

# KaeMix Student 2024 User Guide

KaeMix Documentation

August 20, 2024

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# Summary

- This document describes KaeMix Student's features, user interface, and how to use the program
- For instructions on how to install KaeMix Student, see the installation guide

# Screen Layout

The screenshot shows the KaeMix Student software interface. At the top is the **Menu Bar** with options: FILE, EDIT, PROCESS, DESIGN, PERFORMANCE, TOOLS, SETTINGS, WINDOW, HELP. Below it is the **Ribbon** with various tool icons and tabs: Vessel, Process, Liquids, Drive, Impellers, Baffles, Gas Flow, Sparger, Solids, Particles, File Info, Drawing, Results, Report, Loads, Blending, Suspension, Gas Dispersion, Power, Dimensionless, Guides. The **Design Info** panel on the left contains fields for Tag and Comment. The **Right panel** displays a 3D drawing of a liquid blending tank with a central agitator and a vertical guide. Below the drawing is a **List Commands** section with a toolbar containing Duplicate, New, Delete, and Move (Top, Up, Down, Bottom) buttons, along with a Sort dropdown. At the bottom is the **Design List** table.

**Left panel, multiple tabs with process and design inputs**

Access tabs from Ribbon or Process, Design, and Performance menus

**Right panel:**

- Drawing
- Results
- Report
- Guides

**List Commands**

ID	Ⓢ	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	10.0	4%	00:00:23		7.6/10			

**Design List**

# Built In Examples

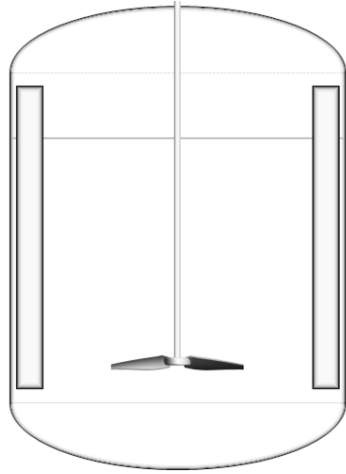
*File → Open Examples*

This will open a file with multiple examples that highlight KaeMix's capabilities

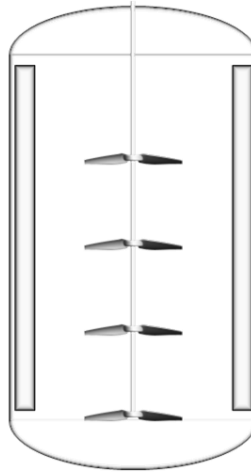
Liquid Blending. M-Scale: 4.5/10. Turbulent. Blendtime: 00:00:39 h:m:s.

ID	Φ	Vessel	T (m)	Z (m)	V <sub>1</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	RPM	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>s</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.7303	ASME	ASME	HF-N	180.0	8.3E-02	10.0	1%	00:00:39		4.5/10			

# Design Examples



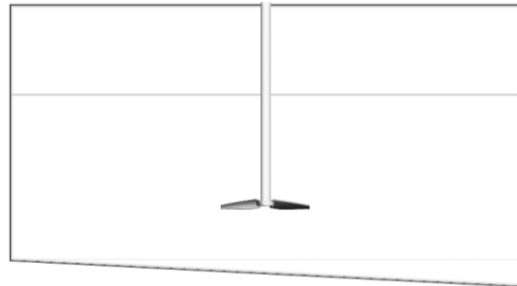
Default design:  
single hydrofoil



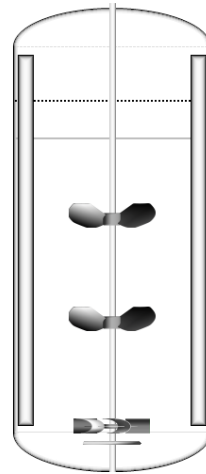
Multiple hydrofoils



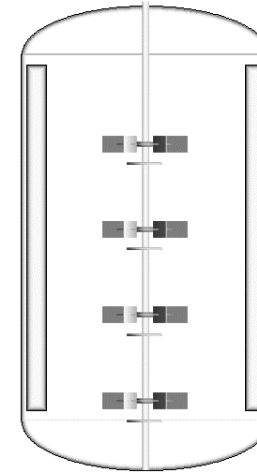
Hydrofoils, a sweeper,  
and helical coils



