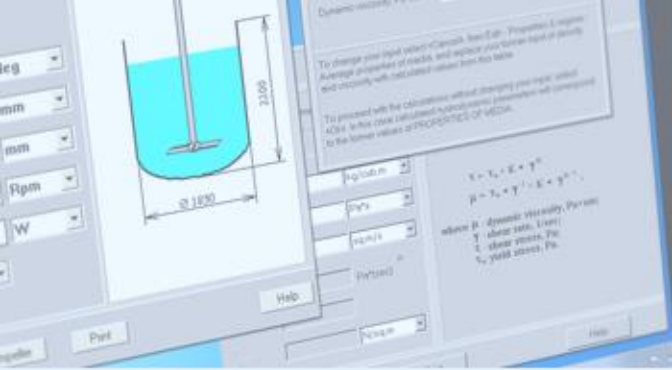
Simulation of Mixing Processes

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The influence of Mixing Processes: from Laboratory to Production

Moshe Bentolila

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About Us

VisiMix.Ltd is a unique software enabling chemical engineers, process engineers and R&D personnel to characterize and visualize mixing processes via a simple, user friendly interface.



Our products allow significant savings in time and costs by drastically reducing the need for trial-and-error. They have been successfully adopted by hundreds of companies.

VisiMix Background

Established in 1995

1995-1998 – Developed the VisiMix Turbulent Product

1998-2000 – Developed the VisiMix Laminar Product

2000-2003 – Developed the VisiMix Different Impellers Product

2003-2004 – Developed the VisiXcel Product

2007-2010 – Developed the VisiMix RSD Product

2011-2013 – Developed the VisiMix Emulsification Product

2014-2017 – Developed the VisiMix 3D, Generic Hydrofoils Blades and Alternative impellers

2018-2019 – Developed Off Center Impellers

2020-2022 – VisiMix Scale Up – Scale Down / Process Evaluation

Today VisiMix has More than 250 Customers



Motivation

Common Questions

- ✓ Did we cover the main parameters during the process development?
- ✓ Will our facilities will be appropriate for the developed process?
- ✓ Does the equipment offer is good for the process?
- ✓ What about safety and runaway scenario?
- ✓ Do our process is robust?
- ✓ Does the operational range parameters are large enough for the manufacture facilities?

The Goal

Once the Science of the process (Chemistry, Biology or physics) is known well, a common situation during the process transfer from lab to production or from site to site is the gap between the old and new results.

- ❑ **Our first goal is to develop a process that will run properly in the first trial on a new scale or site, similar to our successful results in the lab or in the old facility.**

In order to achieve this, we need to evaluate the process with the same conditions we will have in the production phase.

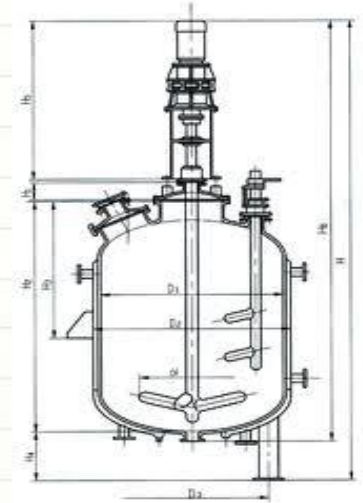
- ❑ **The main parameters we change are the hydrodynamics of the system. If we are able to identify and control these parameters we will be able to achieve to the available and optimal solution.**

Data and Results Management



R&D

Design

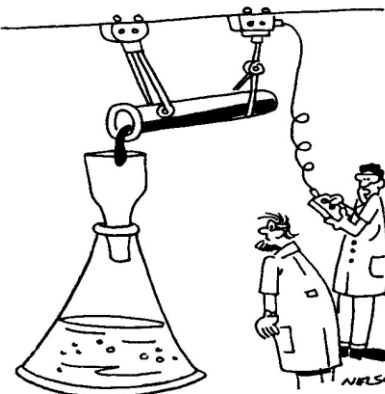


VisiMix

Mixing Simulation Software

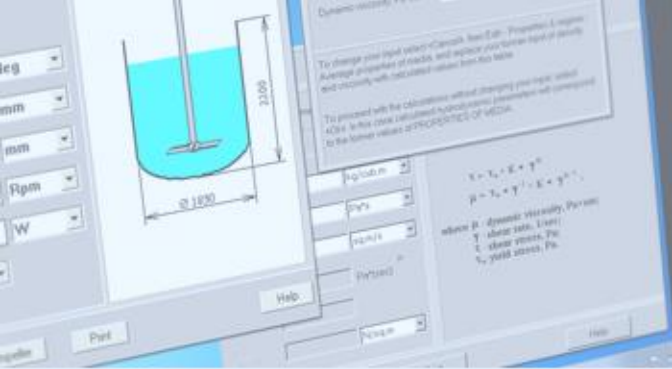
Production

QbD



27/05/2026





What is Good Mixing?

Troubleshooting in Life Science Industry

Savings of 900,000 Euro!

VISIMIX SOLUTIONS



Process: *Trouble shooting in Life Science Industry after break down of equipment*

Task: *Understand reason for failed batches and establish new operation conditions with the new equipment.*

The Process

Chemical reaction on porous beads in the life science industry.

The Problem

One product is produced in three slightly different reactors. An intermig impeller was installed in one of the reactors after a breakdown. The flow properties were much higher for batches from the reactor with the new impeller and several batches were out of specification. It was known that oxygen hydrolysis destroys the sugar molecules while the slurry is basic.

The Traditional Approach

Trial and error in the production facilities in order to do "fine tuning" of the operational parameters in the process. No improvement was observed.

The VisiMix Analysis

VisiMix was used to find out why the process failed and make suggestions to remedy the challenge.

The VisiMix Solution

Due to the design of the old impeller, all beads were found in the lower part of the reactor. VisiMix calculations showed that the improved mixing accelerated hydrolysis. VisiMix also showed that the new impeller was not suited for the process and that the only way to avoid failed batches was to stop using the vessel for this product.

The Results

Oxygen hydrolysis during basic conditions destroys the sugar molecules. Concentration of product much higher below the old impeller. Due to the improved mixing hydrolysis was accelerated.

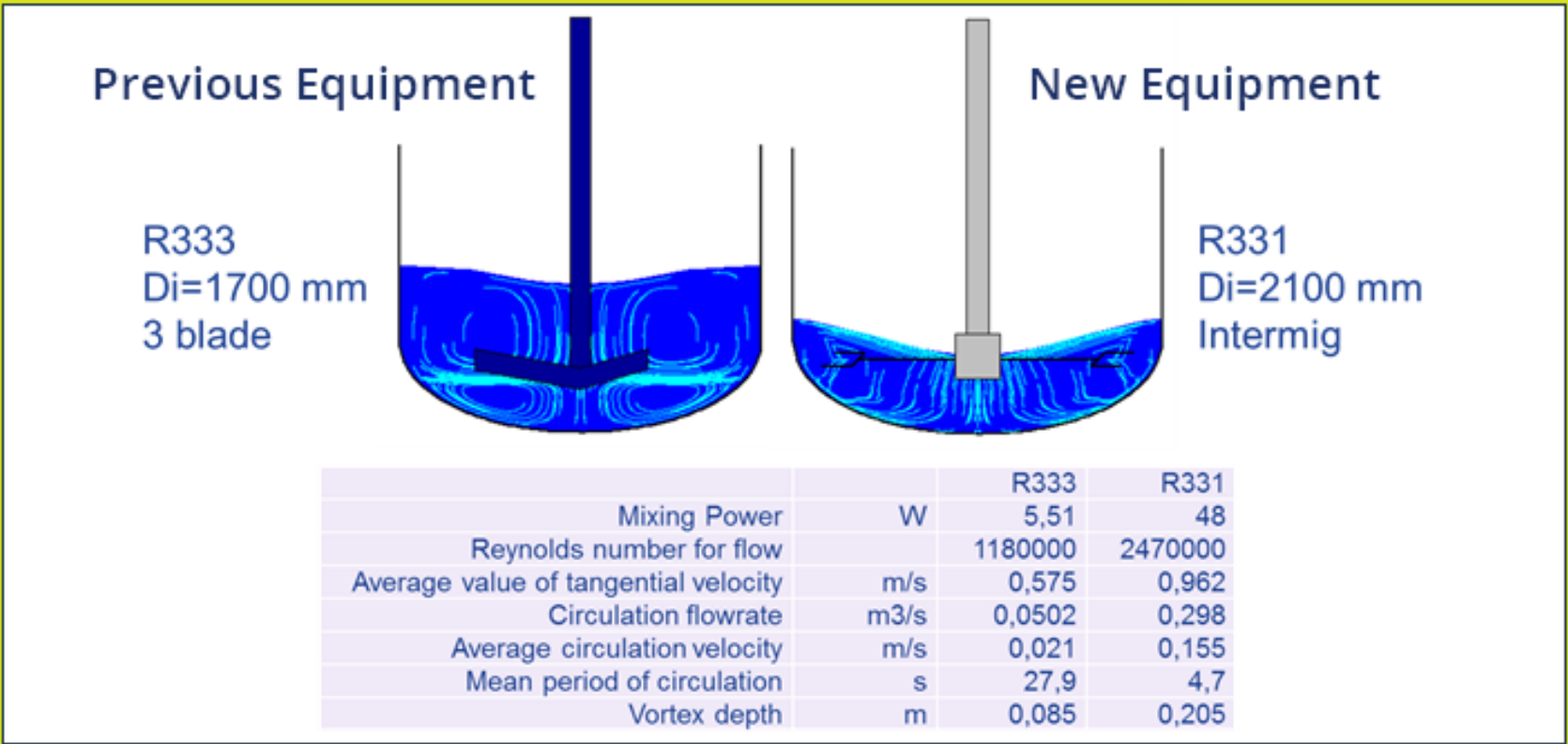
“From the outcome of this case, we understood that the combination of the company knowledge of the process with VisiMix simulation is more than must – in order to succeed to define new equipment for new processes.”

“The Launch was delayed by 6 months and the potential of production during this months is – 1,200,000 Eu and there are some more expenses connected with purchasing equipment”

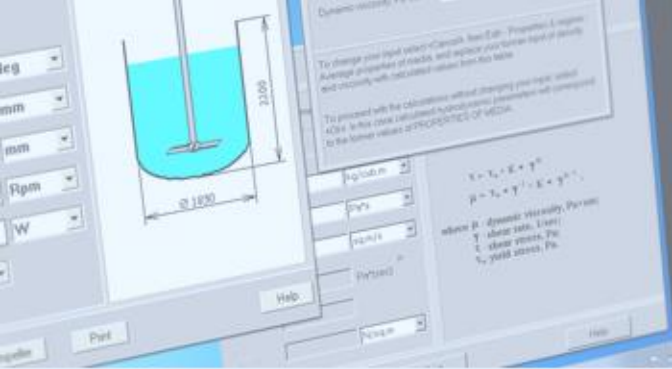
Technical Description

Process :
Troubleshooting in the life science industry after breakdown and repair of equipment

Task :
Understand the reason for failed batches and establish new operation conditions with the new equipment.



Improved mixing accelerated hydrolysis. VisiMix showed that the impeller was not suited for this process, and as a result the production was moved to reactors with appropriate mixing.



Proposed Method

Mixing Calculations in Development

Save with VisiMix (for this example: \$1,000,000 per project)!

VISIMIX SOLUTIONS



Process:

Typical Fine Chemical Development

Task:

Decreasing the Number of required batches for Validation Process in the production step.

The Process

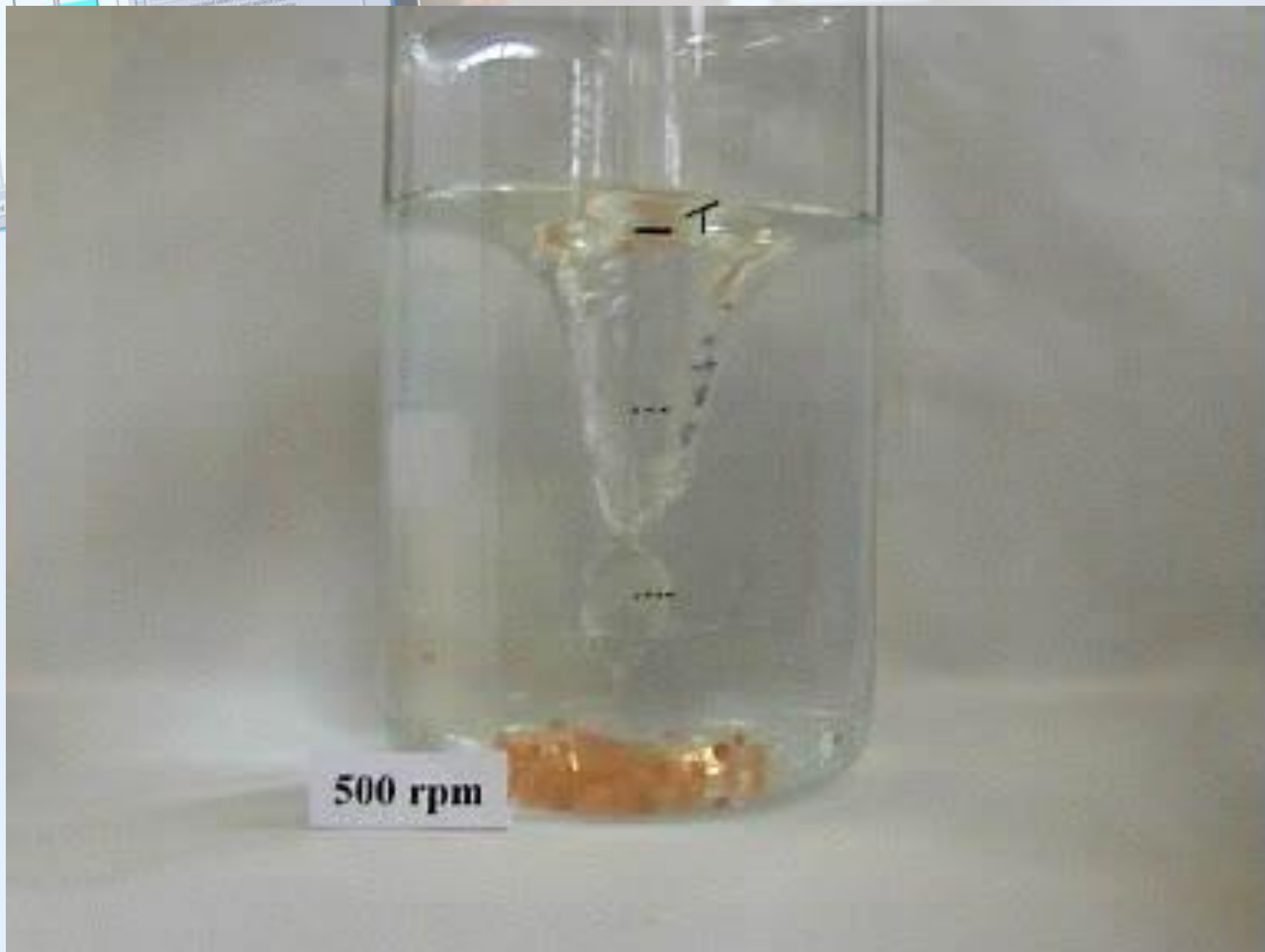
Batch and Semi batch Process.

