ViSiMix RSDE – Program for Selection, Scaling Up and Successful Application of **Rotor/Stator Dispersers**

VisiMix Ltd.

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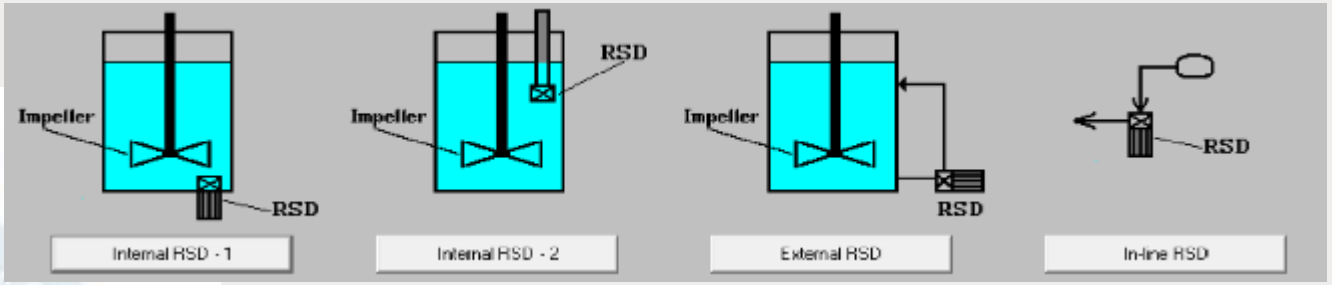
RSD devices

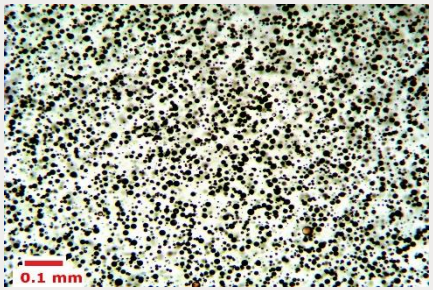

Impeller
RSD
Internal RSD - 1
Impeller
RSD
Internal RSD - 2
Impeller
RSD
External RSD
RSD
In-line RSD

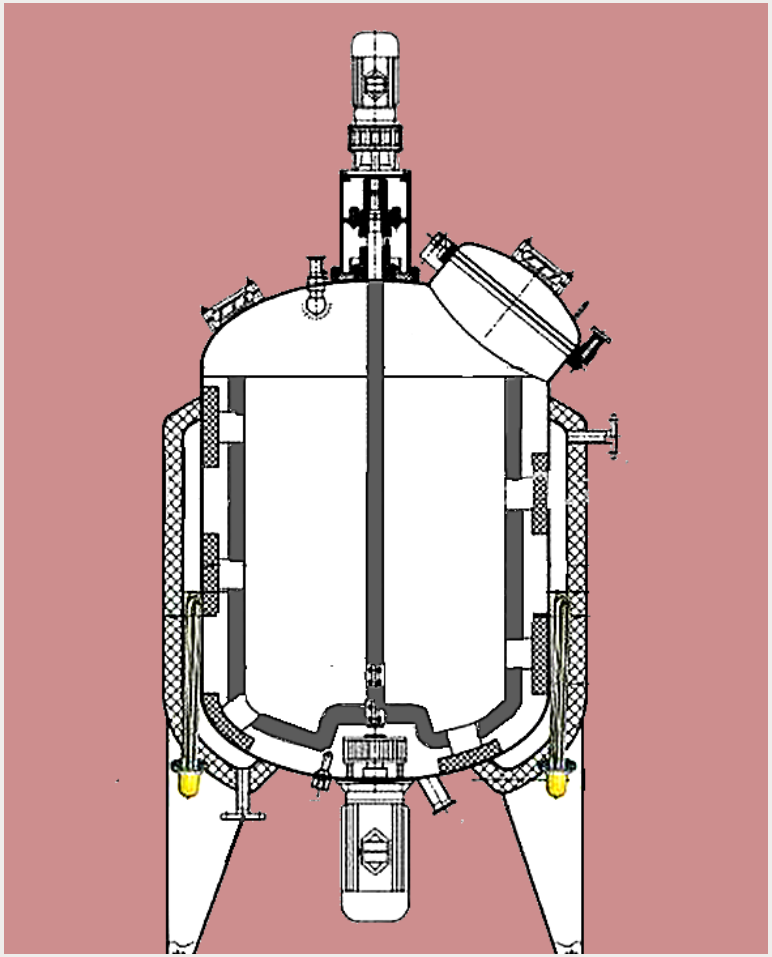

E-STORE


间歇式高剪切乳化机
1024 × 768 - ikacx.en.alibaba.com

Process developed in Lab
How do we scale it up?

?





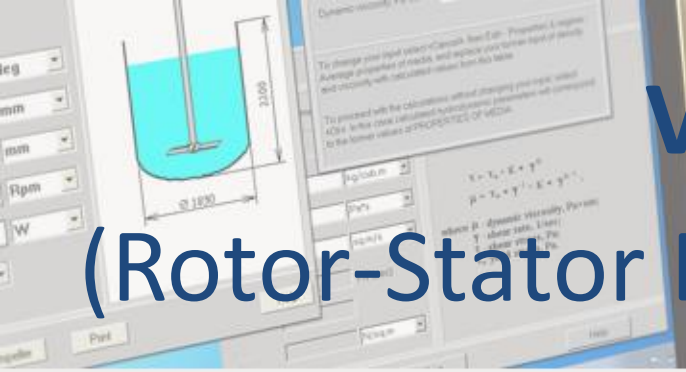
ViSiMiX Ltd.

Founded in 1995

Manufactures software products that allow for solving most practical problems connected with mixing in chemical reactors

Commercial Products:

- ViSiMiX Turbulent
- ViSiMiX Laminar
- ViSiMiX DI
- ViSiMiX PL
- ViSiMiX RSDE



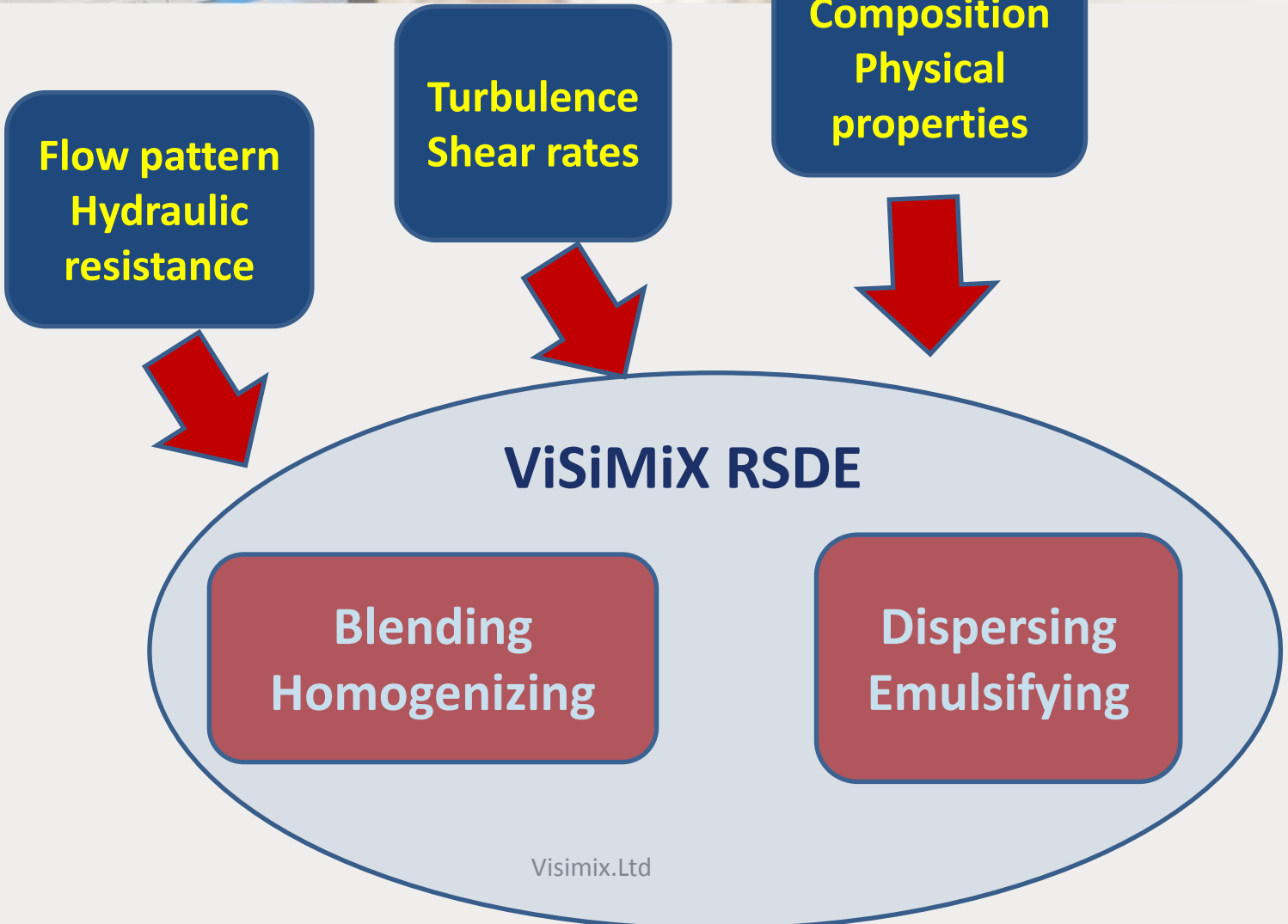
ViSiMiX RSDE
(Rotor-Stator Dispersers and Emulsifiers)

Unique software program for mathematical modeling and technical calculations of installations with RSDE

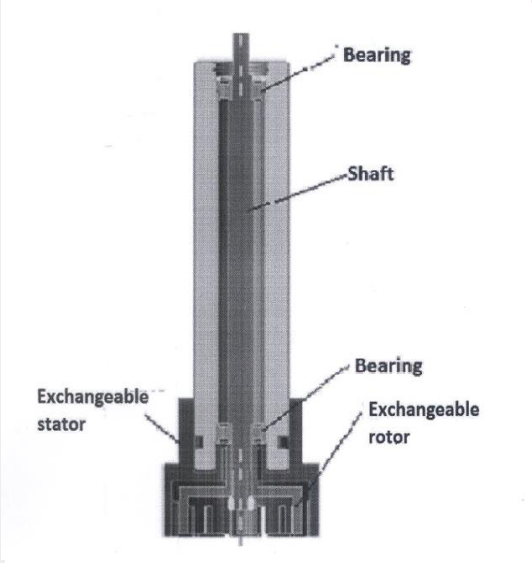
- power, flow characteristics, shear rates and stresses
- homogenizing and emulsion formation
- defining flow and shear parameters for scaling-up