Rectangular vessel with  
sloped bottom



Hydrofoils, a disk  
turbine, and gas sparger



Multiple impellers and  
spargers

# Multiple Design Capability

Liquid Blending. M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
Gas Dispersion. M-Phase: 3.0/10. Dispersing.  $k_a$ : 0.073 1/s

**KaeMix allows multiple designs in one file. These are shown in the Design List. These can be moved, sorted, duplicated, etc. You can also tag them and add comments. Select designs by clicking in the list.**

ID	☑	Vessel	T (m)	Z (m)	$V_i$ (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	$N/N_c$	M-Scale	M-Phase	Tag	Comment
1	☑	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		7.6/10		Single Hydrofoil - Narrow	
2	☑	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.19	9.2/10	3.0/10	Suspension	Fully suspended
3		Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		4.1/10		Multiple spargers	Multiple Rushton
4		Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.3/10		Sweeper	Conical bottom
5	☑	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	10.0	43%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
6	☑	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.3	0.4	76%	00:00:18		5.1/10		Angled Bottom	Rectangular vessel
7	✗	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	7.0	2.18	25.0	9%	00:12:13		0.0/10		Cavern Size	Yield stress fluid

# Unit Systems: Metric and USA

KaeMix Student

FILE EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Open Save File Info Units Quick Agitator Design Copy Drawing Scale-Up Reposition Load Motor Speed Standard Speed Resize Refresh

Design Vessel Process Liquids Drive

Impellers (1-4) (5-8) Set 1

Connected To: Main Drive  
 Style: Disk Turbine  
 Type: Bakker

Diameter (m): 0.8131 / 0.9147  
 Pump Direction: Radial / Up  
 Number of Blades: 6 / 4  
 Blade Width (m): 0.1626  
 Blade Angle (degrees):  
 Number of Impellers: 1 / 2  
 First Bottom Clearance (m): 0.4064 / 1.484  
 Last Bottom Clearance (m): 0.4064 / 2.563  
 Note:  
 Diameter / Tank Ratio (D/T): 0.4 / 0.45  
 Clearance / Tank Ratio (C/T): 0.2 / 0.73  
 Blade Width Ratio (W/D): 0.2  
 Blade Pitch / Diameter (P/D):

Drawing Results Report Loads Blending Suspension Gas Dispersion Power Dimensionless Guides

Liquid Blending. M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
 Gas Dispersion. M-Phase: 3.0/10. Dispersing.  $k_a$ : 0.073 1/s

Select your preferred units  
 Keyboard shortcuts are:  
 ctrl-m → Metric units  
 ctrl-u → USA Customary units

Design 5/8 Duplicate New Delete Move: ↑ Top ↑ Up ↓ Down ↓ Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	☑	Vessel	T (m)	Z (m)	$V_i$ (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	$N/N_c$	M-Scale	M-Phase	Tag	Comment
1	☑	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		7.6/10		Single Hydrofoil - Narrow	
2	☑	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.19	9.2/10	3.0/10	Suspension	Fully suspended
3		Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		4.1/10		Multiple spargers	Multiple Rushton
4		Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.3/10		Sweeper	Conical bottom
5	☑	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	10.0	43%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
6	☑	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.3	0.4	76%	00:00:18		5.1/10		Angled Bottom	Rectangular vessel
7	✗	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	7.0	2.18	25.0	9%	00:12:13		0.0/10		Cavern Size	Yield stress fluid

C:\KaeMix\ExamplesKMS.kaemix



# Workflow





# Workflow

The screenshot displays the KaeMix Student software interface. The top menu bar includes FILE, EDIT, PROCESS, DESIGN, PERFORMANCE, TOOLS, SETTINGS, WINDOW, and HELP. Below the menu is a toolbar with icons for Open, Save, File Info, and various design tools. The main interface is divided into several panels:

- Left Panel (Vessel Design):** Contains fields for Vessel Style (Cylindrical), Diameter (m) (2.032), Width (m), Vessel Material (Stainless Steel), Wall Thickness (m), Bottom Thickness (m), Wetted Parts Material (Stainless Steel), and Sealing (Mechanical Seal - Double).
- Top Panel (Tabs):** A row of tabs for Design, Vessel, Process, Liquids, Drive, Impellers, Baffles, Gas Flow, Sparger, Solids, Particles, File Info, Drawing, Results, Report, Loads, Blending, Suspension, Gas Dispersion, Power, Dimensionless, and Guides. The 'Design' and 'Results' tabs are highlighted with a yellow box.
- Right Panel (Performance Metrics):**
  - Power Draw:** Total  $P_v$  (kW) 4.7889, Total  $P_s$  (kW) 4.2918,  $P_v/P_s$  0.8962.
  - Main Impeller:** 1: Bakker, % Power Draw 45.7, Reynolds Re 13752, Description Turbulent, Power  $P_o$  2.33, Shear Rate (1/s) 15.6, Eff. Visc. (mPa.s) 75.
  - M-Scale:** 7.9/10 (Strong), Blend Time (h:m:s) 00:00:24, Cavern Volume.
  - M-Phase:** 3.0/10 (Moderate), Particle Suspension, Impeller Speed /  $N_p$ , Cloud H/Z, Gas Dispersion (Dispensing), Gas Holdup 13.1%,  $k_a$  (1/s) 0.0729.
- Bottom Panel (Table):** A table titled 'Design 5/8' showing a list of design options with columns for ID, Vessel, T (m), Z (m),  $V_l$  (m<sup>3</sup>), Bottom, Top, Impeller, rev/s, P (kW), Motor (kW), Load (%), Blend Time,  $N/N_p$ , M-Scale, M-Phase, Tag, and Comment.

Two callout boxes provide additional context:

- Left Callout:** "Typically start in the left panel with the design information or vessel design, and then move through the tabs from left to right: vessel, process, liquids, gas, solids, drive, impellers, baffles, etc." An arrow points from this text to the 'Impellers' tab.
- Right Callout:** "In the right panel you can view your progress from either the Drawing or Results tab" An arrow points from this text to the 'Results' tab.

At the bottom right of the right panel, there is a 3D schematic diagram of a stirred tank reactor vessel with two impellers.

# Drawing

Drawing | Results | Report | Loads | Blending | Suspension | Gas Dispersion

Liquid Blending. M-Scale: 10/10. Turbulent. Blendtime: 00:00:17 h:m:s.  
Gas/Solids. M-Phase: 3/10. Dispersing.  $k_a$ : 0.102 1/s. 100% Suspended. CH/Z: 100%

Caption with summary of results

Gassed operating level  
(calculated by KaeMix)

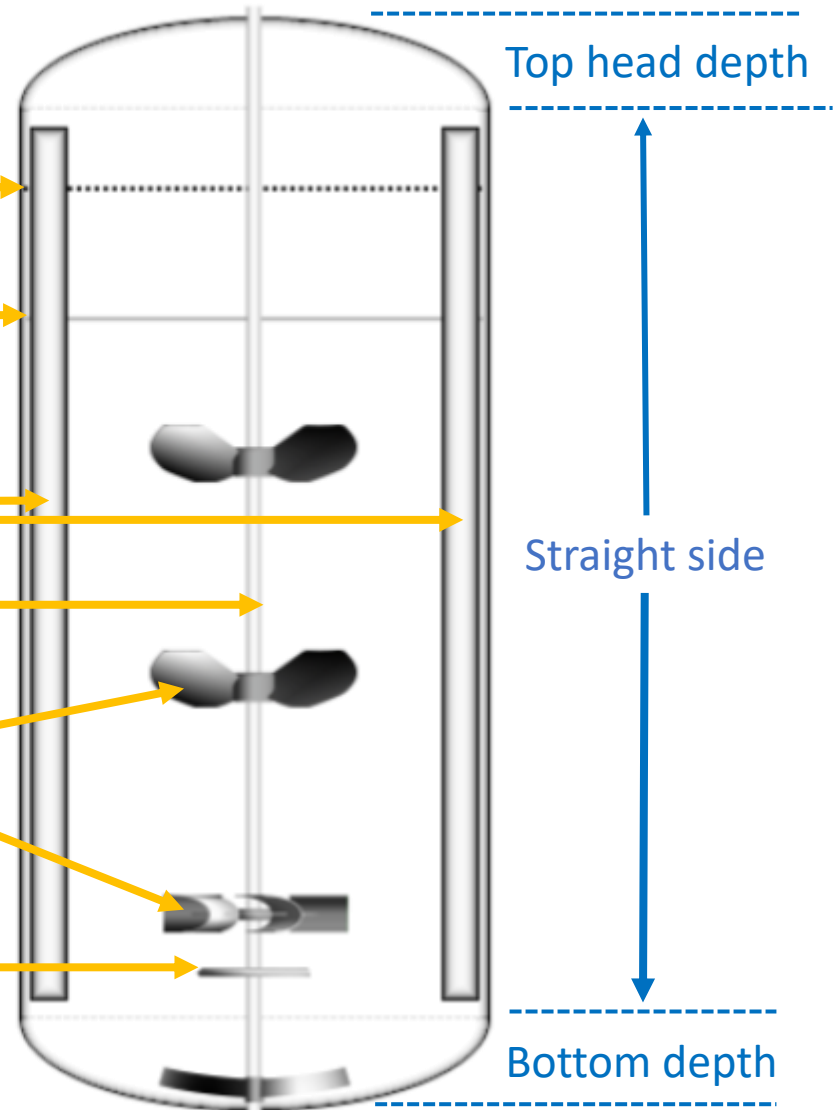
Operating level (includes liquid and  
solids, not gas, specified by user)