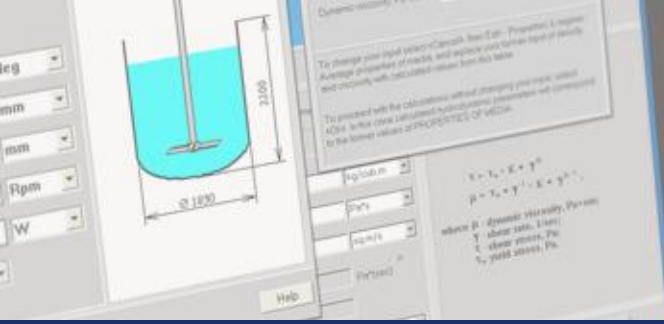
The Problem

Gap between R&D and production results.

The Traditional Approach

Running the process at increasing sized reactors and looking for optimal process and operation parameters at every stage.

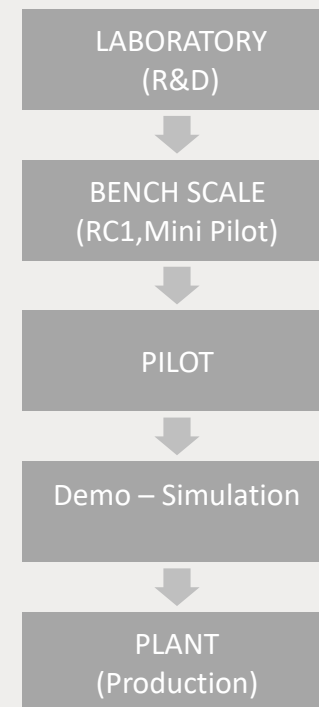
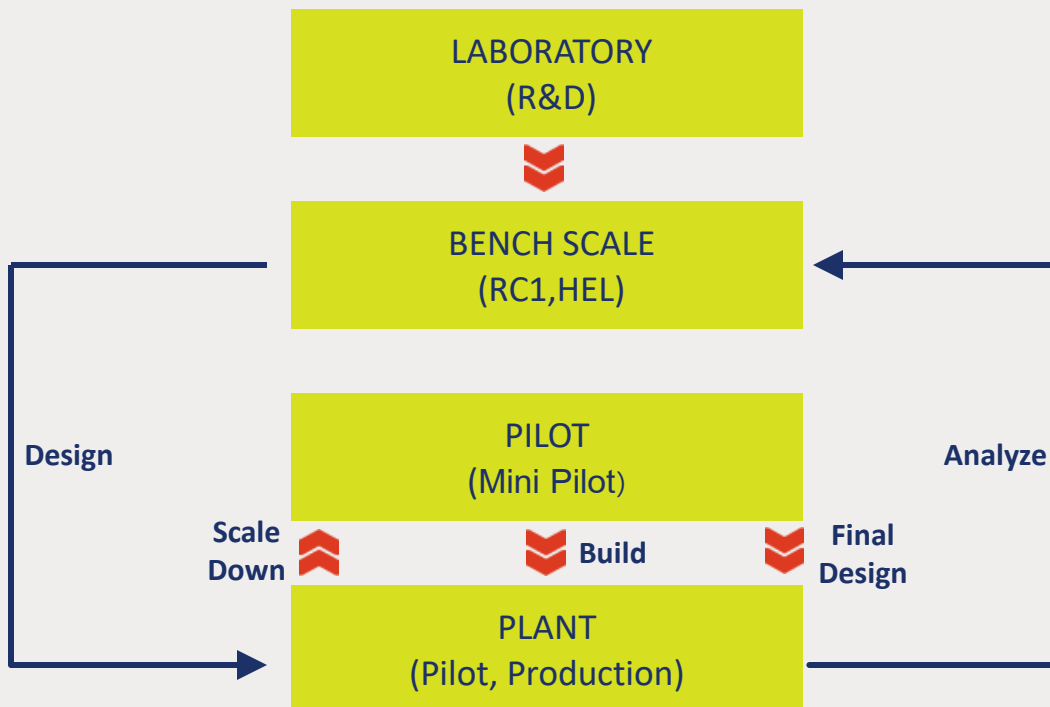




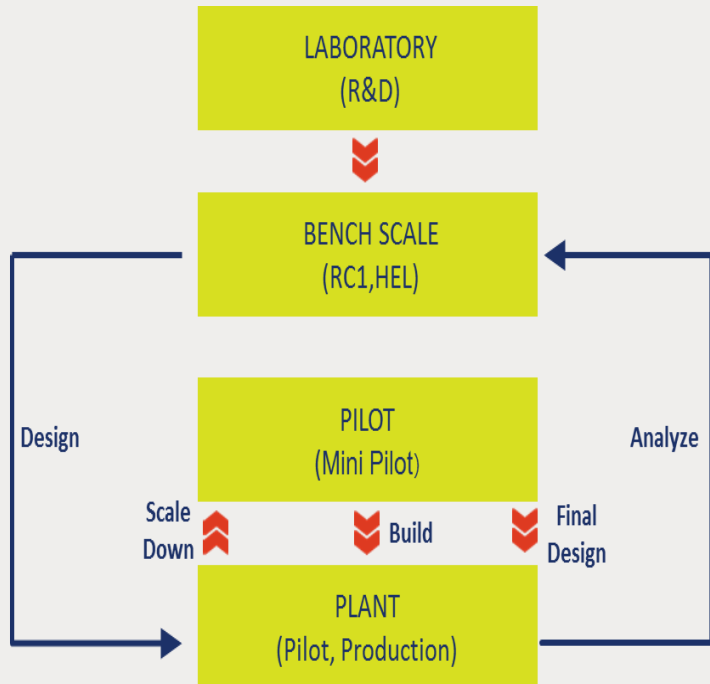
Methodology

(J.M. Berty, CEP, 1979)

New Process with Mixing



Methodology



» **Step 1:** Know the Mechanism of your Process.

» **Step 2:** Calculate Mixing Parameters will be available to provide in the commercial stage equipment.

» **Step 3:** Set Up Lab or Pilot equipment at the same range of work as calculated in Step 2.

» **Step 4:** Run Statistical Design of Experiments under conditions Set Up in Step 3 and select relevant experiments to proof the mechanism and achieved a good product quality, effective process operation and maximum yield.

» **Step 5:** Model Verification by Scaling down in industrial equipment for sample customer product.

» **Step 6:** Generate a Final Design, Procedure an Operation.

Lab and Prod Calculations

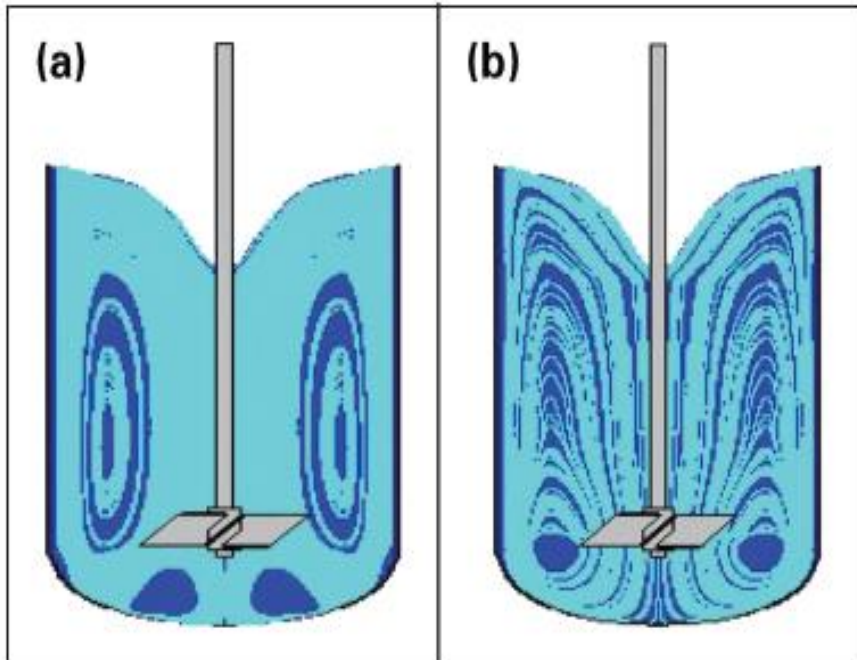


Figure 1. RC-1 General flow – pattern picture, (a) pumping down and (b) pumping up.

Operational Parameter	R 7610	R 7501 Modified
Operation Initial Conditions		
Reactor Volume, L	8	100
Reactor Temperature, °C	70	70
Stirrer Velocity, rpm	450	300
Hydrodynamics		
Mixing Power, W	17	335
Reynolds for Flow	73200	249000
Turbulence Main Characteristics		
Energy Dissipation – Average value, W/kg	2.29	3.61
Energy Dissipation – Maximum Value, W/kg	103	122
Liquid-Solid Mixing Main Characteristics		
Solid Suspended Condition is Expected	OK	OK
Maximum Degree of Non-Uniformity – Axial, %	14	15
Maximum Degree of Non-Uniformity – Radial, %	5	4
Average Concentration of Solid Phase in Continuous Flow, kg/m ³	39	39
Gassing Characterization		
Gas Hold – Up*	0.00024	0.16
Specific Mass Transfer Coefficient Gas – Liquid, 1/s	0.0015	0.655
Gas Mass Transfer Rate*, kg/h	0.0011	6.84
Gas Distribution: Satisfactory, Flooding Not Expected	OK	OK
* Gas Hold-up: represents the average value of volume fraction of gas in the gas-liquid mixture. * Gas Mass Transfer Rate: rate of gas dissolution corresponding to specific mass transfer coefficient.		

Non Ideal Stirring – Non homogeneity

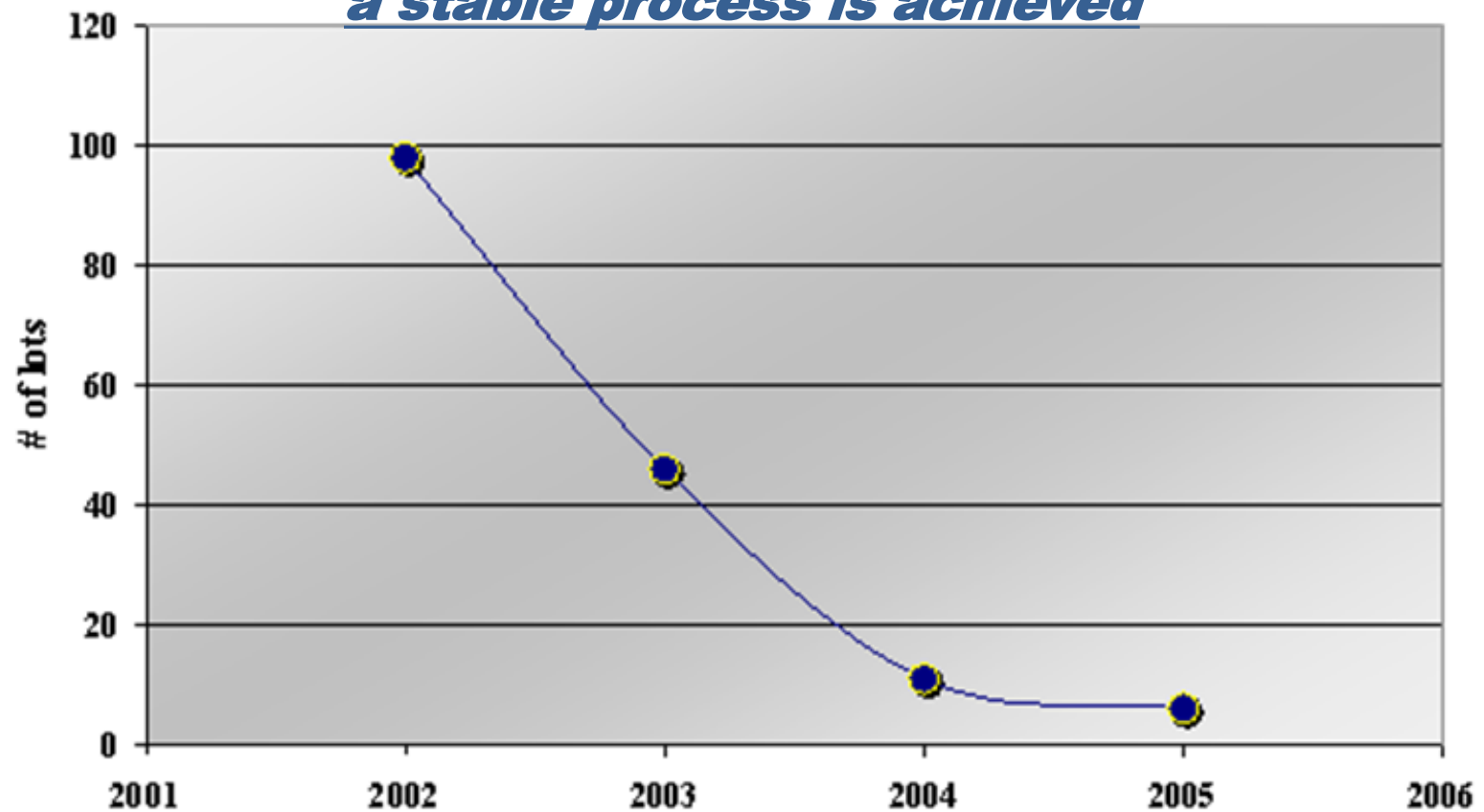
Before performance of scale up experiments **VisiMix** simulation was used to check suspension at different Mini Pilot Reactors:

Reactor	7603	7605	7605	7607
Volume, L	10	25	25	50
RPM	500 (Max)	400	500 (Max)	150 (Max)
Liquid – Solid Mixing				
Solid suspension quality	Complete suspension is questionable. Partial settling of solid phase may occur.	Complete suspension is expected.	Complete suspension is expected.	Complete suspension is questionable. Partial settling of solid phase may occur.
Max. degree of non uniformity of solid distribution				
AXIAL, %	22.3	10.3	29.1	132
RADIAL, %	65.7	34.3	76.3	90.8

Not all Mini Pilot reactor are capable of full suspension of Reagent

Methodology

Number of produced batches needed until a stable process is achieved



Brief Description of Mixing Phenomena

Macromixing Time

- This parameter characterizes the time required for the distribution of solute (admixture, tracer, paint, etc.) throughout the entire volume of the tank.
- It is calculated as the time required to reduce the maximum difference of local concentrations of the admixture to about **1%** of its final average value (in batch mixing conditions).