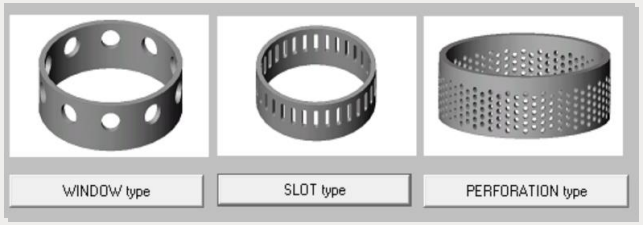
Different types of rotor and stators. Different installation schemes

Methodology



Rotor-Stator devices and Liquids used in experiments



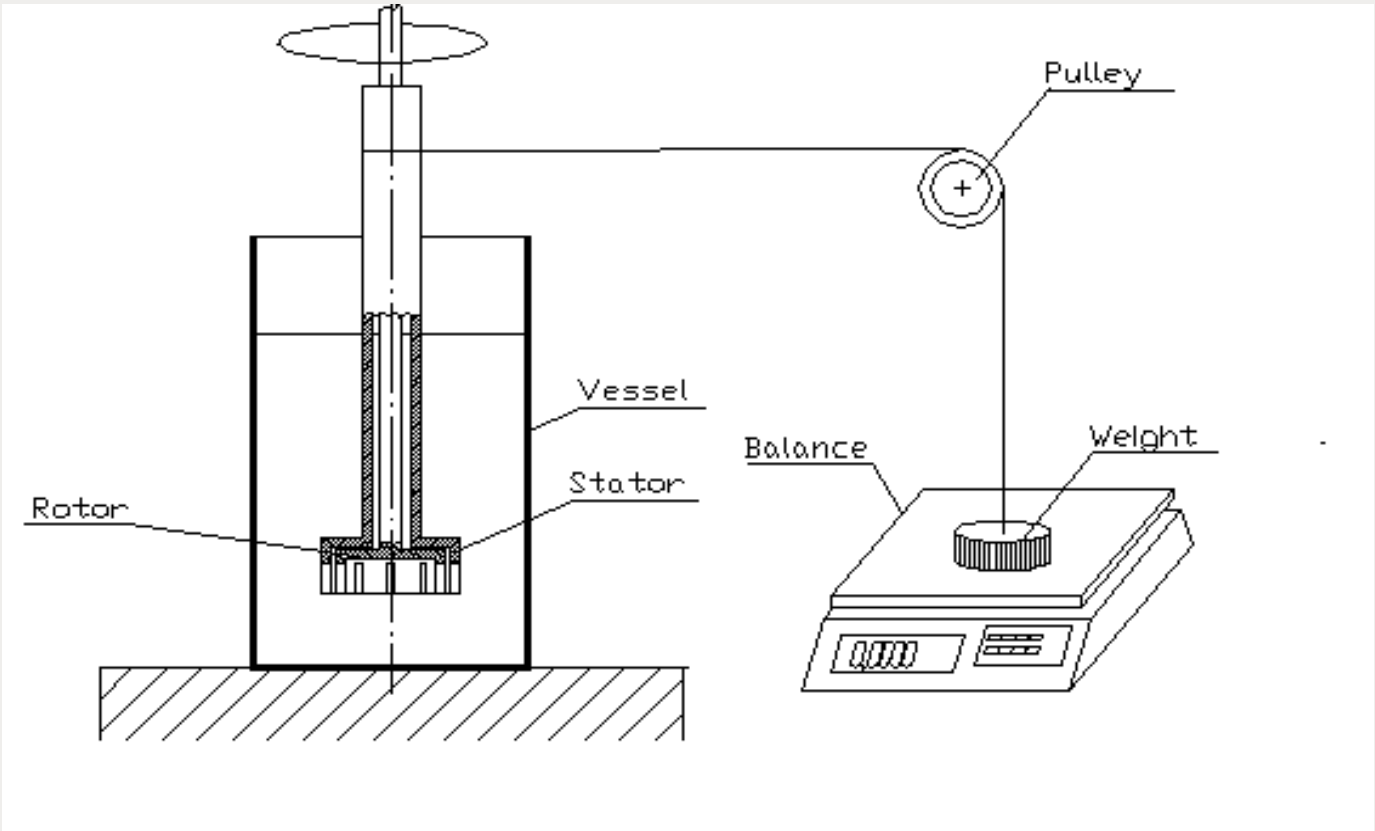


Water – glycerol solutions. Viscosity 1 – 1000 cP

Non – Newtonian liquids:

CMC concentration	Limits of shear rates, 1/s	Power law parameters	
		K	n
1.5 %	10 - 18000	0.251	0.702
2%	2 - 12000	0.890	0.605
2.5%	2 - 8100	1.075	0.630
3%	0.4 - 1800	5.95	0.514
5%	0.8 - 1400	18.77	0.521

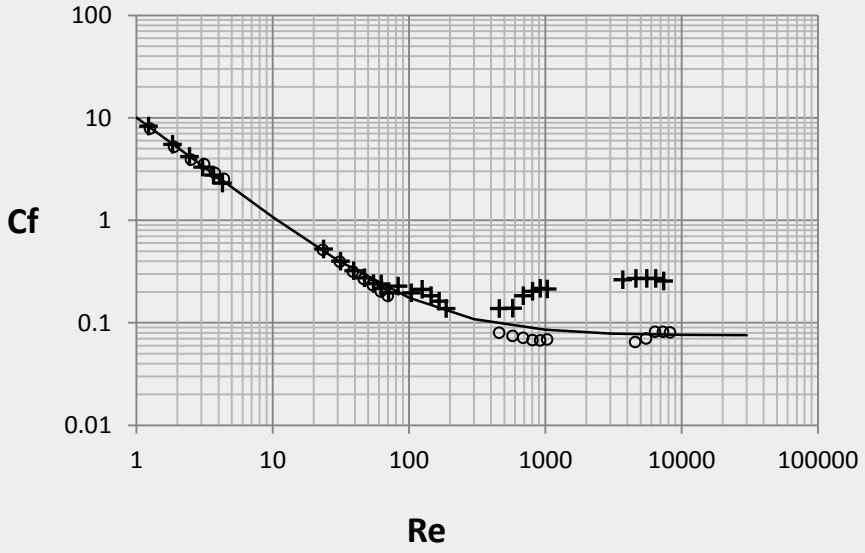
. Scheme of measurement of the torque moment

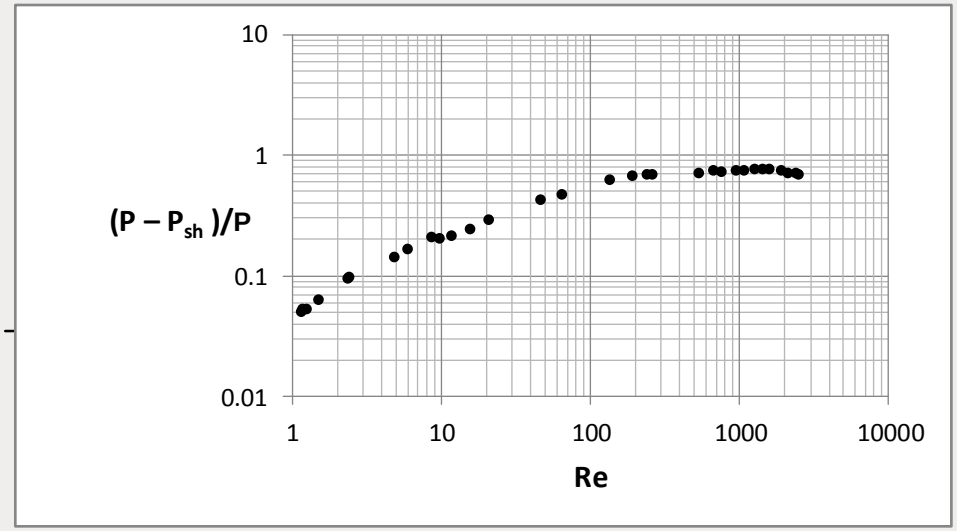


Power consumption due to hydraulic resistance in annular channels between rotor and stator

$$P_{sh} = \omega M_{sh} \qquad M_{sh} = \tau_{sh} F_{st} R_{st}$$

$$\tau_{sh} = C_f \rho V_{tg}^2/2 \qquad C_f = K_1 / Re + K_2$$

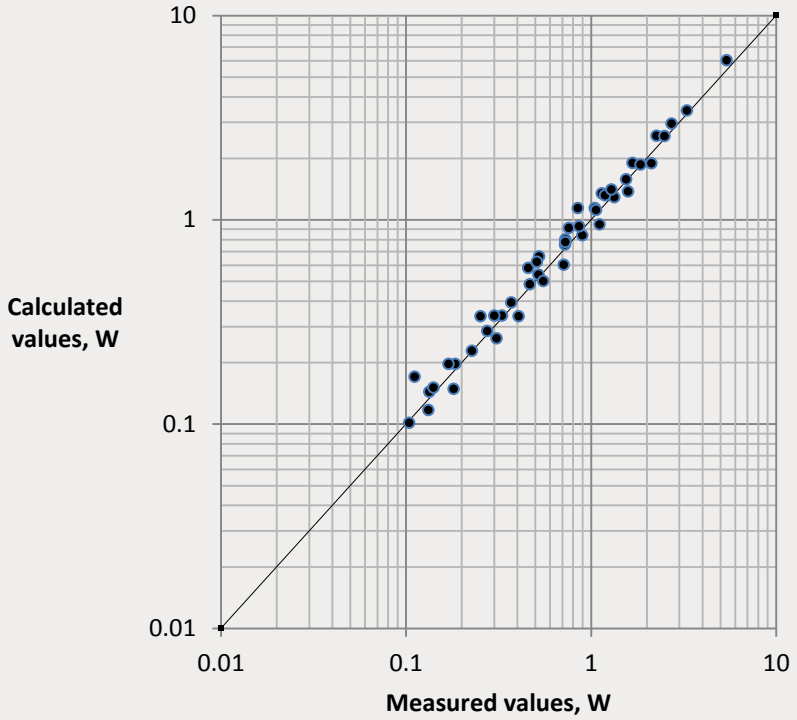




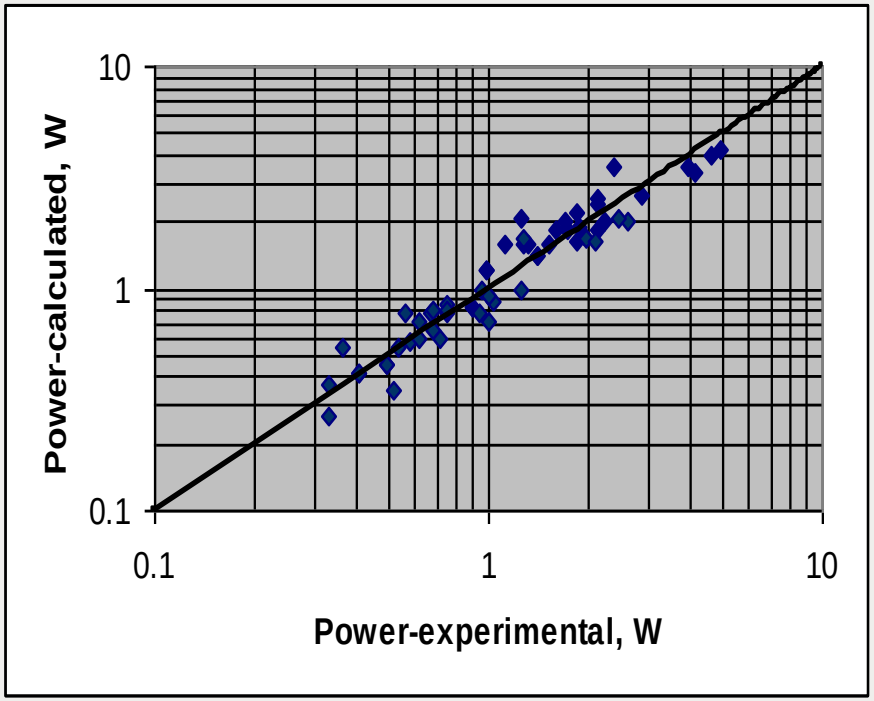
Comparison of Calculated and Measured values of RSD power.