Baffles

Shaft


Impellers

Gas sparger



# Results

- $P_u$ : total power draw of all submerged impellers, ungasged
- $P_g$ : total power draw of all submerged impellers, gassed
- $P_g/P_u$ : ratio between gassed and ungasged power draw
- Main Impeller: name of the impeller with the highest power draw
- % Power Draw: main impeller power draw as percentage of total
- Reynolds Re: Reynolds number of main impeller
- Description: if flow is turbulent or laminar
- Power Po: main impeller power number
- Shear Rate: shear rate in region of main impeller
- Eff. Visc.: effective viscosity based on main impeller shear rate
- M-Scale: a 1 to 10 scale of agitation for liquid mixing
- Blend time: time to reach 100% uniformity in liquid
- Cavern volume: volume of caverns around impellers for yield stress fluids
- M-Phase: a 1 to 10 scale of agitation for the gas and/or solids phases
- Particle Suspension: percentage of the solids suspended into the liquid
- Impeller Speed /  $N_{js}$ : ratio between impeller speed and the just-suspended speed for the impeller that contributes the most to the off-bottom suspension
- Cloud H/Z: ratio between the height of the solids cloud and the operating level
- Gas Dispersion: if the gas is being dispersed or the impeller is flooded
- Gas Holdup: volume of gas divided by total volume (liquid + solid + gas)
- $K_a$ : gas-liquid mass transfer coefficient

Drawing	Results	Report	Loads	Blending	Suspension	Gas Dispersion	Power	Dimensionless
<b>Power Draw</b>		<b>M-Scale</b>		8/10				
Total $P_u$ (kW)	4.8056	Blend Time (h:m:s)		00:00:24				
Total $P_g$ (kW)	3.6888	Cavern Volume						
$P_g/P_u$	0.7676	<b>M-Phase</b>		3/10				
<b>Main Impeller</b>	1: Bakker	Particle Suspension						
% Power Draw	45.5	Impeller Speed / $N_{js}$						
Reynolds Re	13752	Cloud H/Z						
Description	Turbulent	Gas Dispersion		Dispersing				
Power Po	2.33	Gas Holdup		12.5%				
Shear Rate (1/s)	15.6	$k_a$ (1/s)		0.0665				
Eff. Visc. (mPa.s)	75							

# M-Scale

- Originally, a 1 to 10 Scale of Agitation\* for blending applications, described in:

*“How to design agitators for desired process response”*

Hicks et al., Chemical Engineering, April 1976

- Scale of 1 to 10:

- M-Scale 1-2 are for applications requiring minimum fluid velocities to achieve the process result.
- M-Scale 2 will blend miscible liquids to uniformity if specific gravity differences are less than 0.1; blend miscible fluids to uniformity if the viscosity of the most viscous is less than 100 times that of the other; establish complete fluid-batch control; and produce a flat, but moving, fluid-batch surface.
- M-Scale 3-6 are characteristic of fluid velocities in most chemical process industries agitated batches.
- M-Scale 6 will blend miscible liquids to uniformity if specific gravity differences are less than 0.6; blend miscible fluids to uniformity if the viscosity of the most viscous is less than 10000 times that of the other; and produce surface rippling at lower viscosities.
- M-Scale 7-10 are characteristic of applications requiring high fluid velocity for the process result, such as in critical reactors.
- M-Scale 10 will blend miscible liquids to uniformity if specific gravity differences are less than 1.0; blend miscible fluids to uniformity if the viscosity of the most viscous is less than 100,000 times that of the other; and produce surging surfaces at low viscosities.

## M-Scale Descriptions

- 1: Slow
- 2: Mild
- 3: Moderate
- 4: Intermediate
- 5: Medium
- 6: Medium-Strong
- 7: Strong
- 8: Very Strong
- 9: Powerful
- 10: Very Powerful\*

*\* In KaeMix the scale has been extended to a maximum of 14*

# M-Phase

- Originally, a 1 to 10 Scale of Agitation\* for multiphase applications, described in:

For solids: *“Selecting agitator systems to suspend solids in liquids”*

Gates et al., Chemical Engineering, May 1976

For gas: *“How to select turbine agitators for dispersing gas into liquids”*

Hicks and Gates, Chemical Engineering, July 1976

For gas and solids: KaeMix reports the lower value of the gas and solids scales

- Solids suspension:

- M-Phase 1-2 produces motion of all solids. Moving fillets of solids on the bottom are periodically suspended.
- M-Phase 3-5 is sufficient for most suspension applications including dissolving solids. All solids are completely suspended off the vessel bottom. Typically, suitable for slurry drawoff at low exit-nozzle elevations.
- M-Phase 6-8 is for when the solids-suspension level needs to approach uniformity. Typically, suitable for slurry drawoff up to 80% of fluid-batch height.
- M-Phase 9-10 is for applications where the solids-suspension uniformity is the maximum practical. Typically, suitable for slurry drawoff by means of overflow.

- Gas dispersion:

- M-Phase 0 indicates the impeller system is flooded by the gas.
- M-Phase 1-2 is for when the degree of gas dispersion is not critical.
- M-Scale 2 provides a coarse level of gas dispersion and is typical of applications that are not mass-transfer limited.
- M-Phase 3-5 provides complete gas dispersion. Fine bubbles are driven to the vessel wall and recirculated back into the impeller.
- M-Phase 6-10 is for critical gas-liquid reactors where rapid mass transfer is required. Fine dispersions are accomplished, and gas-liquid interfacial area is maximized.

*\* In KaeMix the scale has been extended to a maximum of 14*

# Report

You can view a report from the right panel.

To print it, right click in the report to get the print menu or use *File* → *Print*.

You can save the report or send it to MS-Office or LibreOffice from the File menu.

**File Info**

Project Name	KaeMix Examples Project
Company	KaeMix LLC
Location	Atlantis
Customer	Imagineering Inc
Designer	Orca Doe
Manufacturer	AMCE

**Design Info**

Design	8 ✓
Tag	Gas Dispersion
Comment	Turbine + 2 Up Pumping Impellers
Liquid Flows	Batch System
Gas Dispersion	✓
Solid Suspension	X
Liquid Dispersion	X
Heat Transfer	X

**Program Messages**

Liquid Blending. M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
 Gas Dispersion. M-Phase: 3.0/10. Dispersing.  $k_d$ : 0.073 1/s