Brief Description of Mixing Phenomena

Mean period of circulation

- The average time of a single cycle of media circulation is calculated on the basis of the circulation flow rate.
- In many cases, it is recommended to reduce this parameter, for instance, to avoid significant change of concentration near the inlet pipe.
- To reduce circulation time without increasing the mixing power, try an impeller with a larger tip diameter and lower pitch angle of blades

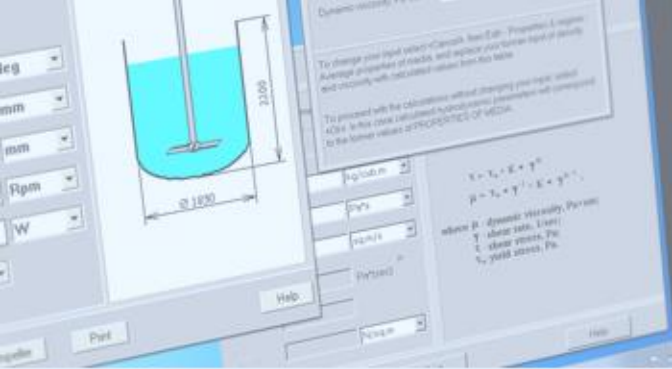
Brief Description of Mixing Phenomena

Characteristic time of micromixing

- This parameter represents an estimate of the time required to achieve uniform distribution of the dissolved substances down to the molecular level.
- It is assumed to depend on the molecular diffusion of solute, while the scale of mixing due to molecular diffusion only is supposed to correspond to the microscale of turbulence.
- Micromixing time is estimated both as the diffusion time, and as the maximum lifetime of a volume element, which has elapsed before the element enters the zone of the maximum dissipation rate

VISIMIX

software for chemical engineering

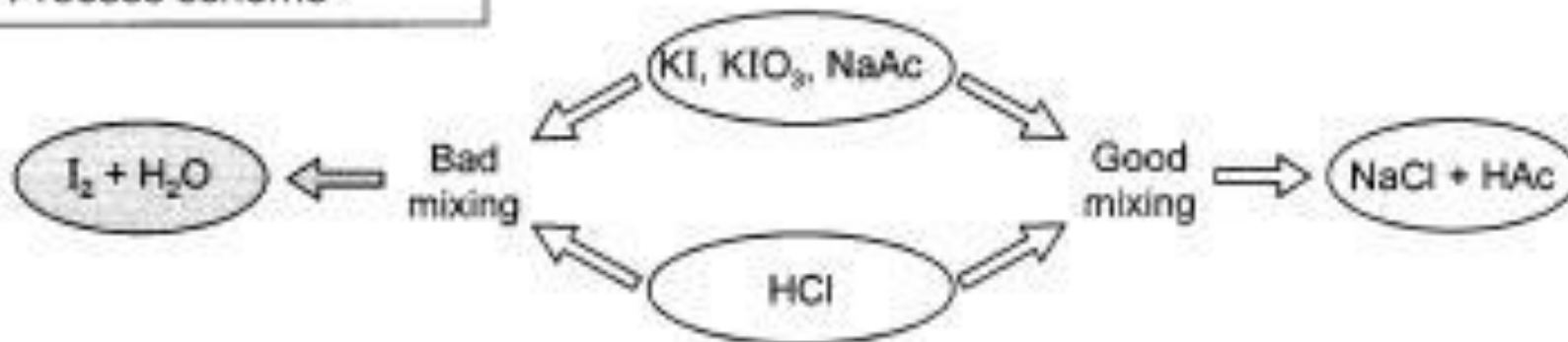


VisiMix Application

Homogeneous Reaction

Chemical Reaction

Process scheme



Reaction equations



Two competing reactions

Lab experiment

Feeding HCl without stirring



Lab experiment

Feeding the HCl upper from the top



Lab experiment

Feeding the HCl close to the impeller low rpm



Lab experiment

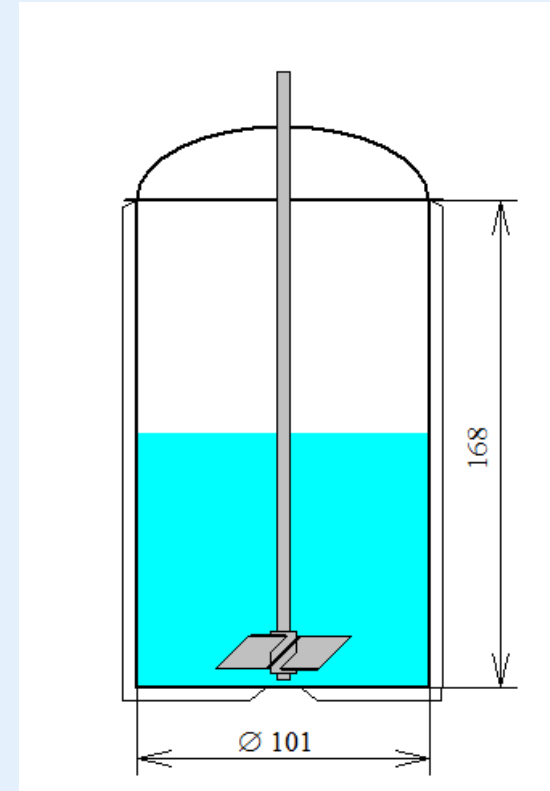
Feeding the HCl close to the impeller high rpm



VisiMix Results



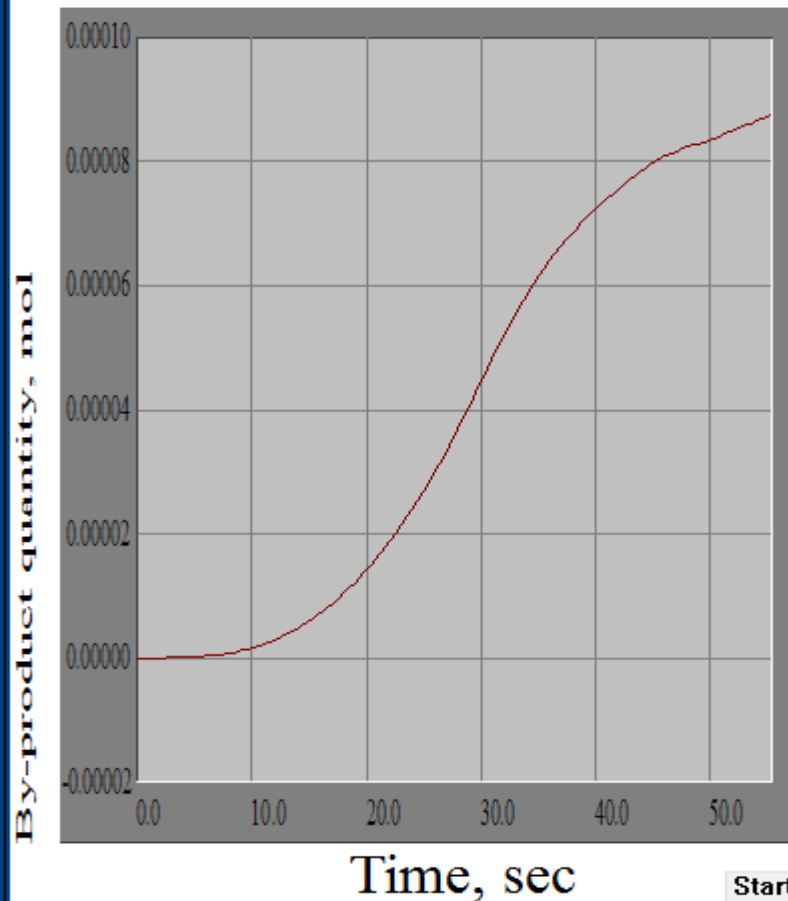
» Optimax



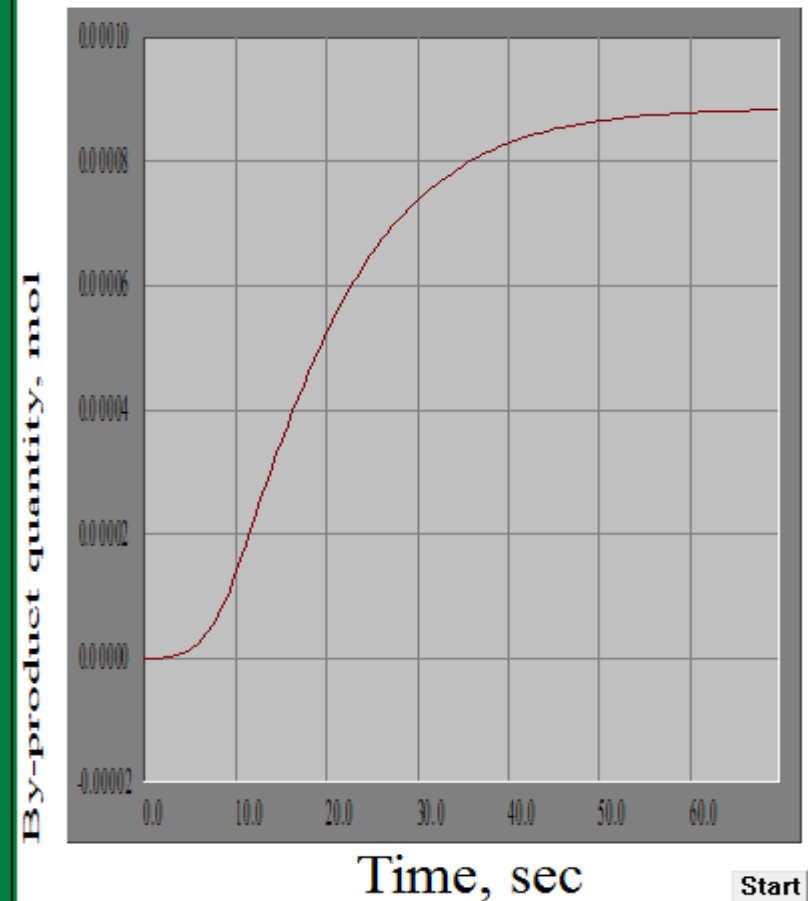
» VisiMix Optimax Model

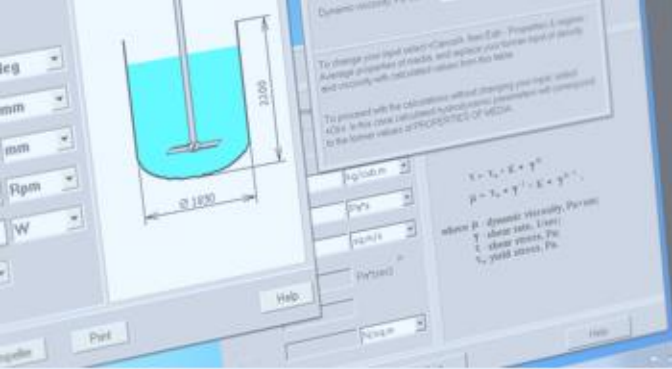
VisiMix Results

By-product quantity, semibatch reactor



By-product quantity, semibatch reactor





Liquid-Liquid Mixing



Impeller Design for Liquid-Liquid Dispersion Using VisiMix RSD/Turbulent

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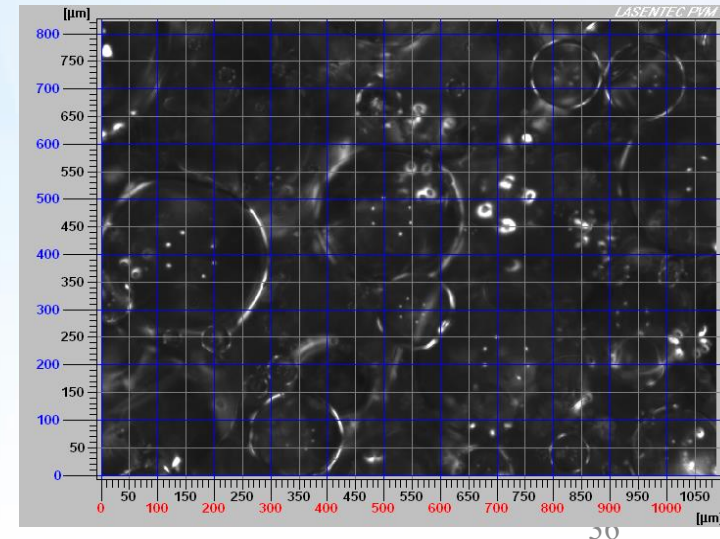
Jerry Salan