RSD with 'closed' stator.

Newtonian media



Non – Newtonian media



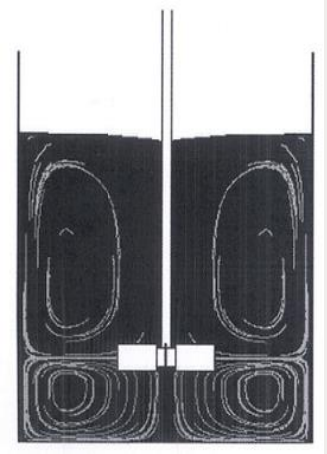
Experimental evaluation of flow capacity of RSD devices

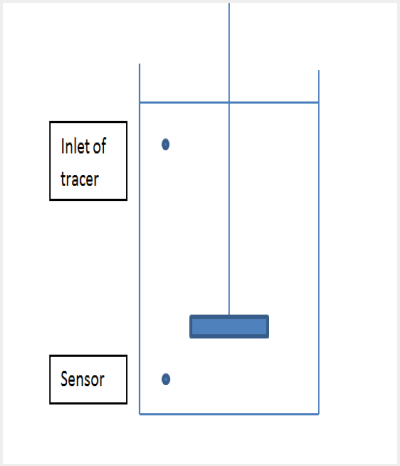
Method 1 : Using power consumption

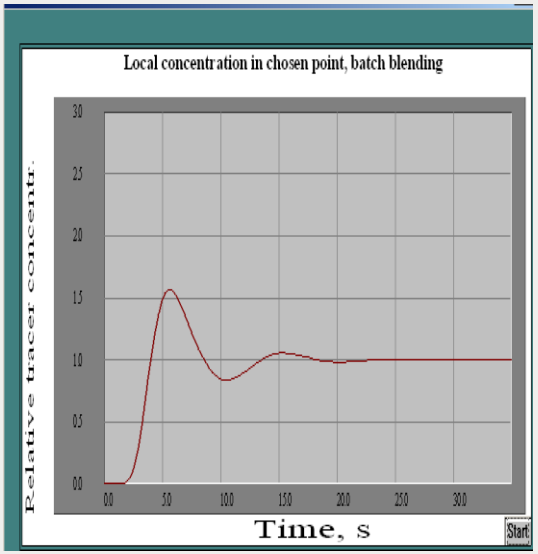
$$P_{kin} = \rho Q \omega^2 R_{rot}^2 / 2$$

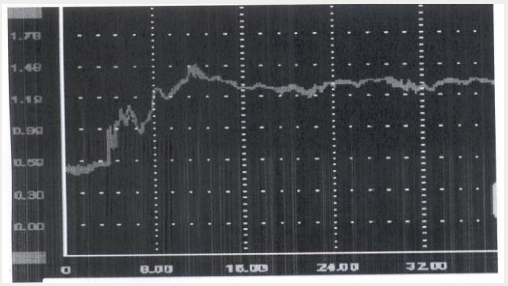
$$Q = 2(P - P_{sh}) / \rho \omega^2 R_{rot}^2$$

Method 2 : By comparison of tracer distribution curves









Flow numbers Nq based on flow rate values defined by two different methods

Stator Internal Diameter, mm	Rotor Diameter, mm	$Nq = Q/ND_{rot}^{3}$	
		Tracer distribution	Power measurements
34	30	0.203	0.223
44	40	0.1	0.0922
44	42	0.165	0.182

FLOW CAPACITY AND POWER CONSUMPTION OF RSD DEVICES

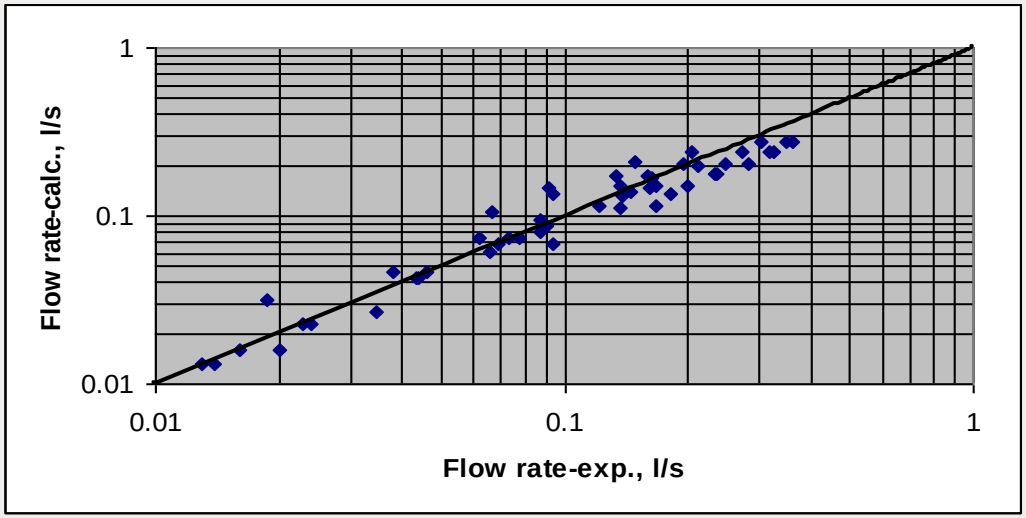
$$P_{cf} = \Delta P_{res}$$

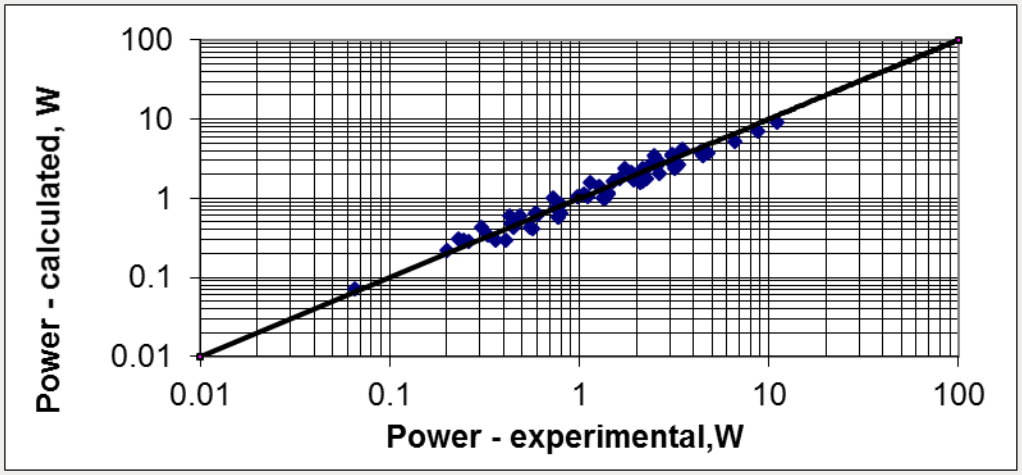
$$P_{cf} = \rho \int \omega^2 r dr$$

$$\Delta P_{res} = \sum C_{f,i} \rho W_{rad,i}^2/2$$

$$C_{f,i} = K_3 / Re + K_4$$

$$W_{rad,i} = Q / A_i$$





Shear rates in RSD channels

Power depends on viscosity

$\mu_{eff} = F(\gamma_{eff})$ – Rheology law

$M_{sh} = F(\gamma_{eff})$

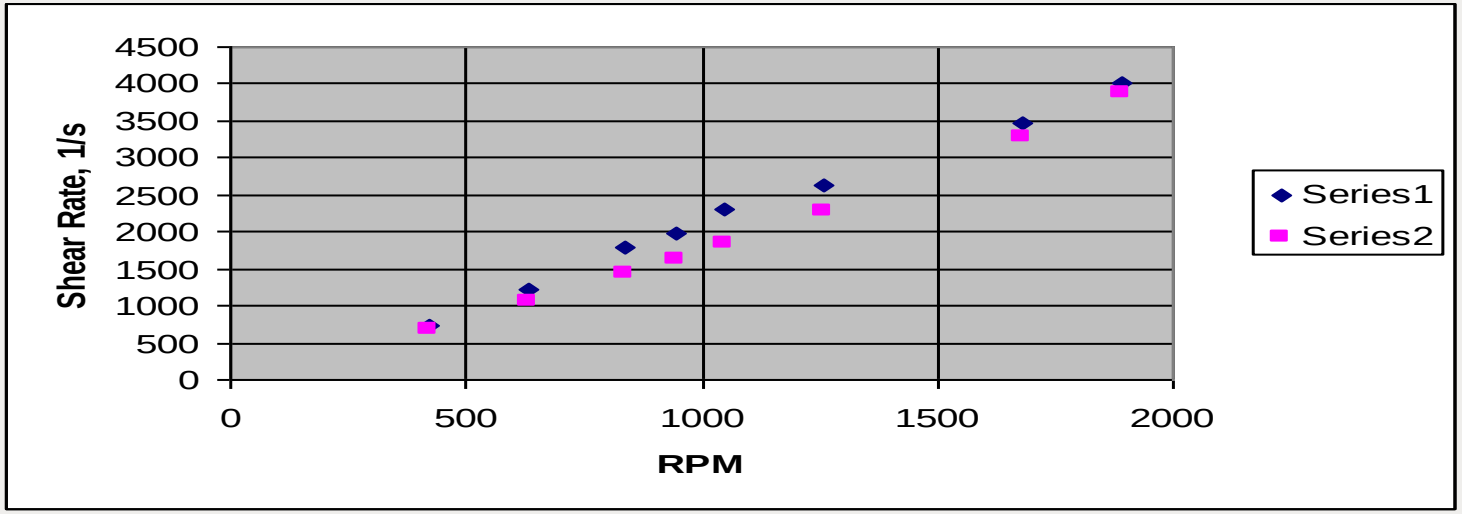
$\varepsilon = \omega M_{sh} / (2\pi \rho R_{st} H_{st}) = \mu_{eff} \gamma_{eff}^2$