**Design 8/11**

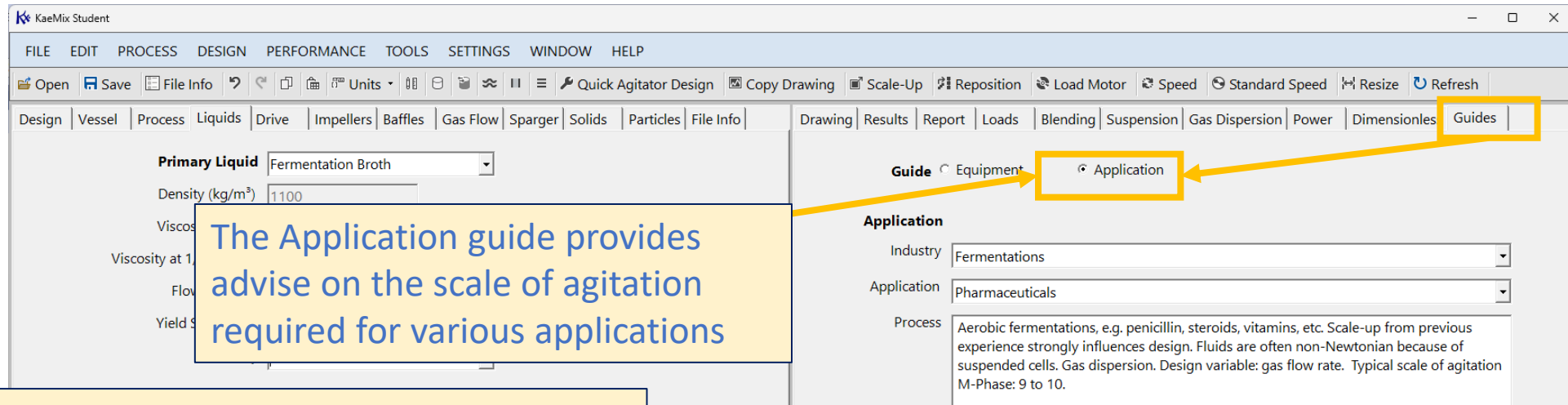
ID	⊕	Vessel	T (m)	Z (m)	$V_L$ (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
5		Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.0/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering	
7		Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.94	33.5	12%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal	
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size	



# Guides



# Guides: Applications



The Application guide provides advise on the scale of agitation required for various applications

Scale of Agitation: a 1 to 10 mixing scale indicating agitation intensity:

- *M-Scale* for liquid blending
- *M-Phase* for blending of liquid with gas and / or solids

**Guide**  Equipment  Application

**Application**

Industry: Fermentations

Application: **Pharmaceuticals**

Process: Aerobic fermentations, e.g. penicillin, steroids, vitamins, etc. Scale-up from previous experience strongly influences design. Fluids are often non-Newtonian because of suspended cells. Gas dispersion. Design variable: gas flow rate. Typical scale of agitation M-Phase: 9 to 10.

**Mixer Design**

A concave-blade, gas-dispersing disk turbine with up-pumping high solidity hydrofoils is recommended.

Source: Gates, Hicks, Dickey. *Application guidelines for turbine agitators*. Chemical Engineering. Dec. 1976. pp. 165-170



# Guides: Equipment

KaeMix

FILE EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Open Save File Info Units Quick Agitator Design Copy Drawing Scale-Up Reposition Load Motor Speed Standard Speed Resize Refresh

Design Vessel Process Liquids Drive Impellers Baffles Heat Gas Flow Sparger Solids Particles Drawing Results Report Loads Blending Suspension Gas Dispersion HT Rate Power Dimensionless **Guides**

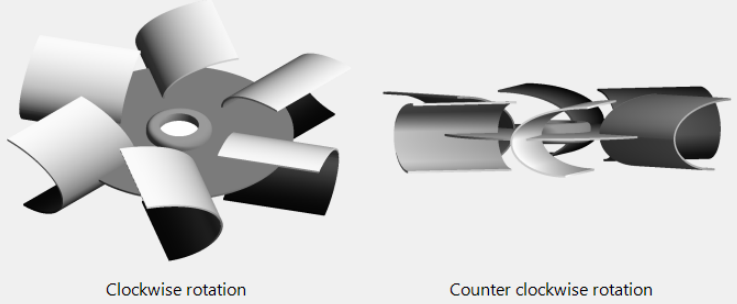
Primary Liquid: Fermentation Broth  
 Density (kg/m<sup>3</sup>): 1100  
 Viscosity: [ ]  
 Viscosity at 1: [ ]  
 Flow: [ ]  
 Yield S: [ ]

**The Equipment guide in the right panel let's you view the different impeller and equipment styles that are available in KaeMix**

Guide  Equipment  Application

Equipment: Disk Turbine  
 Type: Bakker

Vertically asymmetric, deep concave blades. Used for demanding gas dispersion applications such as fermentation.