jerry.salan@nalasengineering.com

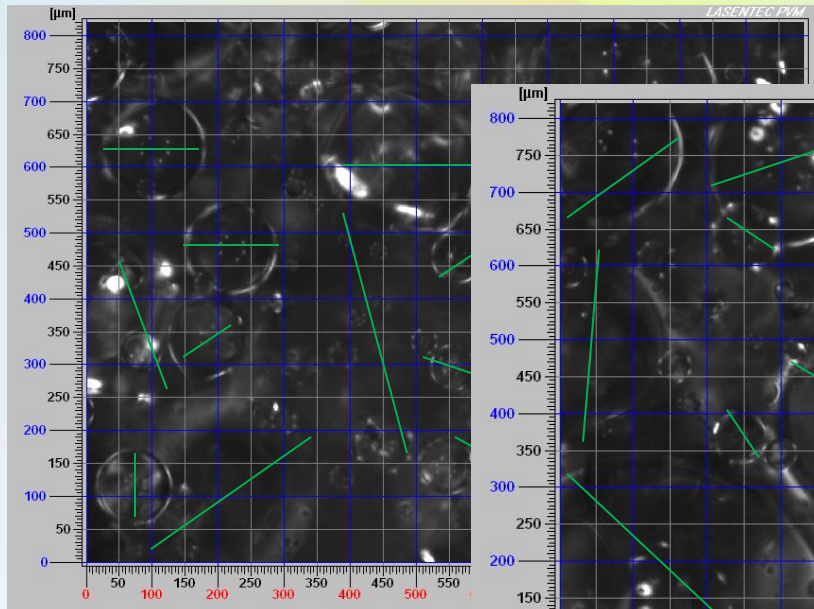
Available for public release

Validate Model Using PVM

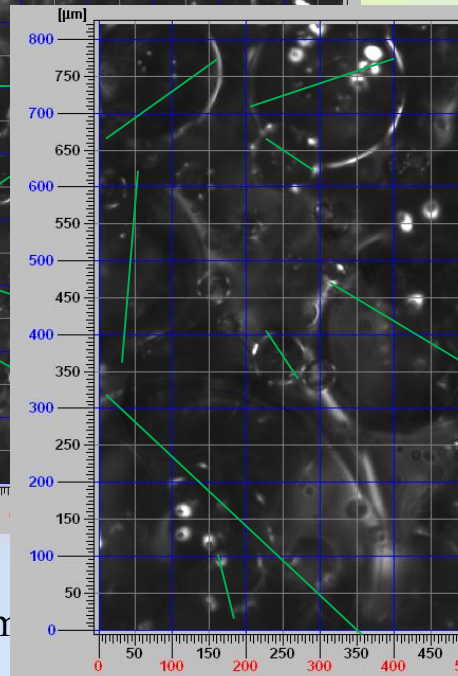
- Taking the PVM data at one setup to test the model for the admixture value.
- Comparing drop size distribution to the VisiMix values
- By matching the shear between systems we hope to match drop size, surface area, and mixing.
 - Mean drop size



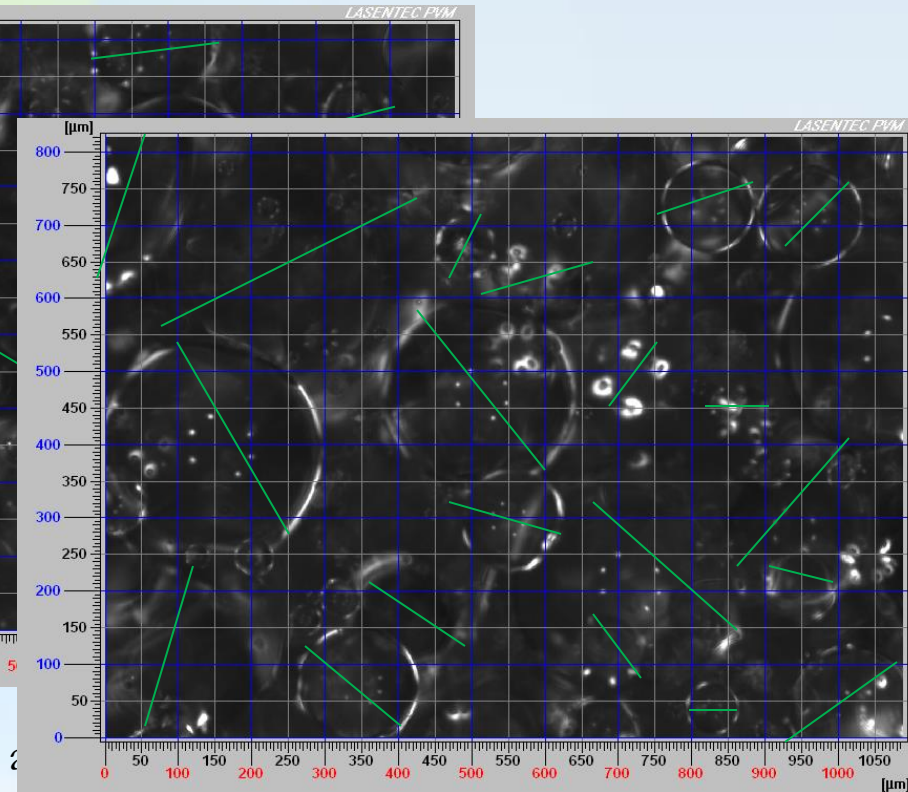
Calculating Drop Diameter from PVM



Average of drop diam
PVM image



Repeat with a

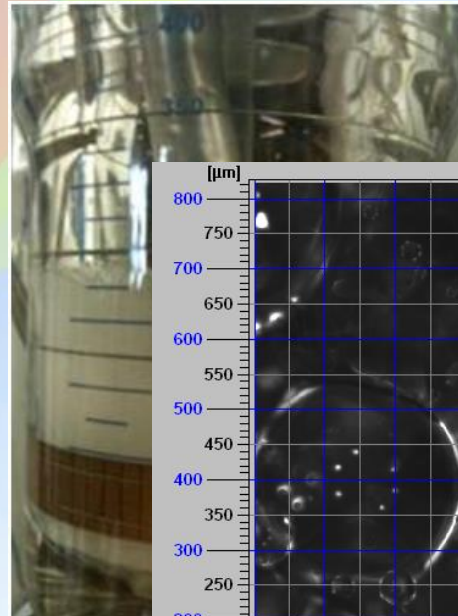


Repeat a third time

The average diameter for all three images is then averaged again and that value is the drop diameter for that RPM

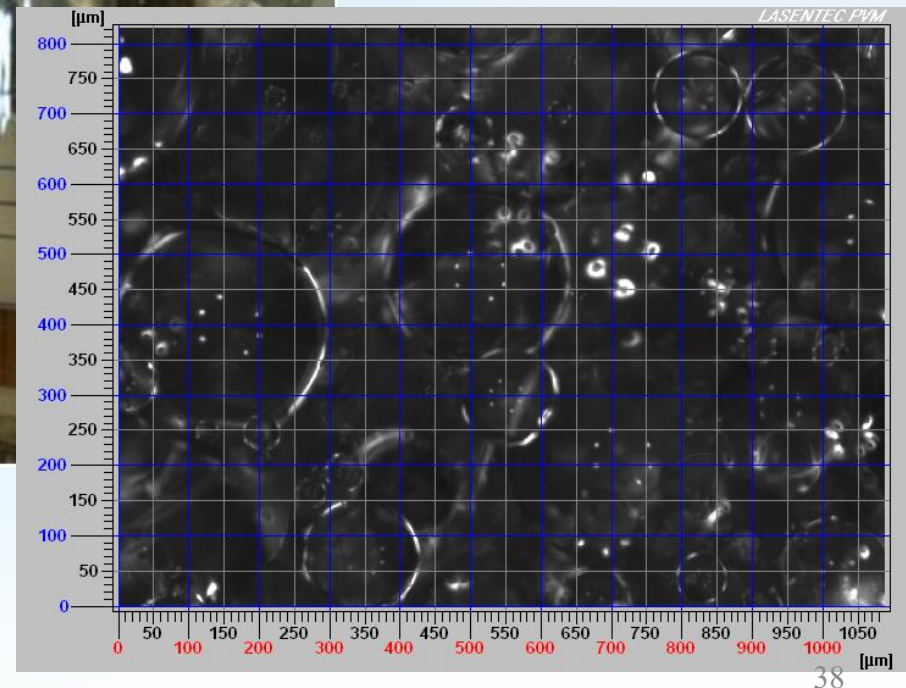
RC-1 Experiments

Pitch blade impeller with PVM and Tr as baffles.

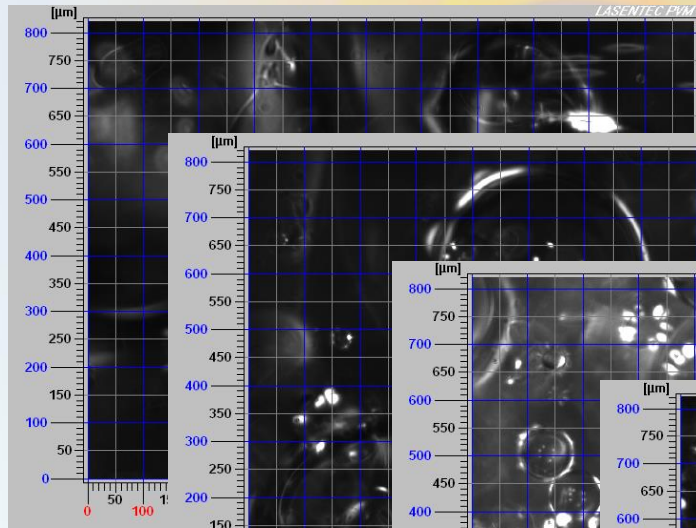


PVM mean $\approx 280 \mu\text{m}$

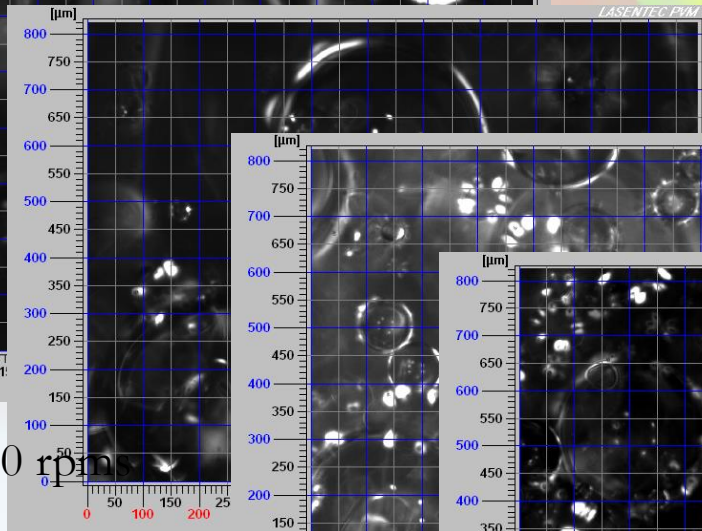
VisiMix calculated mean = $282 \mu\text{m}$
with admixture value set to 0.75



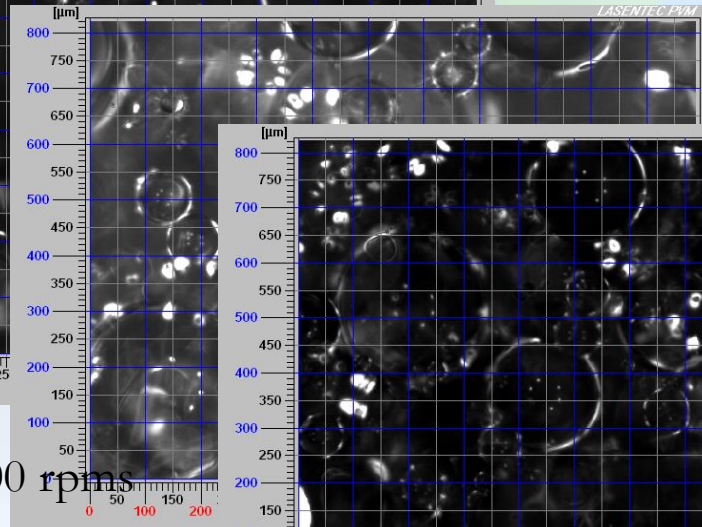
RC-1 Experiments Using PB-Impeller



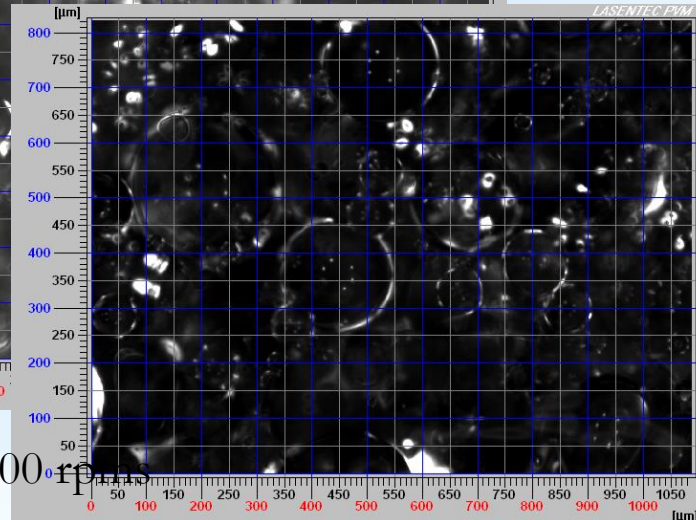
400 rpm



600 rpm



800 rpm



10000 rpm

VisiMix Cal Mean = $689\mu\text{m}$

PVM Mean = $670\mu\text{m}$

VisiMix Cal Mean = $403\mu\text{m}$

PVM Mean = $397\mu\text{m}$

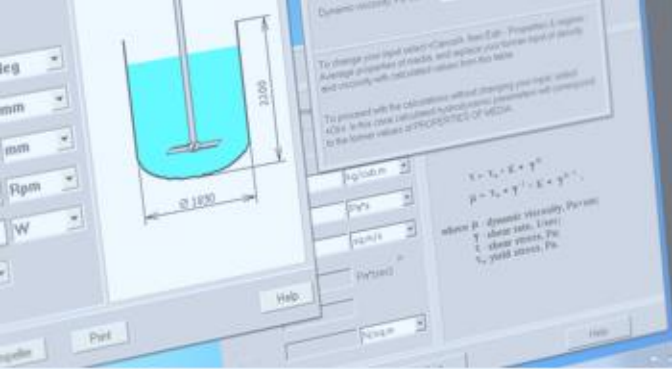
VisiMix Cal Mean = $314\mu\text{m}$

PVM Mean = $301\mu\text{m}$

VisiMix Cal Mean = $281\mu\text{m}$

PVM Mean = $275\mu\text{m}$

Stable Emulsion



VisiMix Application

Crystallization

Mixing Parameters for Crystallization Processes

IMPORTANT PARAMETERS	ANSWERED QUESTIONS AND NOTES
Axial and radial solids uniformity (distribution)	What is the uniformity throughout the vessel? Ensure that solids do not accumulate on the bottom.
Micromixing time	How long is the micro scale degradation of non-homogenized concentration? This is important for precipitations.
Energy of collisions in bulk	What is the collision energy of particles? A high number of collisions in the bulk can affect breakage and secondary nucleation.
Collisions of maximum energy	How often do the slurry particles see the maximum collision energy? What is the frequency near the zone of maximum turbulence near the impeller blades? Frequent collisions lead to more breakage and secondary nucleation.
Local values of energy dissipation	What is the average energy dissipation in the agitator zone? What is in the bulk slurry? What is it at the baffles? Dissipation controls breakage, nucleation and micromixing in these zones.
Maximum energy dissipation	Manipulating energy dissipation in the area behind the agitator blades controls breakage, nucleation and micromixing in this zone.
Time between strong collisions	What is the average period of uninterrupted crystal growth?
Shear rates	What is the likelihood of rupturing the crystal or agglomerates? What is the impact on growth and desolution for the agitation conditions?