$\mu_{eff} = F(\gamma_{eff})$

Measure power ⇒ Know viscosity

Know viscosity ⇒ Know Shear rate

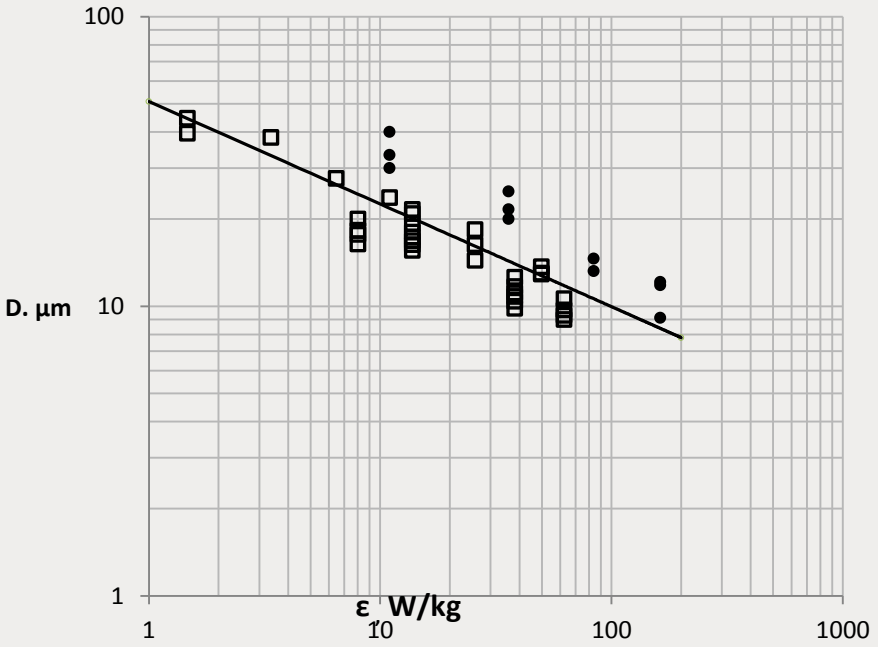
Solve for ***Moment***, ***Viscosity*** and ***Share rate***



Emulsifying action of RSD

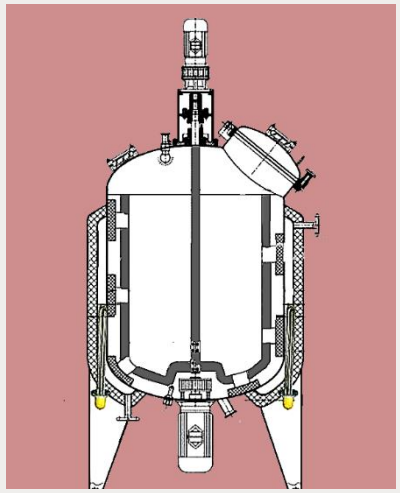
Breaking and coalescence of droplets in high shear channels of RSD

- Mathematical model of drop breaking / coalescence has been successfully used for practical application in the program VisiMix Turbulent (see www.visimix.com) starting from 1996.
- Drop breaking and drop coalescence are result of turbulence
- Frequencies of drop breaking and drop coalescence depend on energy dissipation rate, calculated by RSDE program, drop diameter and physical properties



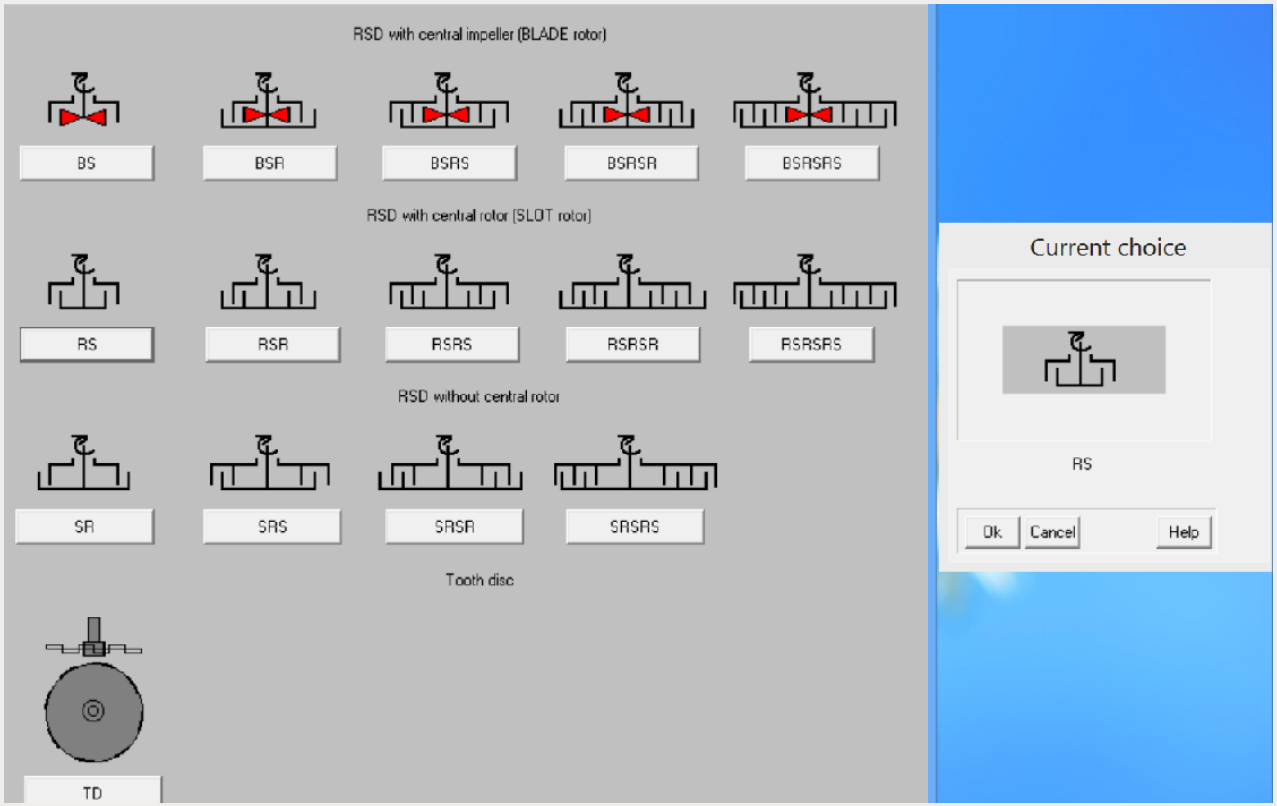
Sauter mean drop size *vs* mean energy dissipation in 50 mm RSD

EXAMPLE OF VISIMIX RSDE SOFTWARE APPLICATION



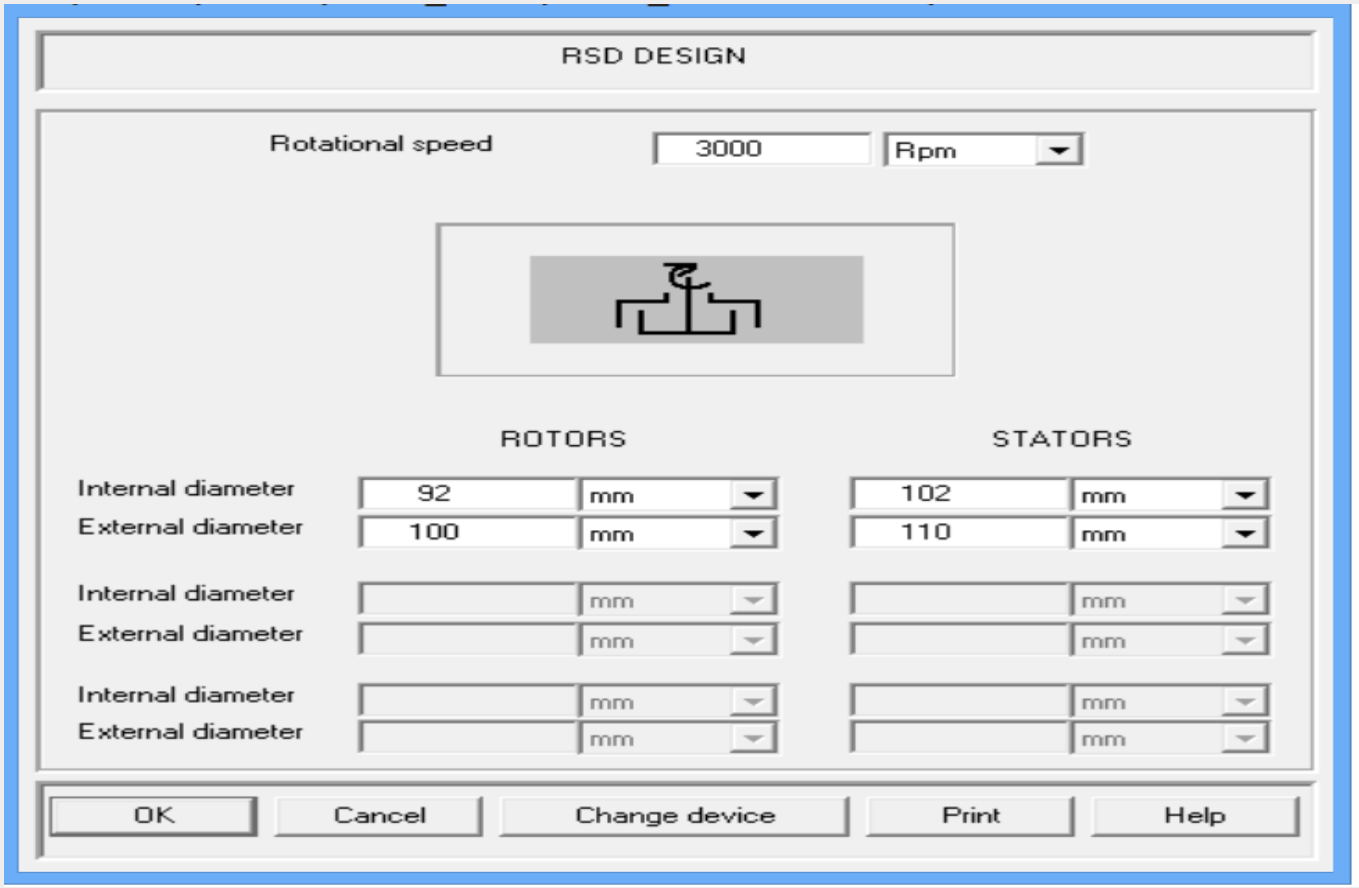
Homogenizing of shampoo in tank with a rotor/stator disperser

Entering of design and dimensions of the rotor/stator device (RSD)