Clockwise rotation      Counter clockwise rotation

Design 8/11 Duplicate New Delete Move: Top Up Down Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	⊕	Vessel	T (m)	Z (m)	V <sub>L</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
5		Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.0/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering	
7		Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.94	33.5	12%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal	
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size	

C:\KaeMix\Examples.kaemix



# File and Design Info



# File Info

The screenshot displays the KaeMix software interface. The 'File Info' tab is active, showing a form for entering project details. A yellow box highlights the 'File Info' menu item in the 'FILE' dropdown, which is also highlighted in the main menu bar. A yellow box highlights the 'File Info' tab in the software's interface. A yellow box highlights the 'File Info' menu item in the dropdown menu. A yellow box highlights the 'File Info' menu item in the dropdown menu.

**Enter the file information here**

**Enter notes here**

**In the File Info tab you can enter relevant information about the contents of this file.**

ID	Ⓢ	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>g</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	10.0	4%	00:00:23		7.6/10		Default Design	
2	✓	Cylindrical	1.52	2.31	4.0193	Ellipse	Ellipse	COW	0.1	16.89	30.0	56%	00:23:03		2.3/10		Helical	
3	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	1.2	6.31	8.0	79%	00:00:22		7.0/10		HTR Coils	
4	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	2.0	3.5	5.0	70%	00:00:19	1.25	9.7/10	3.5/10	Suspension	Fully Suspended
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impellers
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:09		4.3/10		Side Entering	
7	✓	Horizontal	1.18	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:13		5.8/10		Horizontal	

# Design Info

KaeMix

FILE EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Open Save File Info Quick Agitator Design Copy Drawing Scale-Up Reposition Load Motor Speed Standard Speed Resize Refresh

Design Vessel Process Liquids Drive Impellers Baffles Heat Gas Flow Sparger Solids Particles Drawing Results Report Loads Blending Suspension Gas Dispersion HT Rate Power Dimensionless Guides

**Design Info**

Tag: Gas Dispersion

Comment: Turbine + 2 Up Pumping Impellers

Notes:

In this tab you can enter design related information and notes.

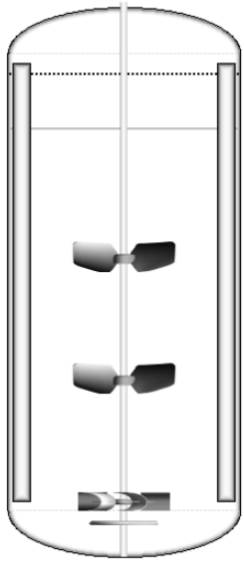
**Additional Phenomena**

- Gas Dispersion
- Solids Suspension
- Heat Transfer
- Liquid Dispersion

**Additional Components**

- Draft Tube
- Stage Dividers

Liquid Blending. M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
Gas Dispersion. M-Phase: 3.0/10. Dispersing.  $k_a$ : 0.073 1/s



Note: whereas the File Info applies to the whole file, the Design Info is separate for each design in the file.

Design 8/11 Duplicate New Delete Move: Top Up Down Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	Φ	Vessel	T (m)	Z (m)	$V_L$ (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>c</sub>	M-Scale	M-Phase	Tag	Comment
5		Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.0/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering Pumper	
7		Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10			
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.94	33.5	12%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal	
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size	

C:\KaeMix\Examples.kaemix



# Vessel Design



# Vessel Design (1/3)

Application Vessel Process Liquids Gas Flow Solids

### Vessel Design

Vessel Style: Cylindrical

Straight Side (m): 4.064

Diameter (m): 2.032

Width (m):

Bottom Style: Elliptical

Bottom Depth (m): 0.4064

Bottom Volume (m<sup>3</sup>): 0.8786

Top Head Style: Elliptical

Top Head Depth (m): 0.4064

Top Head Volume (m<sup>3</sup>): 0.8786

Total Volume (m<sup>3</sup>): 14.06

Vessel Material: Stainless Steel

Wall Thickness (m):