Mixing Parameters for Crystallization Processes

Cooling crystallization of API in 6000 liter reactor.

Campaign	$X(v,90) < 250 \mu m$
First	195
Second	325

After investigation it was found that the tip diameter of the Agitator was damaged and the real diameter is a 80 % of the reported one.

ENERGY DISSIPATION - MAXIMUM VALUE

Parameter name	Units	Value
Energy dissipation - maximum value	W/kg	191

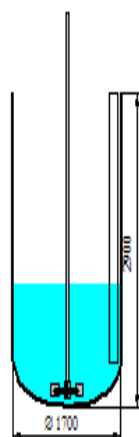
For HELP press F1

ENERGY DISSIPATION - MAXIMUM VALUE

Parameter name	Units	Value
Energy dissipation - maximum value	W/kg	115

For HELP press F1

[VisiMix_R3107] - Drawing of apparatus



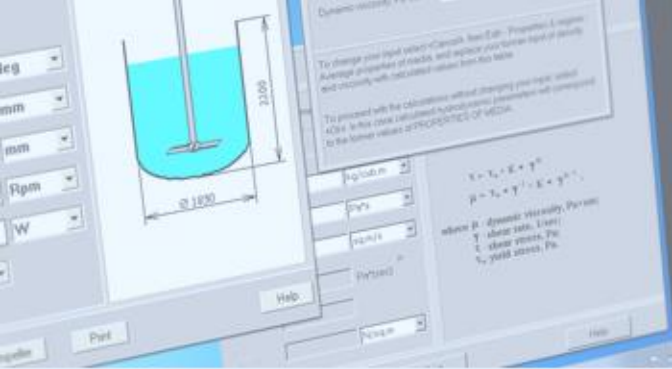
For HELP press F1

[VisiMix_R3107-new] - Drawing of apparatus



Volume

For HELP press F1

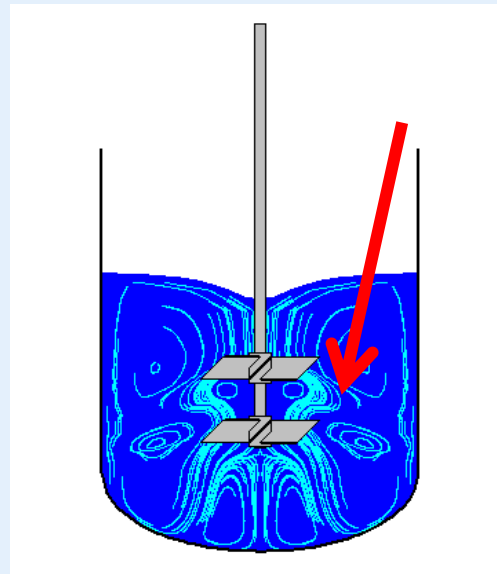
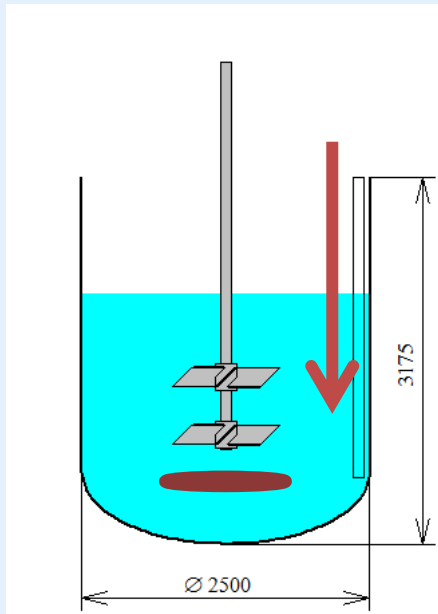


VisiMix Application

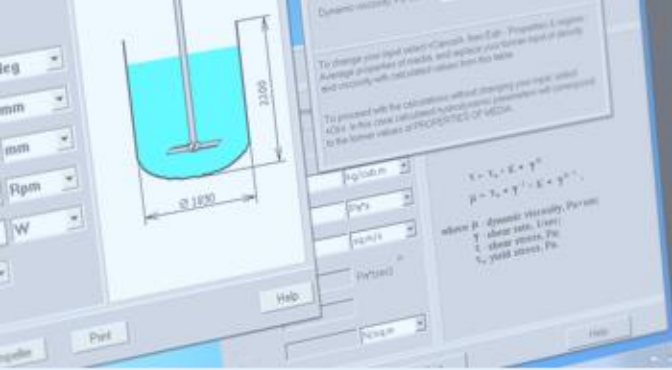
Gas Liquid Reaction

Description

- Gas – Liquid reaction in pilot scale ~ 1000 liter is finished after 4 Hour
- Same in Production 4 Days.



After Change
Position the
process take
around **14 hours**

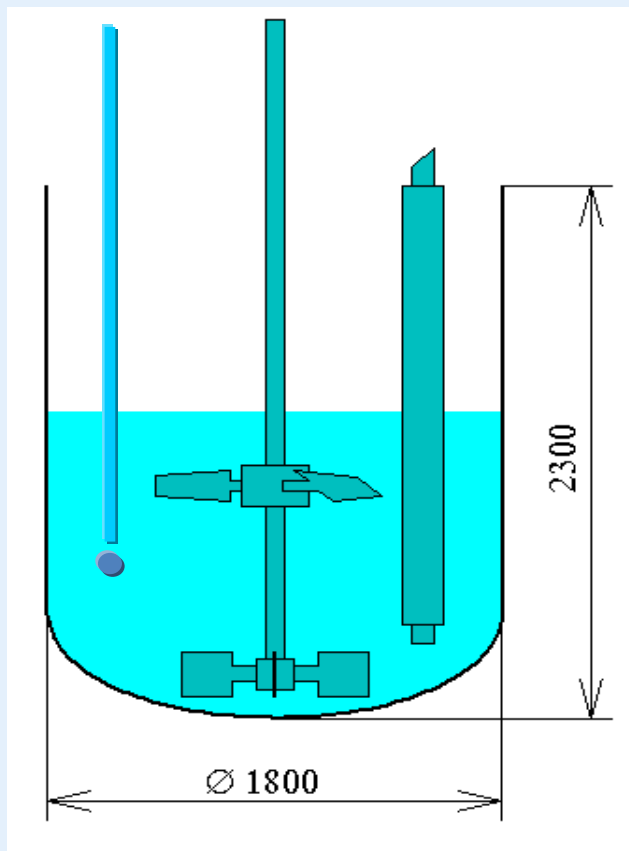


VisiMix Application

High Shear Rate in Semi Batch Homogeneous Reaction

Process and Quality Problem

Feed R-Cl



R-6826

Process

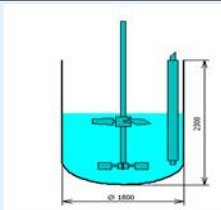


Impurity

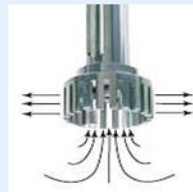


Impurity Results at Laboratory and Production

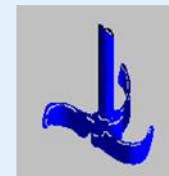
[%]impurity	RPM	Impeller type	system
0%	15,000 rpm	rotor stator	Laboratory reactor
0.3%	1,500 rpm	3-blade	
0.6%	800 rpm		
1.5%	100 rpm		
0.3% - 0.6%	140 rpm	bottom – flat blade up - turbofoil	R-6826



R-6826



Rotor stator



Lab impeller

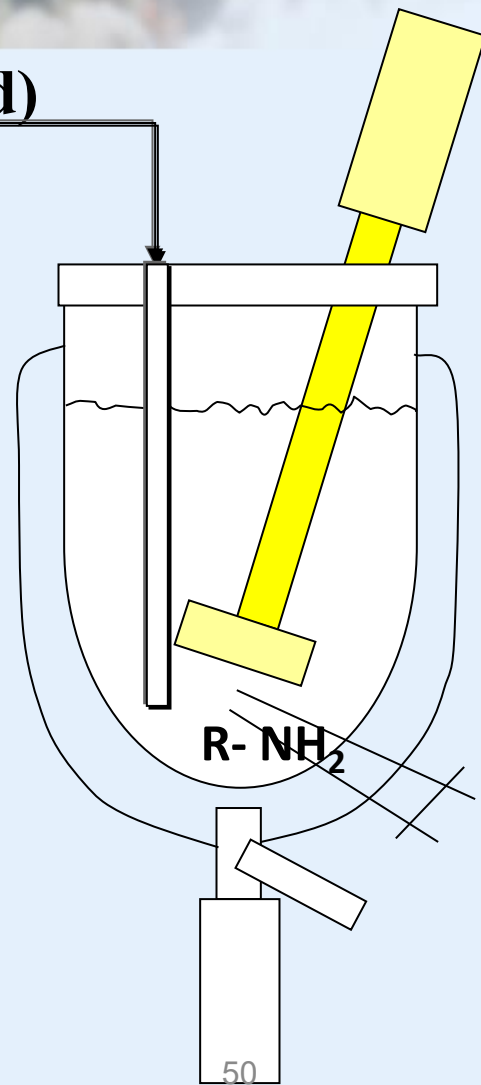
Working with Rotor Stator at Laboratory Scale

Problem

How to scale up ?

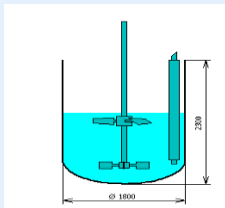
Potential Saving :

MORE than 250 K\$

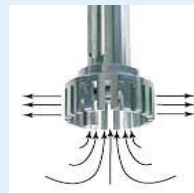


Calculating Shear Forces with VisiMix

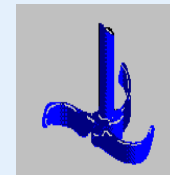
Turbulent shear rate [1/s]	[%]impurity	RPM	Impeller type	system
780,000	0%	15,000 rpm	rotor stator	Laboratory reactor
32,900	0.3%	1,500 rpm	3-blade	
12,900	0.6%	800 rpm		
580	1.5%	100 rpm		
15,200	0.3% - 0.6%	140 rpm	bottom – flat blade up - turbofoil	R-6826



R-6826

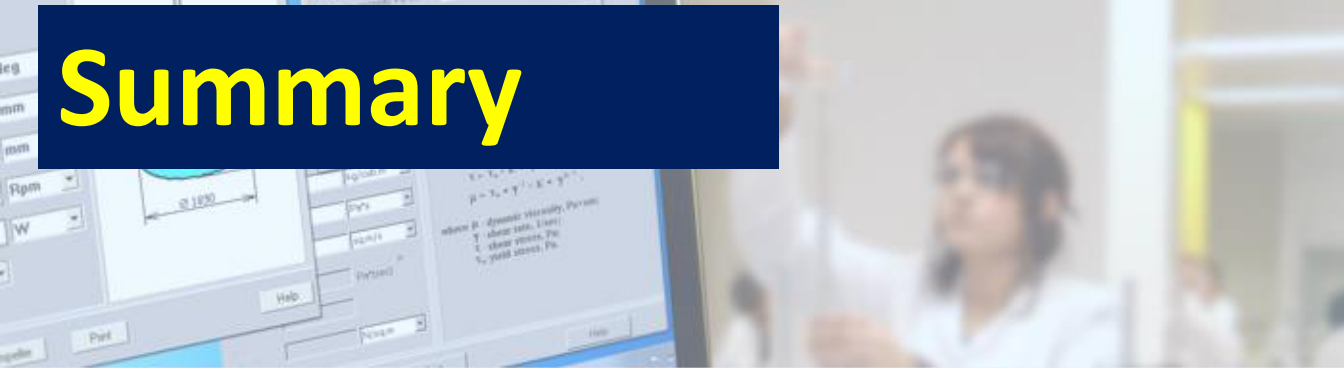


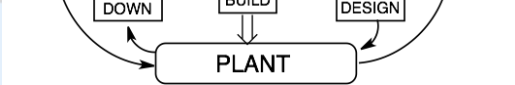
Rotor stator



Lab impeller

Summary



- » **Step 1: Know the Mechanism of your Process.**
 - » **Step 2: Calculate Mixing Parameters will be available to provide in the commercial stage equipment.**
 - » **Step 3: Set Up Lab or Pilot equipment at the same range of work as calculated in Step 2.**
 - » **Step 4: Run Statistical Design of Experiments under conditions Set Up in Step 3 and select relevant experiments to proof the mechanism and achieved a good product quality, effective process operation and maximum yield.**
 - » **Step 5: Model Verification by Scaling down in industrial equipment for sample customer product.**
 - » **Step 6: Generate a Final Design, Procedure an Operation.**
- 

VisiMix Products



VisiMix Turbulent

Low viscosity liquids
and multi- phase
system



VisiMix DI

Combined mixing
devices



VisiMix Laminar

Highly viscous and
non- Newtonian



VisiMix RSDE

Rotor Stator Disperser
and/or Emulsifier



VisiMix Pipeline

Carreau rheological
model



VisiXcel

Creating an organized
data base



Bubble columns

simulations with bubble
mixing



VisiMix 3D Viewer

3-dimensional
visualization



VisiMix Off-Center

modeling and
technical calculations



Scaling Up/ Down

SCALING up/down efforts



Process Evaluation

performance of mixing
operations



VisiMix Chem



Sensitivity Analysis

VisiMix Products

VisiMix 2K8 Turbulent – for **low-viscosity** liquids and multiphase systems.