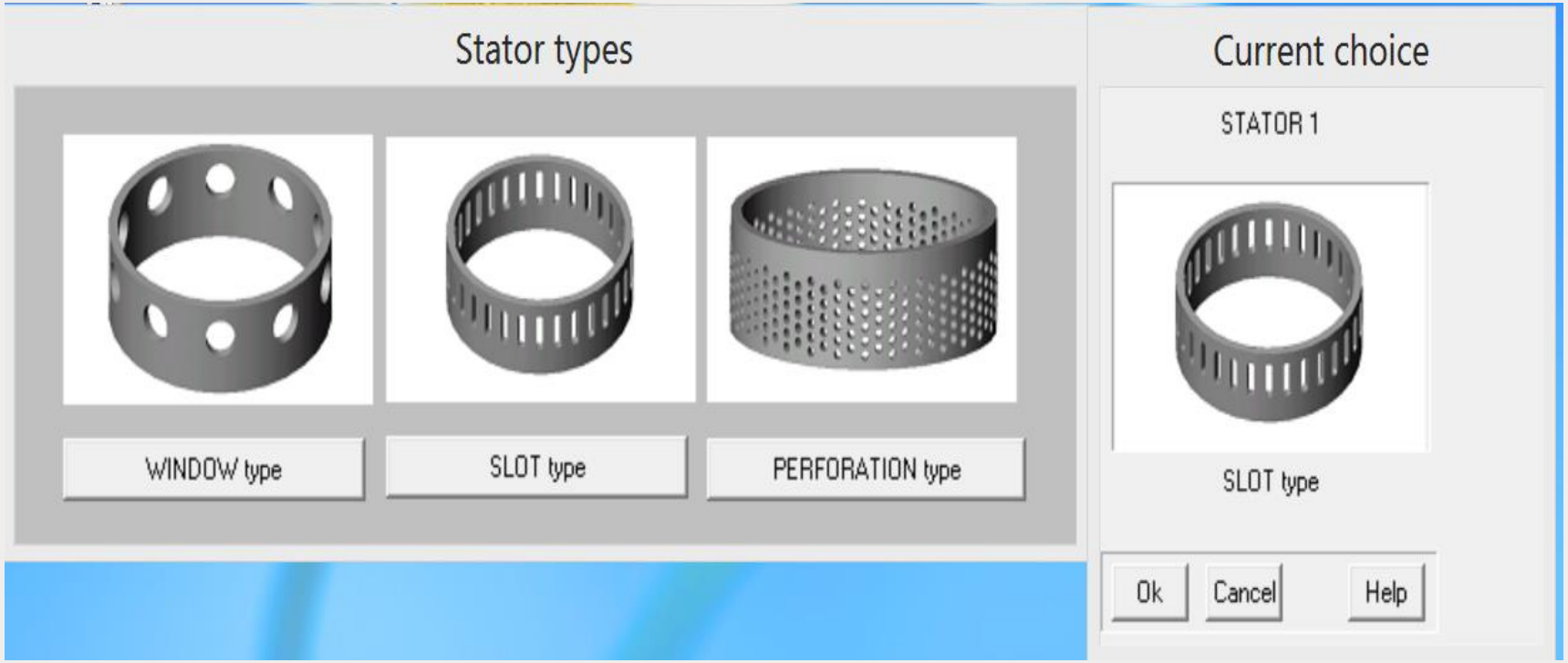
Selection of RSD design scheme

Entering of design and dimensions of the rotor/stator device (RSD)



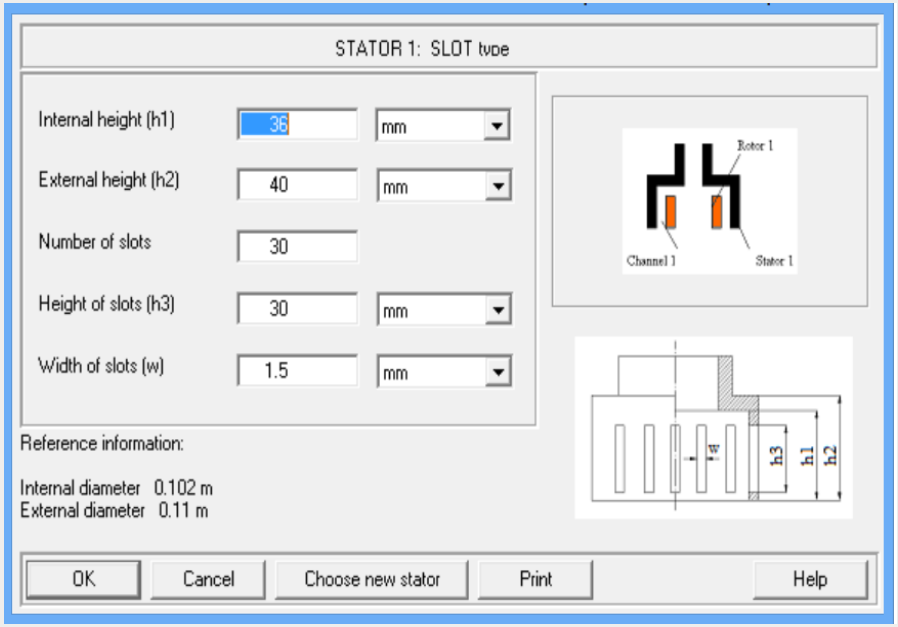
Entering of main RSD data

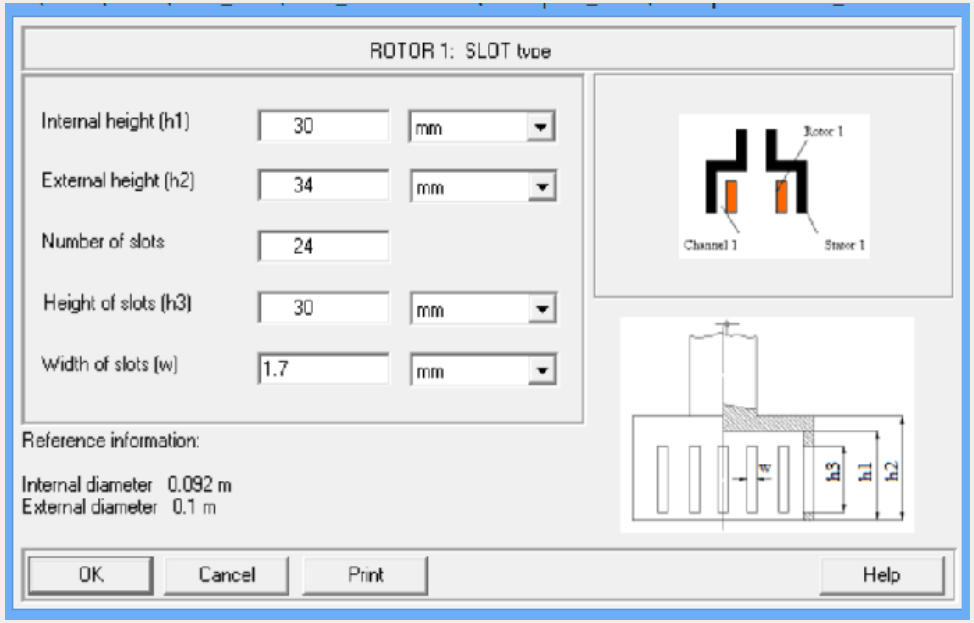
Entering of design and dimensions of the rotor/stator device (RSD)



Entering Stator type

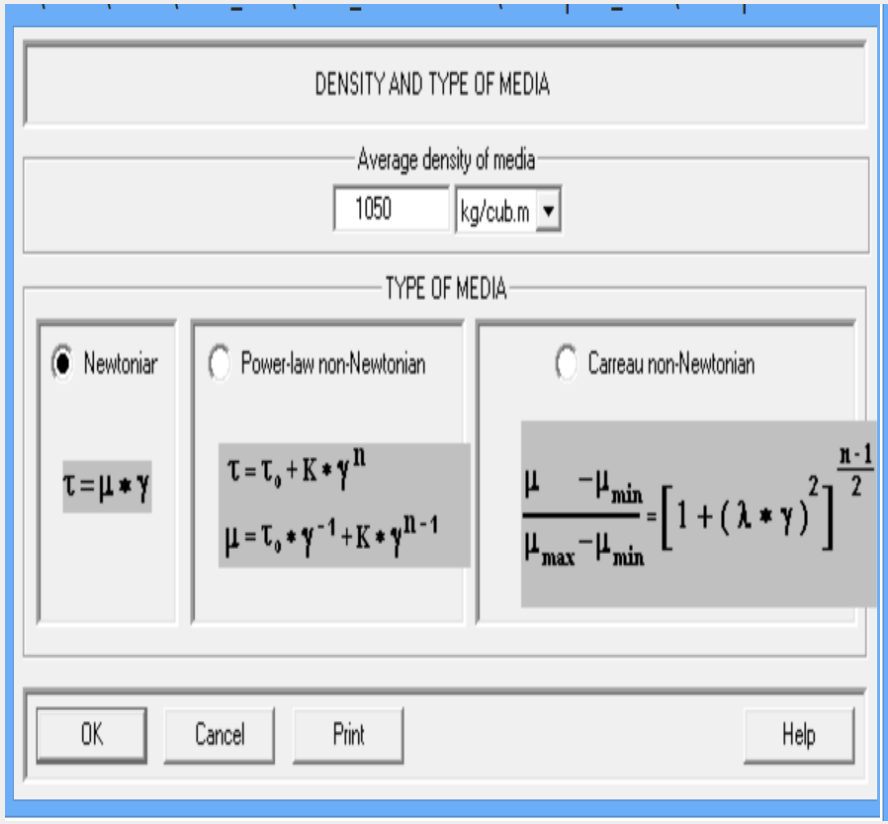
Entering of design and dimensions of the rotor/stator device (RSD)

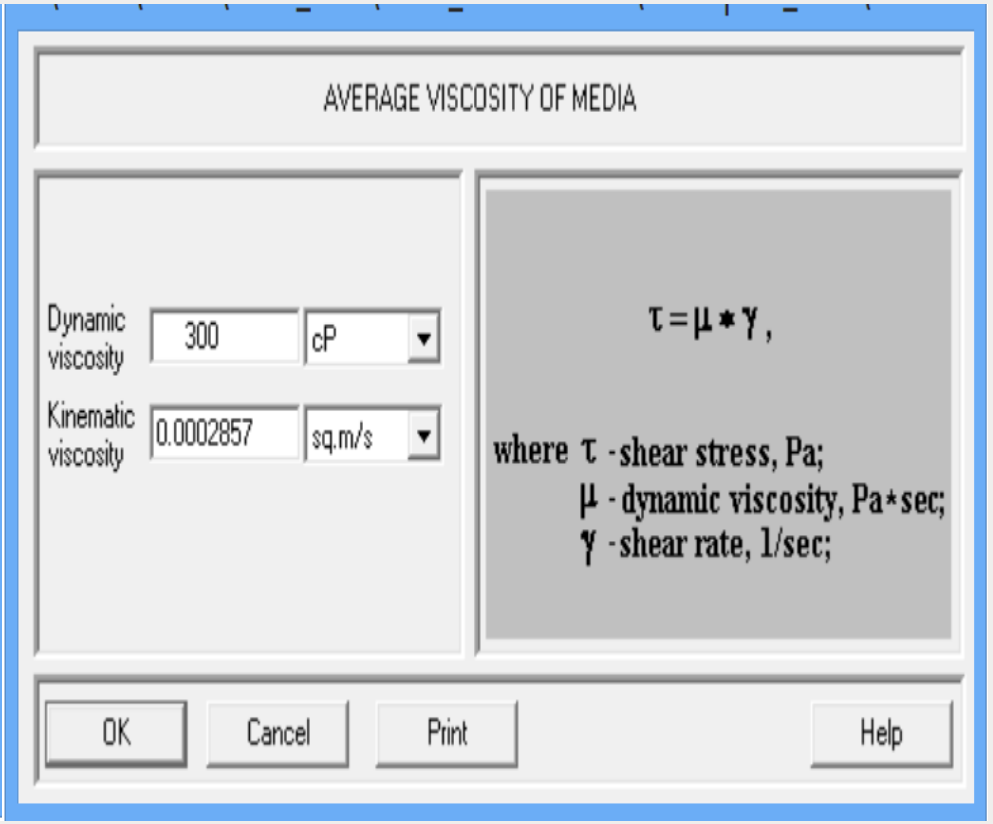




Entering dimensions of stator and rotor

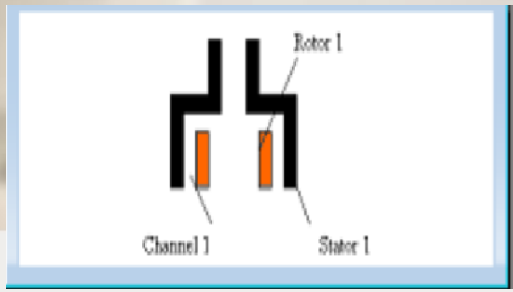
Entering density and viscosity of media

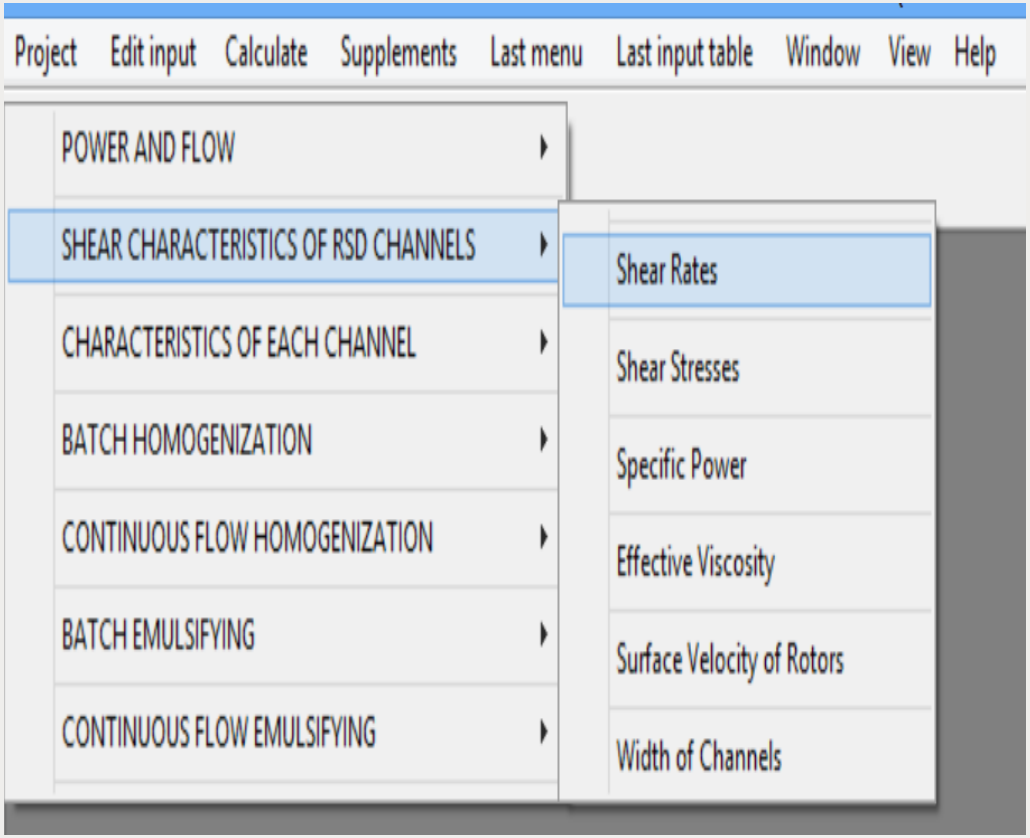


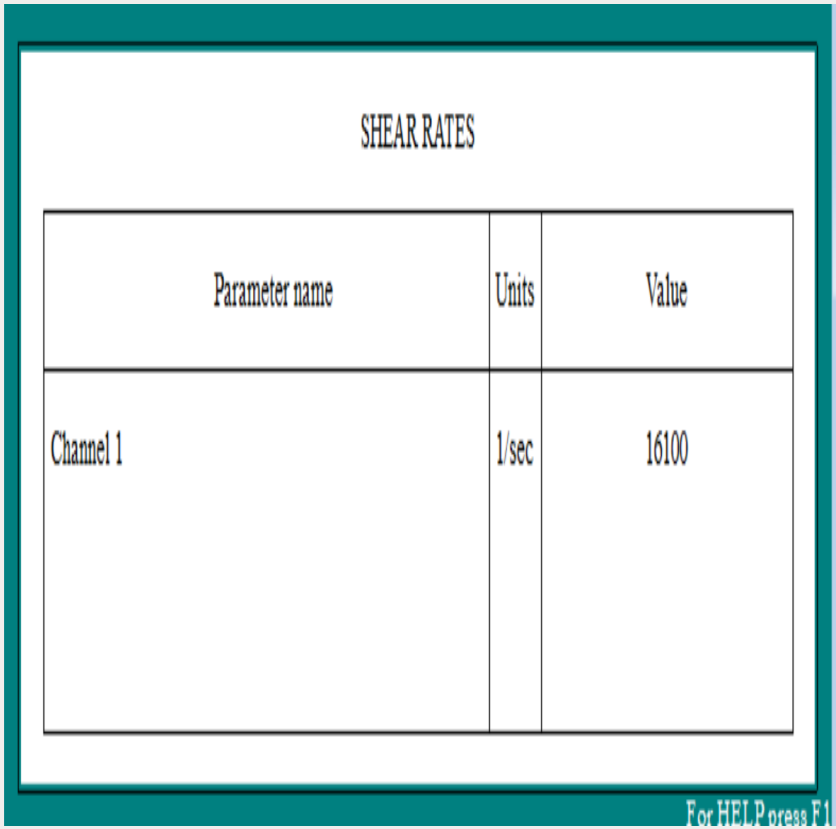


Mathematical modeling and calculations

Defining shear characteristics of the RSD

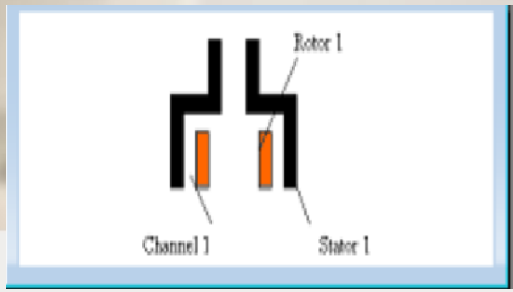


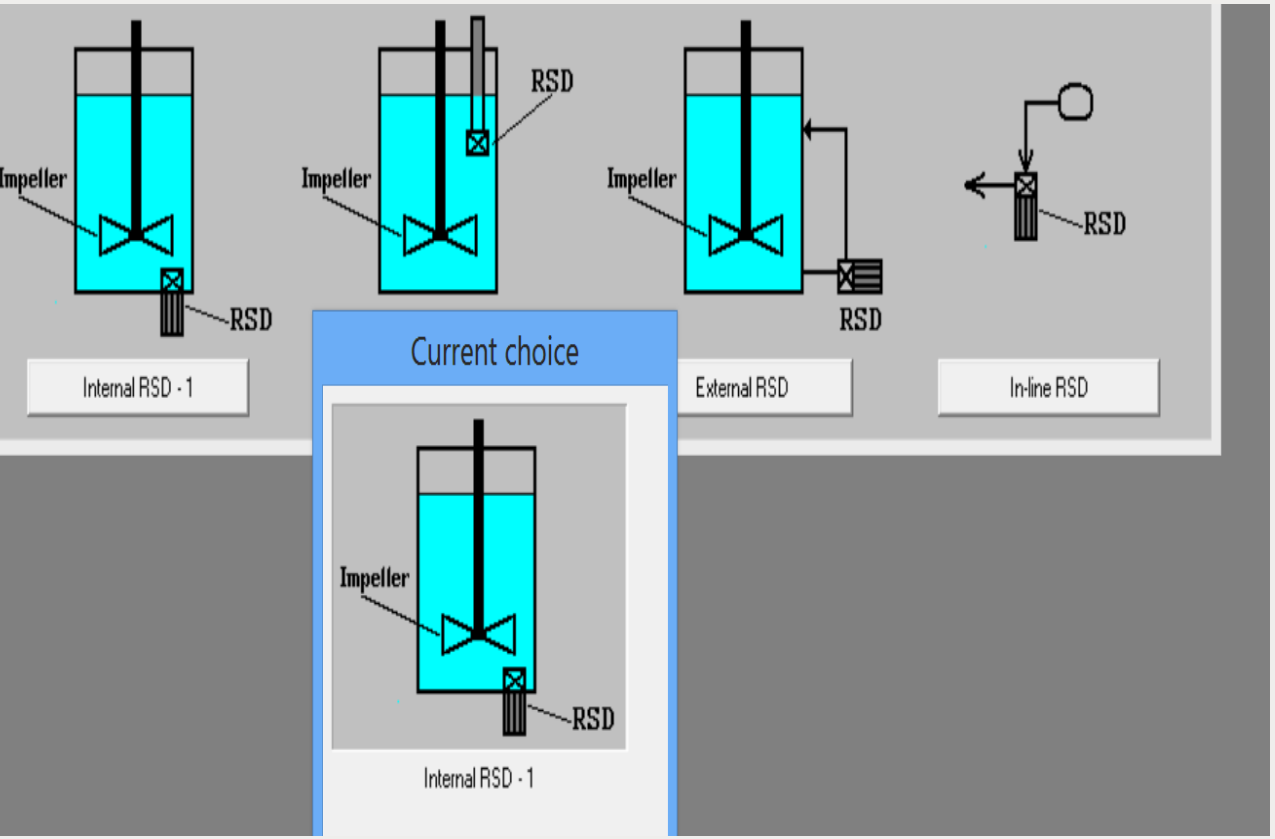




Mathematical modeling and calculations

homogenization of media in the tank