The program provides process parameters necessary for analysis, scaling-up and optimization of mixing tanks and reactors with all types of impellers

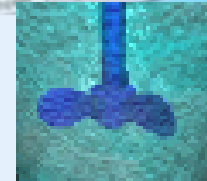
Calculations of:

- ✓ Blending
- ✓ Suspension
- ✓ Dissolution
- ✓ Emulsification
- ✓ Gas dispersion
- ✓ Heat transfer
- ✓ Chemical reactions
- ✓ Mechanical stability of shafts

VisiMix Products

VisiMix *2K8 Laminar* - for highly viscous media

- ✓ Newtonian and non-Newtonian
 - ✓ Macro-scale blending
 - ✓ Micromixing in high-shear areas
 - ✓ Heat transfer
-
- pastes
 - creams
 - shampoos
 - liquid soaps
 - gels
 - ointments
 - paints:
 - coatings
 - slurries
 - polymer solutions



VisiMix Products

VisiMix 2K8 *Different Impellers* – for combined mixing devices

- The program handles mixing devices consisting of any 2 – 5 impellers.
- Different distances between impellers
- Used in combination with VisiMix Turbulent.
- Provides parameters of hydrodynamics, turbulence and heat transfer.

VisiMix Products

VisiMix VisiXcel – Data Base (DB) – automatic conversion tool:
Visimix Output to Excel Spreadsheet

- ✓ Integrates VisiMix report parameters in standard Excel worksheets
- ✓ Analysis VisiMix results in Excel
- ✓ Builds a Database of mixing tanks and reactors.
- ✓ Builds a Database of projects - for processes
- ✓ Makes correlation between plant equipment nomenclature to VisiMix database of mixing tanks and reactors in VisiMix Project Database.
- ✓ Easy access to design data of the mixing tanks, to process parameters and to corresponding results of VisiMix modelling.
- ✓ Results of VisiMix mathematical modelling in the **VisiMix VisiXcel-DB** and arrange the data according to the reactor nomenclature.
- ✓ Easy access to recalculation of the VisiMix modelling from the Database of the reactors & the projects

VisiMix Products

VisiMix Pipe-Line



- ✓ Calculates hydraulic resistance of simple pipelines for liquid viscosity and non-Newtonian products.
- ✓ *Chemical engineers benefit from a quick and user friendly method for charging times and the bottle-necks in the line.*
- ✓ **Includes :** - Pipes - Riffled hoses – Elbows – Valves - And more
- ✓ Also comes with a **database containing rheological constants** for the typical commercial non-Newtonian products - pastes, creams, shampoos, paints, etc. (see **Help Section for details**)
- ✓ *The **first and only tool** calculating flow resistance for liquids that correspond to **Carreau rheological model**. (See Help Section for details)*

VisiMix Products

VisiMix RSDE (Rotor Stator Disperser Emulsification)

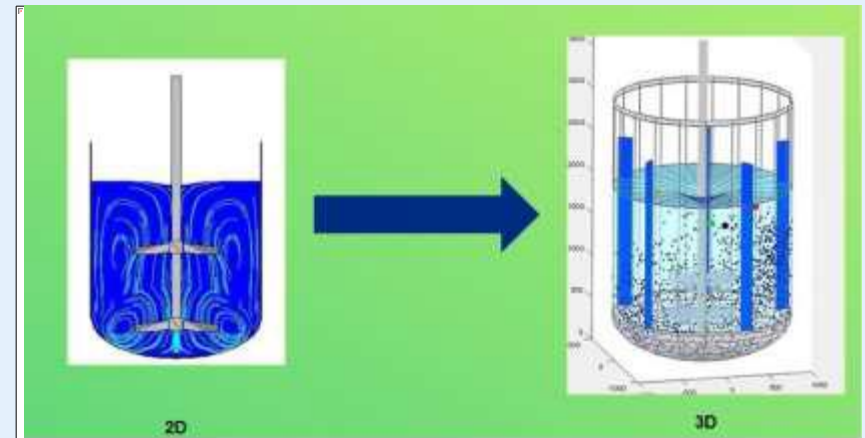
- ✓ The revolutionary new VisiMix RSDE - Rotor Stator Disperser Emulsification software is the first product of its kind that provides support for mixing devices for media subjected to high shear stress:
Based on 3 years dedicated research in a lab with dedicated equipment
Works with all types of media - both high and low viscosity liquids, Newtonian and Non-Newtonian.
- ✓ Input geometrical data and process parameters and obtain fast and reliable results with one click
- ✓ VisiMix RSDE enables you to quickly calculate
 - Shear rates and stresses in internal spaces
 - Pumping capacities
 - Power consumption and torque

VisiMix New Version

NEW!

3D Visualization of Mixing, Based on the Hydrodynamic Model of the Flow Pattern.

- ✓ This is an exciting 3D visualization based on the VisiMix calculations
- ✓ Grasp the VisiMix results much better.
- ✓ The VisiMix process now looks alive.
- ✓ It is much easier to understand and explain VisiMix results to others and to management.



NEW!

VisiMix New Version



Alternative Impellers

- ✓ Now anyone from your professional can use VisiMix for the entire range of impeller geometries and can now be studied for **known power and flow numbers**.

ALTERNATIVE IMPELLER. SCHEME IS SYMBOLIC.

Tip diameter (D) mm 3

INPUT OPTIONS

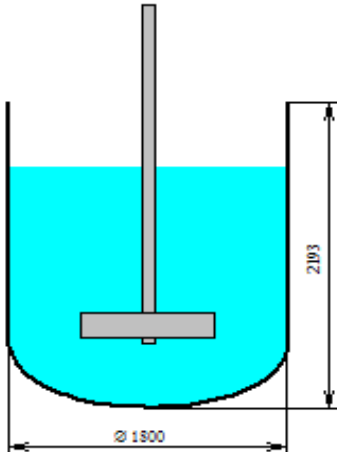
Np - Power Number & Nq - Circulation Flow Number	Np - Power Number & Tip Pitch Angle of Blades
☐	☐

Power number Np

Circulation flow number Nq

Tip pitch angle of blades deg

Np and Nq - values based on experimental measurements in water in a fully baffled tank with $H/T = 1$ and $T/D = 3$.
Here T - tank diameter, H - level of liquid, D - tip diameter of impeller.

A schematic diagram of a stirred tank reactor. It shows a cylindrical tank with a flat-blade impeller at the bottom. The liquid level is indicated by a blue fill. Dimensions are given: the tank diameter is 1800 (labeled as Ø 1800) and the liquid height is 2193. The impeller has a diameter of 900.

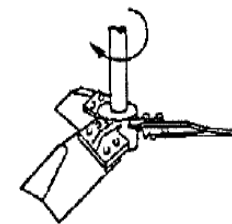
Hydrofoil Impellers

A New Option of Selecting Hydrofoil Impellers from Different Manufacturers

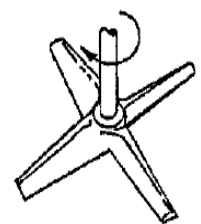
- ✓ Provide streamlined flow as compared to axial imp's
- ✓ Give low shear but more uniform velocity
- ✓ Results in lower power consumption
- ✓ Used mainly for blending of miscible liquids, suspensions of solids and gas-liquid, liquid-liquid mixing



Lightnin A310



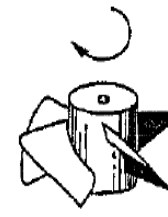
Chemineer HE3



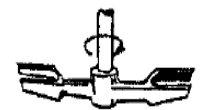
EMI Rotofoil



Lightnin A315

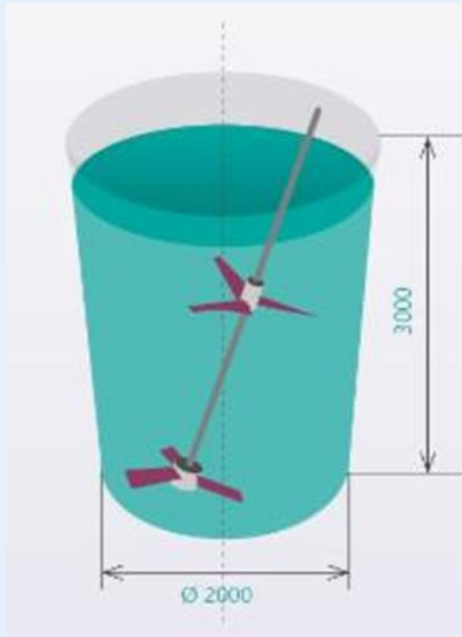


Prochem Maxflo



Ekato INTERPROP

2019 - VisiMix Off Center Impellers



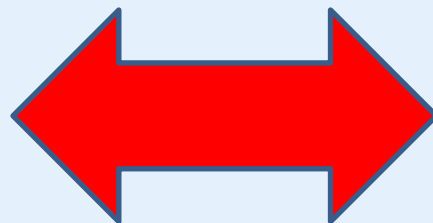
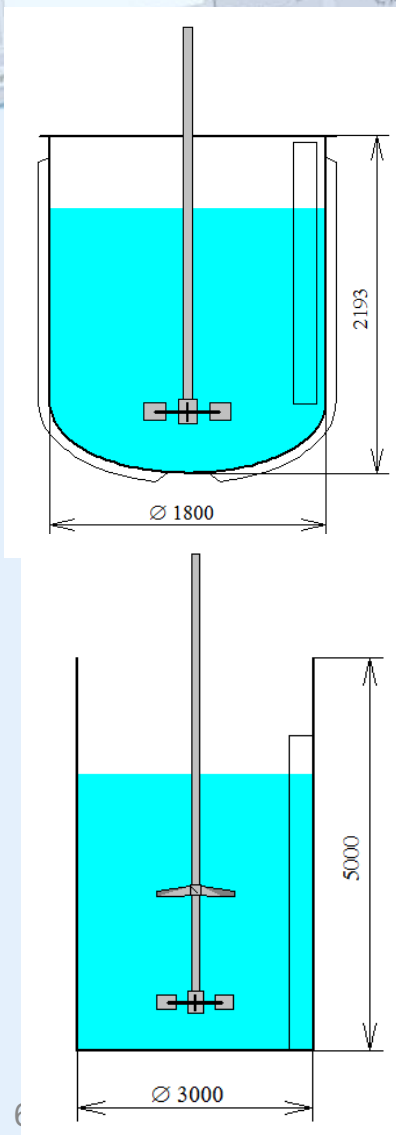
**New
Release!!**

Special
price for
participants

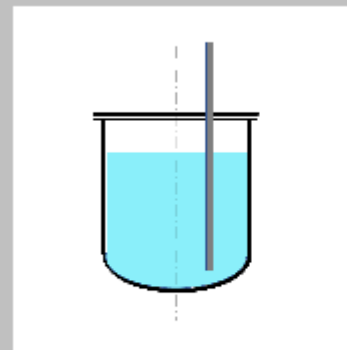
VisiMix



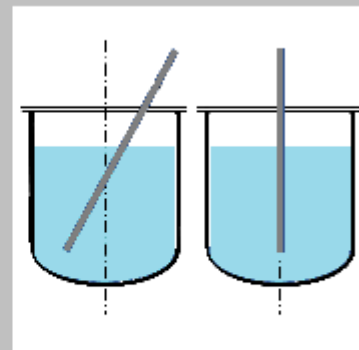
Off Center Impeller Options



SCHEME TYPES

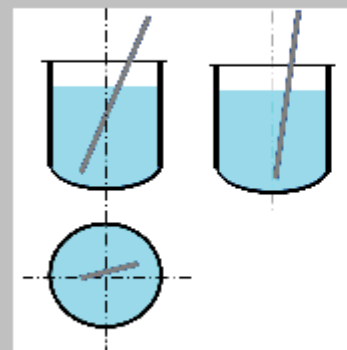


Off-center vertical shaft

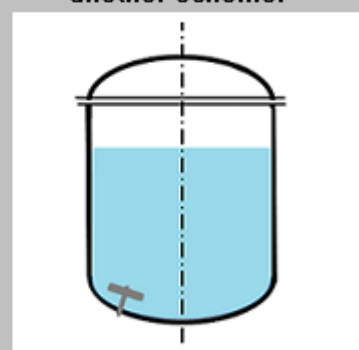


Shaft inclined in one plane

FOR ELLIPTICAL BOTTOM ONLY!
For flat/conic bottom select another scheme.