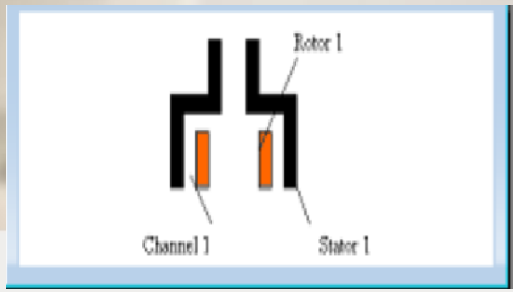
Entering

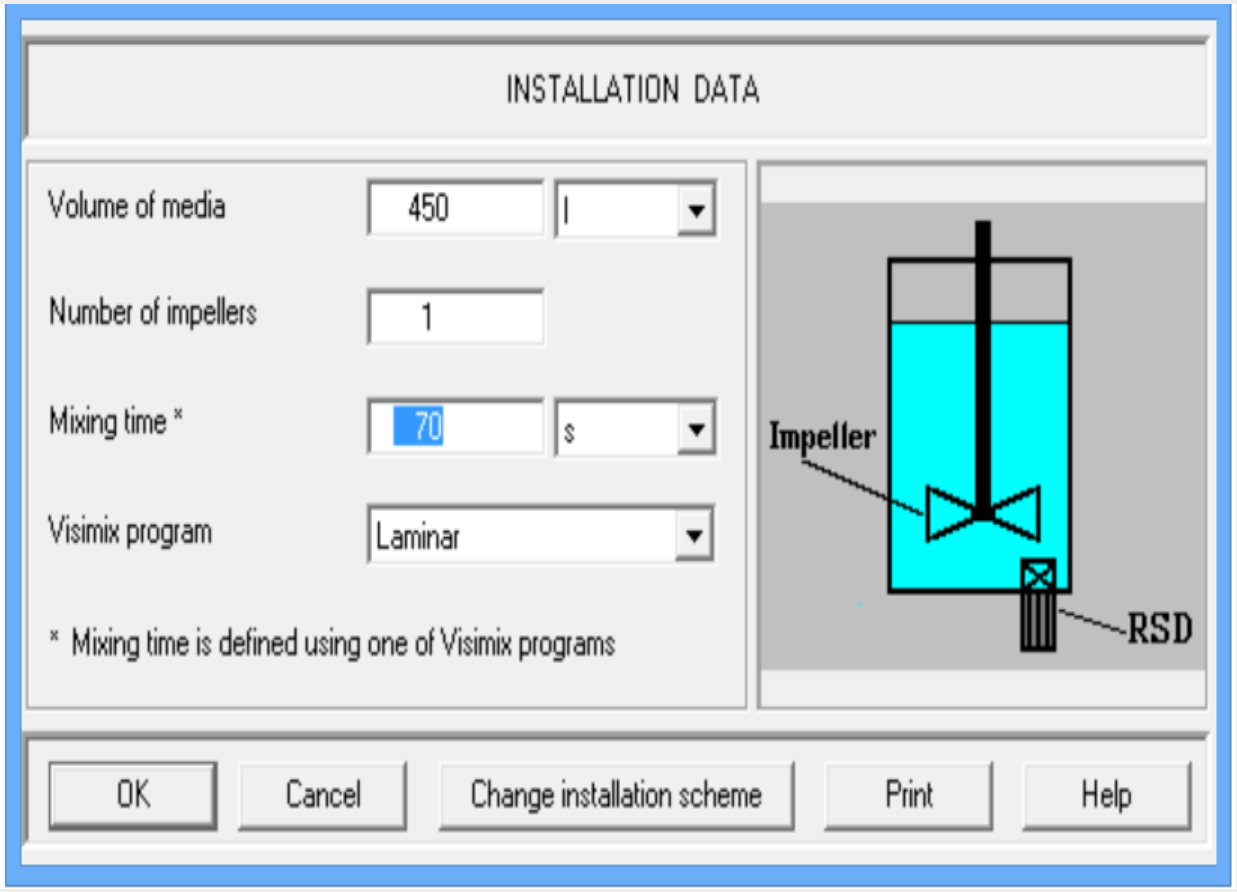
Installation

Scheme

Mathematical modeling and calculations

homogenization of media in the tank

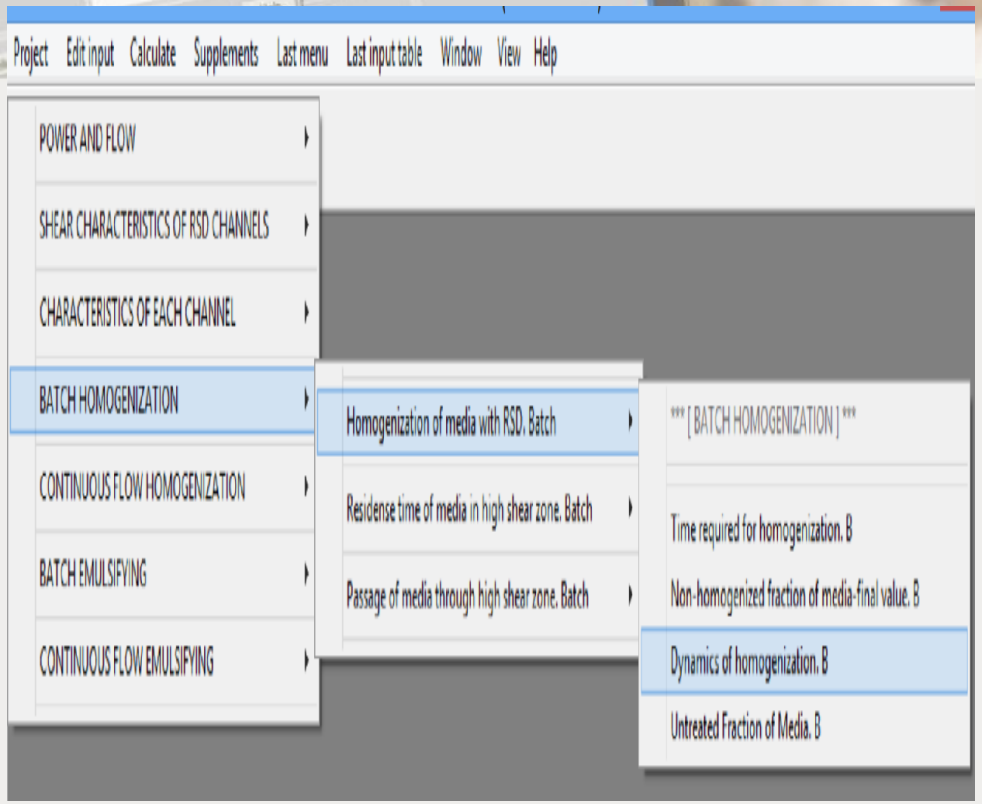


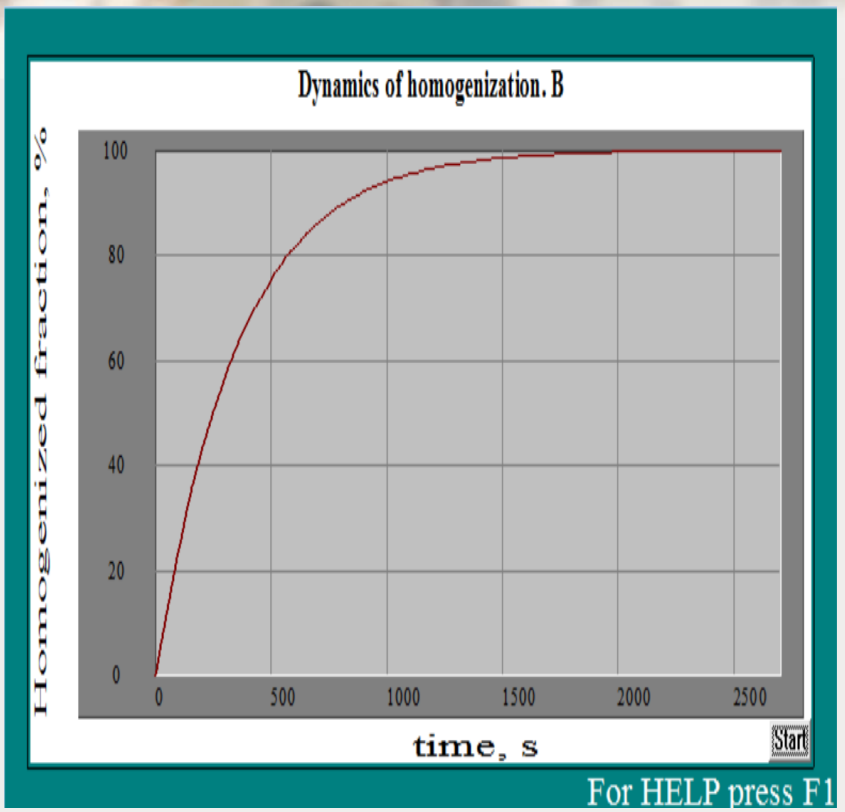


Entering mixing tank data

Mathematical modeling and calculations

homogenization of media in the tank

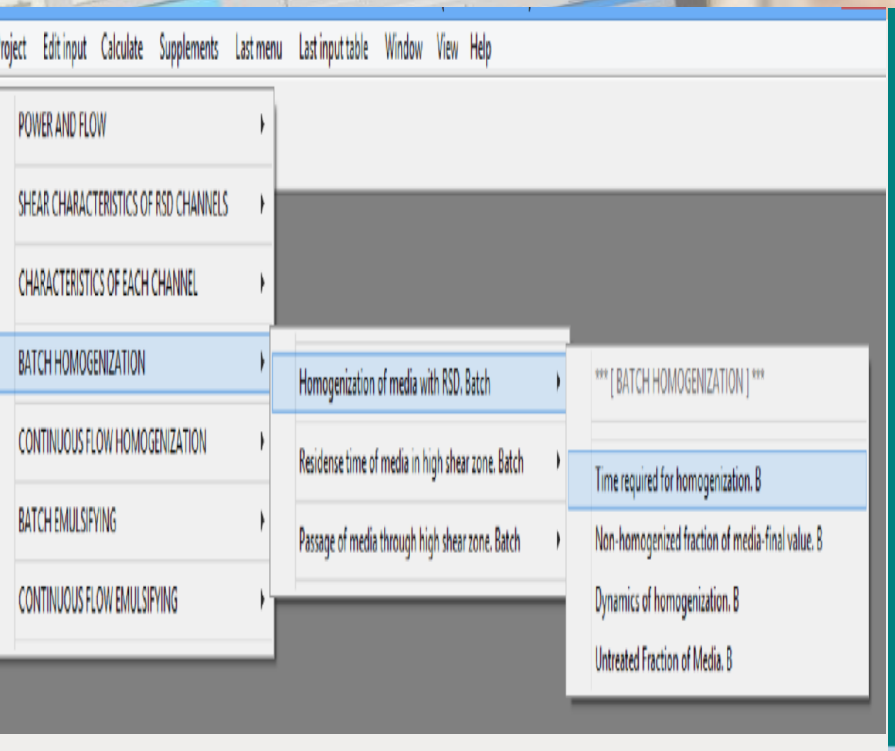




The **Homogenized fraction of media** is a part of media that has passed through the homogenizer for one or more times

Mathematical modeling and calculations

Defining necessary batch duration



TIME REQUIRED FOR HOMOGENIZATION. B

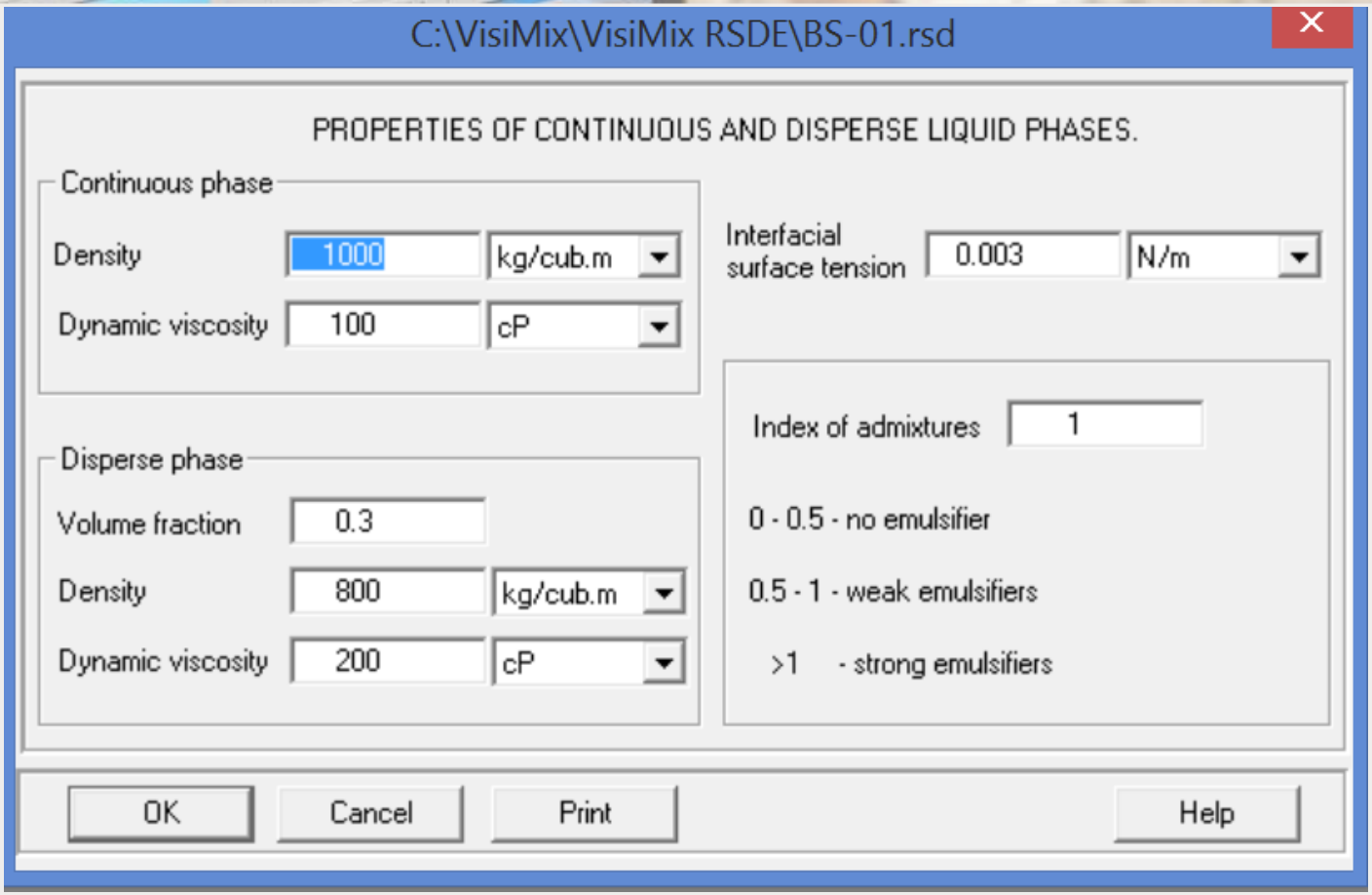
Parameter name	Units	Value
Time for 95% homogenization. B	s	1060
Time for 98% homogenization. B	s	1390
Time for 99% homogenization. B	s	1630
Time for 99.9% homogenization. B	s	2450
Time for 99.99% homogenization. B	s	3270

For HELP press F1

Define process duration corresponding to the required product quality

Mathematical modeling and calculations

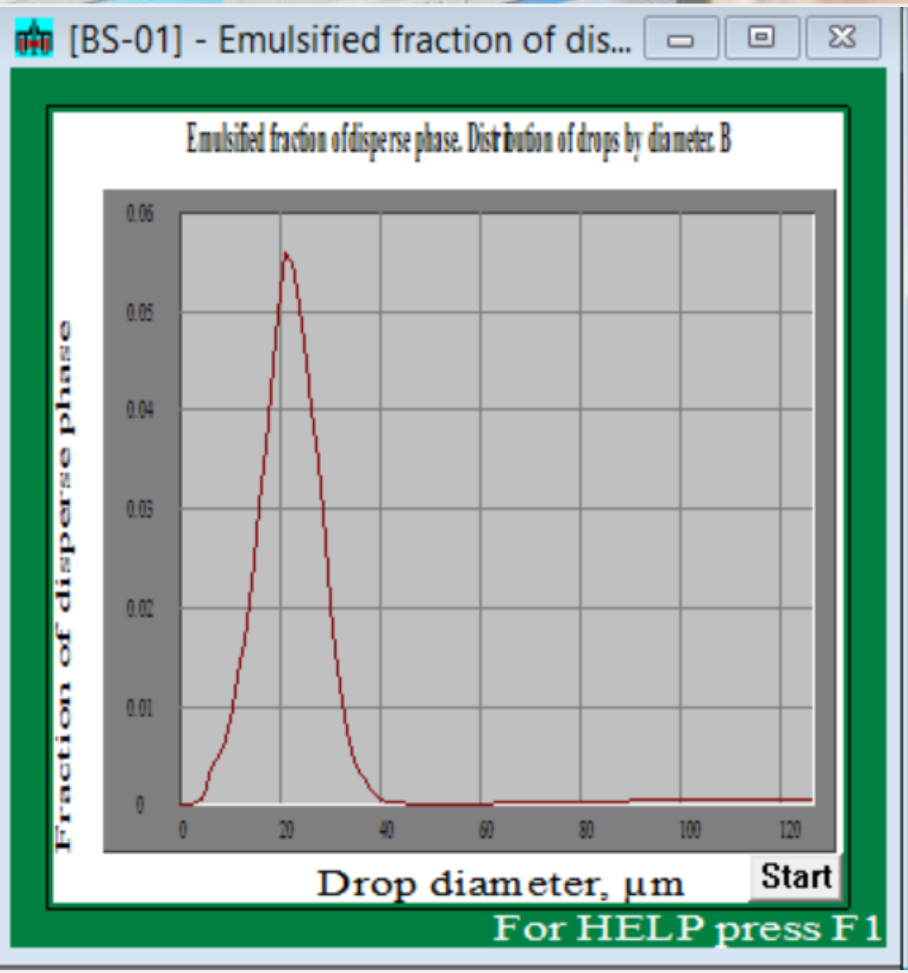
Batch Emulsifying

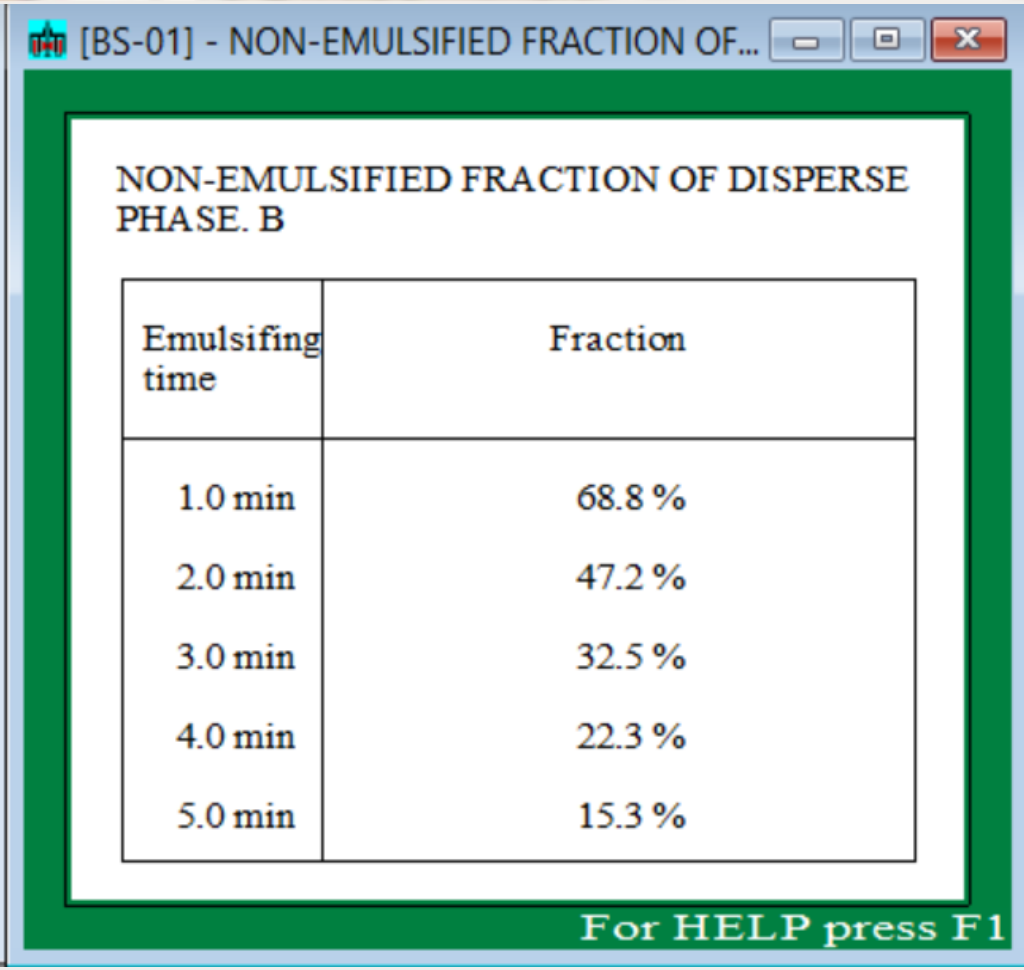


Entering Characteristics of Continuous and Disperse liquid phases

Mathematical modeling and calculations

Batch Emulsifying





Emulsifing time	Fraction
1.0 min	68.8 %
2.0 min	47.2 %
3.0 min	32.5 %
4.0 min	22.3 %
5.0 min	15.3 %

Thank You

Come and visit us at our stand

A33, Hall 9.1

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