Shaft inclined in two planes



Bottom entrance of shaft

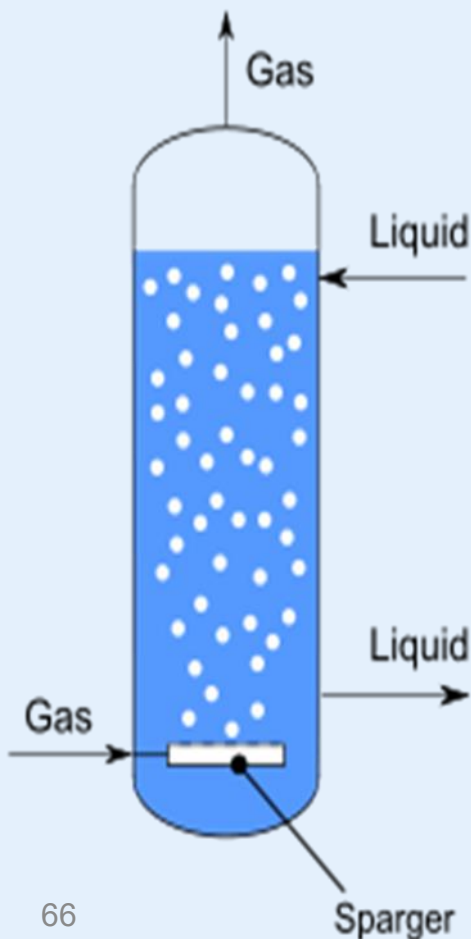
VisiMix Off Center Impellers

- The first release of the program allows for entering of mixing devices with :
 - one or two impellers (identical or different)
 - vertical and inclined head-entering shafts
 - bottom-entering mixing devices with single impeller.
- The program outputs include
 - main parameters of hydrodynamics (power, flow velocities, etc.)
 - turbulence (maximum and other local values, etc.)
 - heat transfer corresponding

2020 - VisiMix Bubble Columns

End of April 2020! Follow our Future Announcement!

**New
Release!!**



Column Diameter (D) , m
1300

Total Column Hight (H) , m
3200

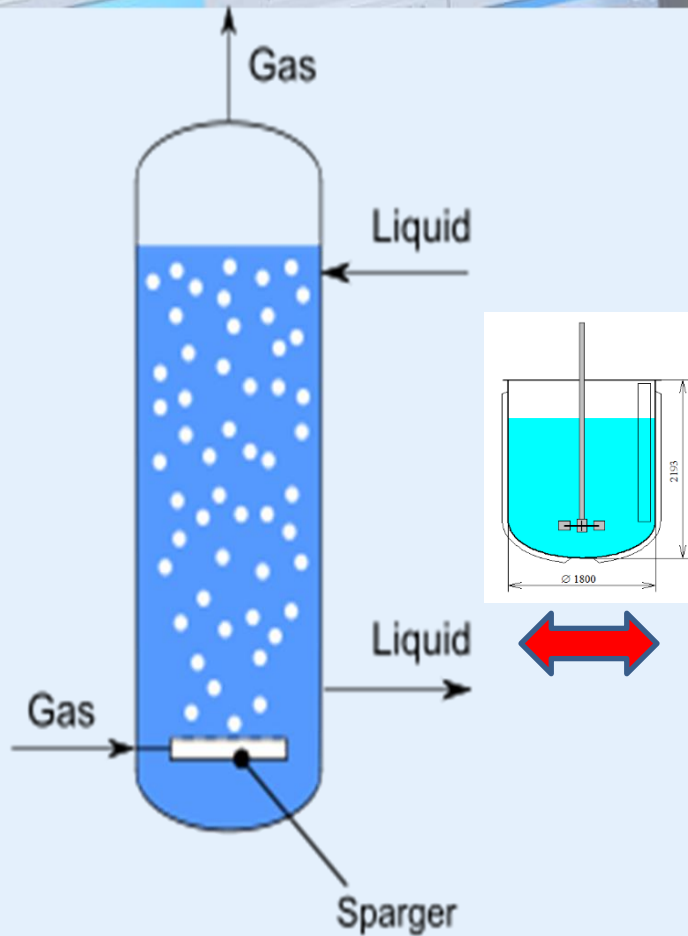
Liquid Depth (H1) , m
2800

Gas Flow Rate , qub.m/s
5

Calculate

Print **Exit**

Bubble Columns Interphase

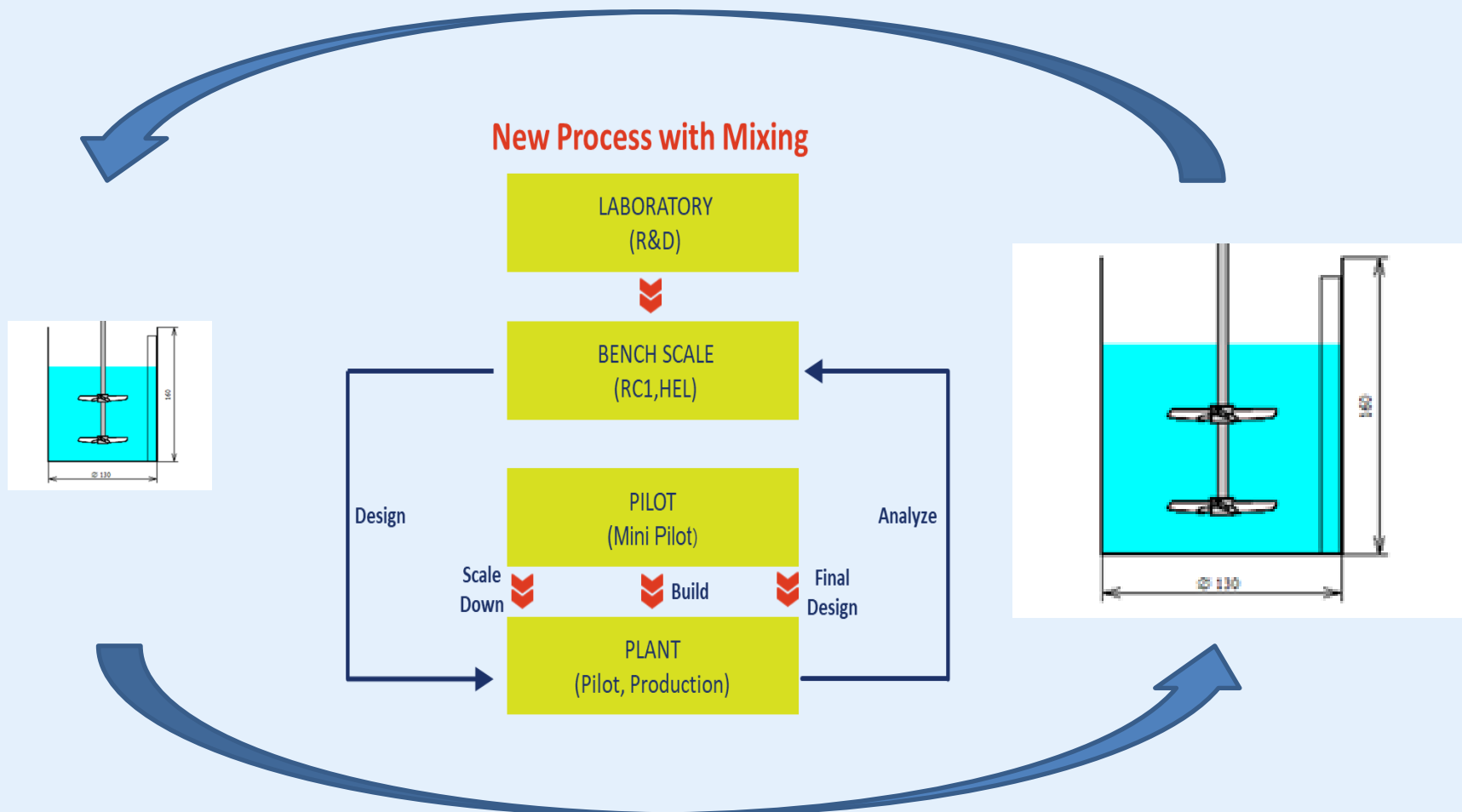


Prepare Visimix Input Data for Heat Transfer Calculations in Bubble Columns

Jacketed Tank with Flat Bottom		Impeller PITCH PADDLE. MULTISTAGE	
Inside diameter, m	1300	Tip diameter(D), m	650
Total tank height, m	3200	Impellers number	3
Level of media, m	2800	Dist. between stages, m	560
FLAT BAFFLE-1		Number of blades	
Number	4	Pitch angle, deg	30
Width, m	130	Width of blade, m	65
Length, m	2800	Dist. from bottom, m	560
Dist. from bottom	0	Rotation speed, rpm	0.06284
Angle to radius (fi)	0	Motor power, kw	3.998E+05
Circulation Flow, qub.m/s 2.652E+05		Near Wall Velocity, m/s 0.3996	

Column Diameter (D) , m	1300
Total Column Height (H) , m	3200
Liquid Depth (H1) , m	2800
Gas Flow Rate , qub.m/s	5
Calculate	
Print Exit	

VisiMix Scale Up/Down



VisiMix Scale Up/Down

SCALE UP / DOWN

Tank size	Prototype	Target
Tank volume, cub.m	15.2	0.00100
Tank diameter, mm	2440	98
Rotation speed, rpm	75	639
Main mixing parameters	Visimix results	Estimate
Impeller tip velocity, m/s	5.11	1.70
Average energy dissipation rate, W/kg	0.189	0.190
Maximum local energy dissipation rate, W/kg	11.3	11
Turbulent shear rate near the impeller blades, 1/s	3370	3400
Mixing time, s	26.8	3.20
Characteristic time of micromixing, s	2.89	2.90
Impeller Reynolds number	2.11e+01	29000

Scale up/down similarity variables (key mixing parameters to be reproduced)

- ☐ Impeller tip velocity
- ☒ Average energy dissipation rate
- ☐ Maximum local energy dissipation rate
- ☐ Maximum shear rate
- ☐ Mixing time
- ☐ Micro-mixing time
- ☐ Impeller Reynolds number
- ☐ Enter target rotation speed, rpm

Key process characteristic to be reproduced

- Pick-up of particles. Liquid-solid mixing
- Pick-up of particles. Liquid-solid mixing
- Suspension axial distribution. Liquid-solid mixing
- Mass transfer rate. Liquid-solid mass transfer
- Mean drop size. Liquid-liquid mixing
- Emulsion specific surface. Liquid-liquid mixing
- Complete emulsifying
- Mass transfer rate. Gas-liquid mixing
- Gas pick-up on surface. Liquid-liquid mixing
- Distribution of reactants. Single phase reaction
- By-product formation. Single phase reactions

Random upward turbulent fluctuations of sufficiently high intensity pick-up solids by offsetting their gravitational settling to the tank bottom and preventing accumulation of solids there.

To scale solids pick-up, the program

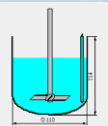
- maintains geometric similarity of tank hardware dimensions and the same relevant physical properties and process characteristics, selects liquid depth proportional to tank size, and

- selects impeller rpm to maintain the same intensity of turbulent fluctuations by keeping either

- * the same mean energy dissipation rate for a BAFFLED TANK, or

- * the same impeller tip velocity

VisiMix Process Evaluation



Unit operation:
Suspension of Solid Particles

Open Save As Export to Excel Close Exit

1 C:\Users\Moshe Bentolila\Desktop\lab VSM
2 C:\Users\Moshe Bentolila\Desktop\Production 1.vsm
3 C:\Users\Moshe Bentolila\Desktop\Production 2.vsm
4 C:\Users\Moshe Bentolila\Desktop\Production 3 VSM

Target parameters

Parameter	1	2	3	4	5	6
Project Name	lab	Production 1	Production 2	Productio...		
=== TARGET PARAMETERS						
Complete/incomplete suspension	complete	incomplete	complete	incomplete		
Maximum degree of non-uniformity, axial, %	24.1	24.2	23.4	21.9		
Maximum degree of non-uniformity, radial, %	42.5	13.3	12.7	0.34		
Maximum local concentration of solid phase, kg/cub.m	138	130	129	124		
Minimum local concentration of solid phase, kg/cub.m	44.7	67.3	68.4	79.2		
Average concentration of solid phase in continuous flow, ...	138	130	129	124		
Frequency of collisions of maximum energy, 1/s	0.0698	0.0272	0.0271	0.00233		
=== BASIC DEVICE CHARACTERISTICS						
Tank diameter, mm	110	1800	2000	1800		
Type of impeller	pitched paddle	pitched paddle	pitched paddle	Lightnin A310		
Impeller tip diameter, mm	60	982	1090	900		
Impellers number	1	1	1	1		
Maximum energy of collisions, J	2.89e-12	4.38e-13	4.36e-13	1.37e-12		
Presence of baffles	YES	YES	YES	YES		

Brief description of the application

1. General

This application presents results of VisiMix simulations of selected unit operation for a number of VisiMix projects that differ from each other by equipment design, scale or process regime.

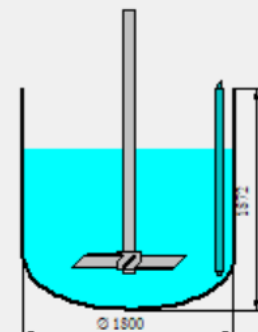
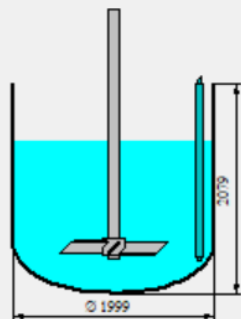
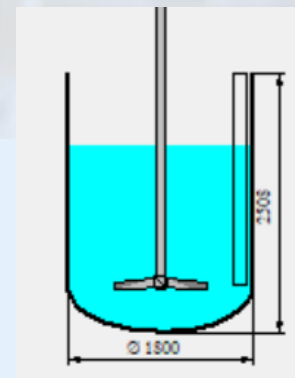
This comparison is performed with respect to unit operation (technical target of the mixing operation defined by user).

Results of different VisiMix projects comparison organized in form of set of tables and graphs containing values of

User Notes:

Target parameters >> Mixing tank data >> Background parameters >>

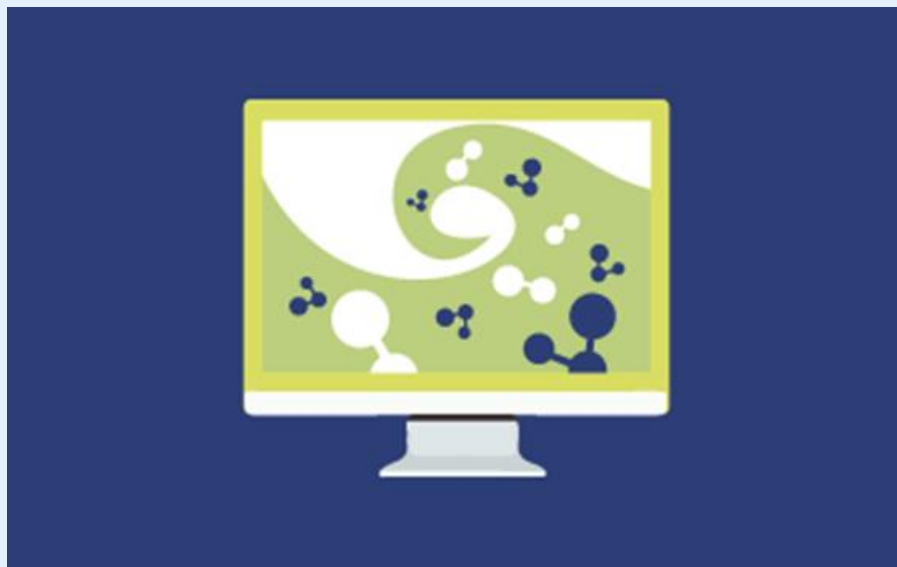
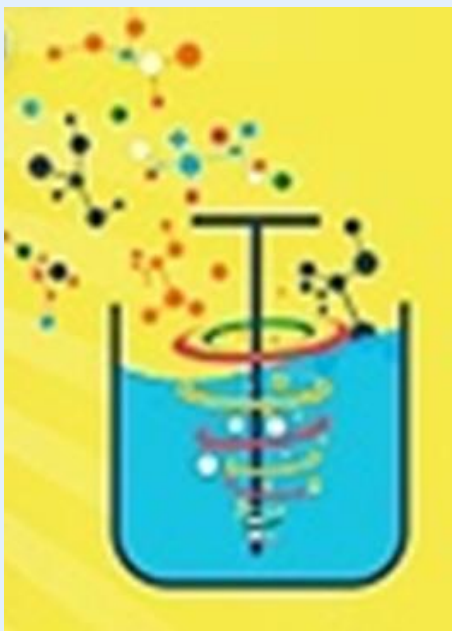
Basic Mixing Characteristics >> Radial Distribution of solids >> Axial Distribution of solids >> All in One >>





VisiMix Chem

Real-world chemical reactor dynamics





VisiMix Chem

Real-world chemical reactor dynamics

A unified platform for data exchange and active collaboration between chemists and chemical engineers

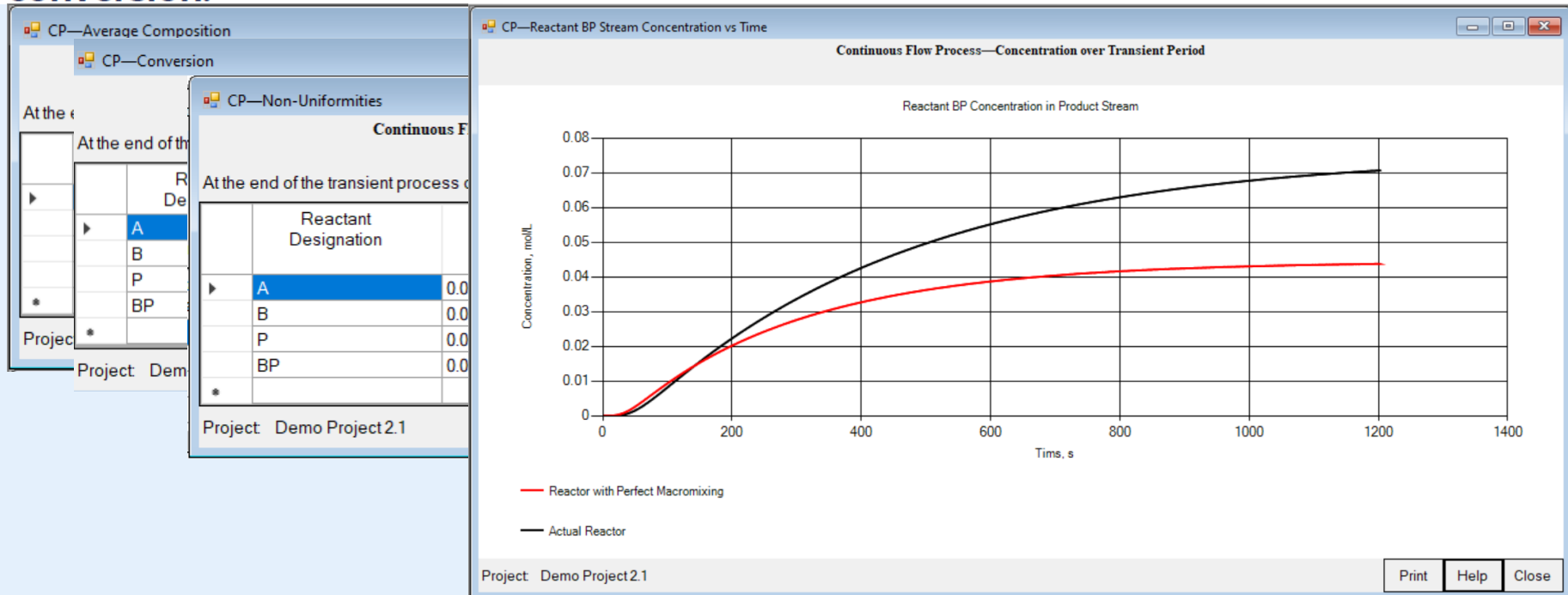
- ♦ **Rapidly obtain** reliable information about each reactant concentration in a **real-world** mixing reactor, where macromixing and micromixing processes interact with chemical kinetics
- ♦ **Scale-up** to the industrial scale a process successfully implemented at the laboratory scale
- ♦ **Analyze** the **product output and purity** as functions of initial reactant concentrations, feed chemical composition, mixing system design, inlet point positions, etc.



VisiMix Chem

Real-world chemical reactor dynamics

Visimix Chem enables a user to look into a REAL-WORLD mixing reactor by rapidly obtaining RELIABLE information about each reactant concentration and conversion:



VisiMix Chem

Real-world chemical reactor dynamics



A unified platform for data exchange and active collaboration between chemists and chemical engineers specializing in different phases of new product development at the lab, pilot, and production scales.



Visimix Chem enables a **CHEMIST** to present in a unified language:

- ◇ results of laboratory work suitable for scale-up and knowledge transfer
- ◇ characteristics of a problematic industrial process for scale-down and subsequent laboratory investigation

Visimix Chem enables a **CHEMICAL ENGINEER** to:

- ◇ reliably select optimal equipment and its best operation conditions for process development at the pilot or production scales
- ◇ design new equipment

Celebrating three decades of our accomplishments in mixing simulation, Visimix presents Visimix Chem, a revolutionary product for simulating real-world chemical reactor dynamics. Visimix Chem is completely compatible with Visimix Turbulent.

Sensitivity Analysis function



Run Multiple Calculations

Master project : C:\Users\Moshe Bentolila\Desktop\VisiMix Working Files\Program Visimix Turbulent SV.VSM

Sensitivity analysis

Single phase hydrodynamics, turbulence and mixing

Sensitivity Variable	Unit	Value for Master Project	Minimum Value	Maximum Value	Number of Steps
Impeller rotation speed	rpm	125	10	25	12

Step	Master	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Value	125	10	11.4	12.7	14.1	15.5	16.8	18.2	19.5	20.9	22.3	23.6	25
Passed	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

Disable messages ☒

Run Display result Cancel Help

Visimix simulations will be performed only for values of input parameters that are inside the program applicability range.



Sensitivity Analysis function

Get Multiple Calculations Results



Process analysis/Comparative assessment OR Sensitivity analysis of Visimix projects



Unit operation:
Single phase hydrodynamics, turbulence, and mixing

Open Save As Export to Excel Close Exit

1 C:\Users\Moshe Bertollia\Desktop\VisiMix Working Files\Program Visimix Tu
2 ...S1...
3 ...S2...
4 S3

Major Target (Overall Mixing) Characteristics and Design Parameters

Parameter	1	2	3	4	5	6	7	
Project Name	Program Vi...	...S1..	...S2..	...S3..	...S4..	...S5..	...S6..	...
=== SENSITIVITY VARIABLES								
Rotational speed, rpm	125	10	11.4	12.7	14.1	15.5	16.8	18
Depth of media, mm	1720	1720	1720	1720	1720	1720	1720	17
=== TARGET PARAMETERS								
Mixing power, W	3520	1.81	2.65	3.72	5.05	6.66	8.59	10
Macromixing time, s	21.8	274	241	215	194	177	163	15
Characteristic time of micromixi...	5.41	183	160	143	129	117	108	97
Gas pick up from surface is exp...	not expected	not expe...	not expe...	not expe...	not expe...	not expe...	not expe...	nc
Vortex depth, m	0.101	0	0	0.00104	0.00127	0.00153	0.00181	0.1
=== MAJOR DESIGN PARAM...								
Tank diameter, mm	1800	1800	1800	1800	1800	1800	1800	18
Type of impeller	disk turbine	disk turbi...	disk turbi...	disk turbi...	disk turbi...	disk turbi...	disk turbi...	dis
Impeller tip diameter, mm	600	600	600	600	600	600	600	60
Number of impellers	1	1	1	1	1	1	1	1
Presence of baffles	YES	YES	YES	YES	YES	YES	YES	Yt
Volume of media, m^3	4	4	4	4	4	4	4	4

Summary description of the advanced function

1. General

This application presents results of VisiMix Turbulent simulations of selected unit operation for a number of VisiMix Turbulent projects that differ from each other by equipment design, scale or process regime (for the Comparative assessment/Transfer of projects function), or only in terms of a value of the sensitivity variable (for the Sensitivity analysis function).

This comparison is performed with respect to unit operation (i.e., a technical target of the mixing operation defined by

User Notes :

Target and Design Parameters >> Design Parameters >> Media Properties >> Mixing Characteristics >> All in One >> Tangential velocity profile >>

Type here to search

13:32 23/05/2025

A screenshot of the VisiMix software interface showing a 3D model of a stirred tank reactor with a central impeller. Dimensions like 3100 and 1830 are visible. Text on the screen includes instructions on how to change input values and average properties.

VisiMix Orientation

A small 3D visualization of a stirred tank reactor, showing a blue liquid being agitated by a central impeller.

The VisiMix Demonstration Tools:

- ✓ VisiMix Turbulent – Examples & User Guide
- ✓ VisiMix Laminar - Examples & User Guide
- ✓ VisiMix Different Impellers – Examples & User Guide
- ✓ VisiMix RSDE– Examples & User Guide
- ✓ VisiMix Turbulent SV – Trial & Education
- ✓ VisiMix Review of Mathematical Models
- ✓ Selected Verification Examples

*The Comparison between Published Experimental Data and
VisiMix Calculations*

<http://www.visimix.com>

Millions Saved By Using VisiMix!

Benefit Examples Reported by Customers.

VisiMix LTD, is pleased to provide you with some very important new information on VisiMix Savings, which we have compiled for publication. These documents, show **savings of millions of dollars per year**. Please click the links directly below to view the following savings examples:

[Mixing Calculations in Development](#) (Saved - \$1,000,000)

[Productivity Improvement In API Company](#) (Saved - \$1,600,000)

[RSD Application in a Chemical Reaction Process](#) (Saved - \$250,000)

[Control Morphology and P.S. in Energetic Material Processes](#) (Saved - \$900,000)

[Troubleshooting for Crystallization Processes](#) (Saved \$2,000,000)

[Troubleshooting in Life Science Industry](#) (Saved €900,000)

[Three Phase System – Solid-Liquid-Liquid](#) (Saved €1,200,000)

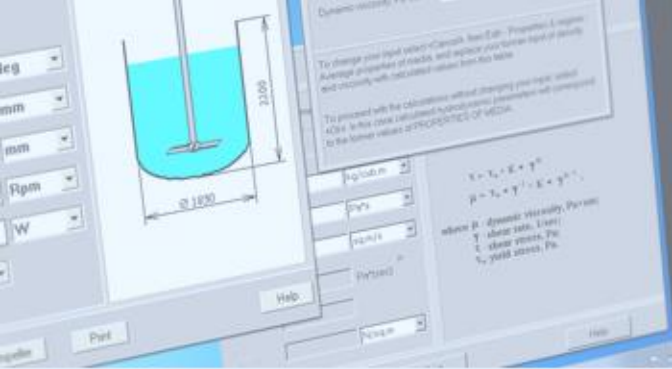
[Improve Dissolution of Organic Solid](#) (Saved €1,200,000)

[Physical Properties of the Final Product \(Solid\) – Ensuring Regulatory Compliance of \\$20,000,000 Sales](#)

We also invite you to view some highlights from our very successful **[International Conference in Boston](#)** and Atlanta that took place in 2011 and 2014 which united users and future users of the VisiMix Software to share some insights into the various uses and benefits of the software.

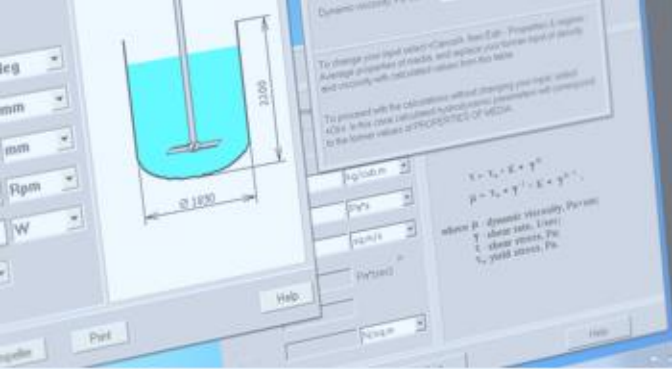
Conclusion

- **Using VisiMix Products support you can**
 - **understand better your processes**
 - **Reduce dramatically your Scaling up processes and Scaling down**
 - **Save a huge amount of Time & Money (\$1,000,000 +)**
- **The VisiMix Products are friendly and easy to use with very quick results.**
- **The VisiMix results are based on a systematic and seriously experimental checking – and found very reliable.**
- **VisiMix Projects Parameters and Data Base allows you to share and transfer the data with colleagues in the company.**



Thank you for your attention





Thank You

For your attention

VisiMix Ltd.

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Tel: 972 - 2 - 5870123 | Fax: 972 - 2 - 5870206
E-mail: info@visimix.com