Bottom Thickness (m):

Wetted Parts Material: Stainless Steel

Sealing: Mechanical Seal - Double

## Vessel Styles

**Vessel Design**

Vessel Style: Cylindrical

Straight Side (m): Cylindrical

Rectangular

## Sealing Options

Bottom Depth (m)

Bottom Volume (m<sup>3</sup>)

Top Head Style

Top Head Depth (m)

Top Head Volume (m<sup>3</sup>)

Total Volume (m<sup>3</sup>)

Vessel Material

Wall Thickness (m)

Bottom Thickness (m)

Wetted Parts Material

Sealing: Mechanical Seal - Double

- Axial Shaft Seal
- Bellow Seal
- Cartridge Seal
- Dripless Seal
- Gas Barrier Seal
- Gland Packing Seal
- Labyrinth Seal
- Lip Seal
- Mechanical Seal - Double
- Mechanical Seal - Single
- None - Open to Surroundings
- Radial Shaft Seal
- Stuffing Box
- Stuffing Box - 3 Rings
- Stuffing Box - 6 Rings
- Tandem Seal

## Bottom Styles

Bottom Style: ASME

Bottom Depth (m): Flat

Bottom Volume (m<sup>3</sup>): ASME

Top Head Style: Conical

Top Head Depth (m): Dish

Top Head Volume (m<sup>3</sup>): Elliptical

Total Volume (m<sup>3</sup>): Hemispherical

Vessel Material: ASME F&D (6%)

Wall Thickness (m): ASME F&D (10%)

Bottom Thickness (m): ASME 80:10

Wetted Parts Material: ASME 80:6

Sealing: DIN 28011

- 2:1 Elliptical
- 1.9:1 Elliptical
- Angled Left to Right
- Angled Right to Left
- Angled Back to Front
- Angled Front to Back

## Materials

Vessel Material: Stainless Steel

Wall Thickness (m): Composite

Bottom Thickness (m): Concrete

Wetted Parts Material: Glass

Sealing: Perspex

- Platinum
- Plexiglass
- PVC
- Stainless Steel
- Stainless Steel 304LSS
- Stainless Steel 304SS
- Stainless Steel 316LSS
- Stainless Steel 316SS
- Stainless Steel 317LSS
- Titanium
- Titanium - Grade 2

# Vessel Design (2/3)

Settings | Equipment Preview **OFF**  
Standard dropdown when clicking  
Bottom Style

**Vessel Design**

Vessel Style: Cylindrical

Diameter (m): 2.032

Width (m):

Straight Side (m): 2.438

Bottom Style: ASME

Bottom Depth (m): Flat

Bottom Volume (m<sup>3</sup>): ASME

Top Head Style: Conical

Top Head Depth (m): Dish

Top Head Volume (m<sup>3</sup>): Elliptical

Total Volume (m<sup>3</sup>): Hemispherical

Sealing: ASME F&D (6%)

Vessel Material: ASME F&D (10%)

Wall Thickness (m): ASME 80:10

Bottom Thickness (m): ASME 80:6

Wetted Parts Material: DIN 28011

Note: DIN 28013

Settings | Equipment Preview **ON**  
opens graphical selection panel  
when clicking Bottom Style

**Vessel Design**

Vessel Style: Cylindrical

Diameter (m): 2.032

Width (m):

Straight Side (m): 4.064

Bottom Style: ASME

Bottom Depth (m): 0.3441

Bottom Volume (m<sup>3</sup>): 0.6796

Top Head Style: Elliptical

Top Head Depth (m): 0.4064

Top Head Volume (m<sup>3</sup>): 0.8786

Total Volume (m<sup>3</sup>): 13.859

Sealing: Mechanical Seal

Vessel Material: Stainless Steel

Wall Thickness (m): 0.003

Bottom Thickness (m): 0.003

Wetted Parts Material: Stainless Steel

Note:

**Bottom Style**

Flat

ASME

Conical

ASME F&D (6%)

Dish

ASME F&D (10%)

Elliptical

ASME 80:10

2:1 Elliptical

ASME 80:6

1.9:1 Elliptical

DIN 28011

Hemispherical

DIN 28013

Angled Left to Right

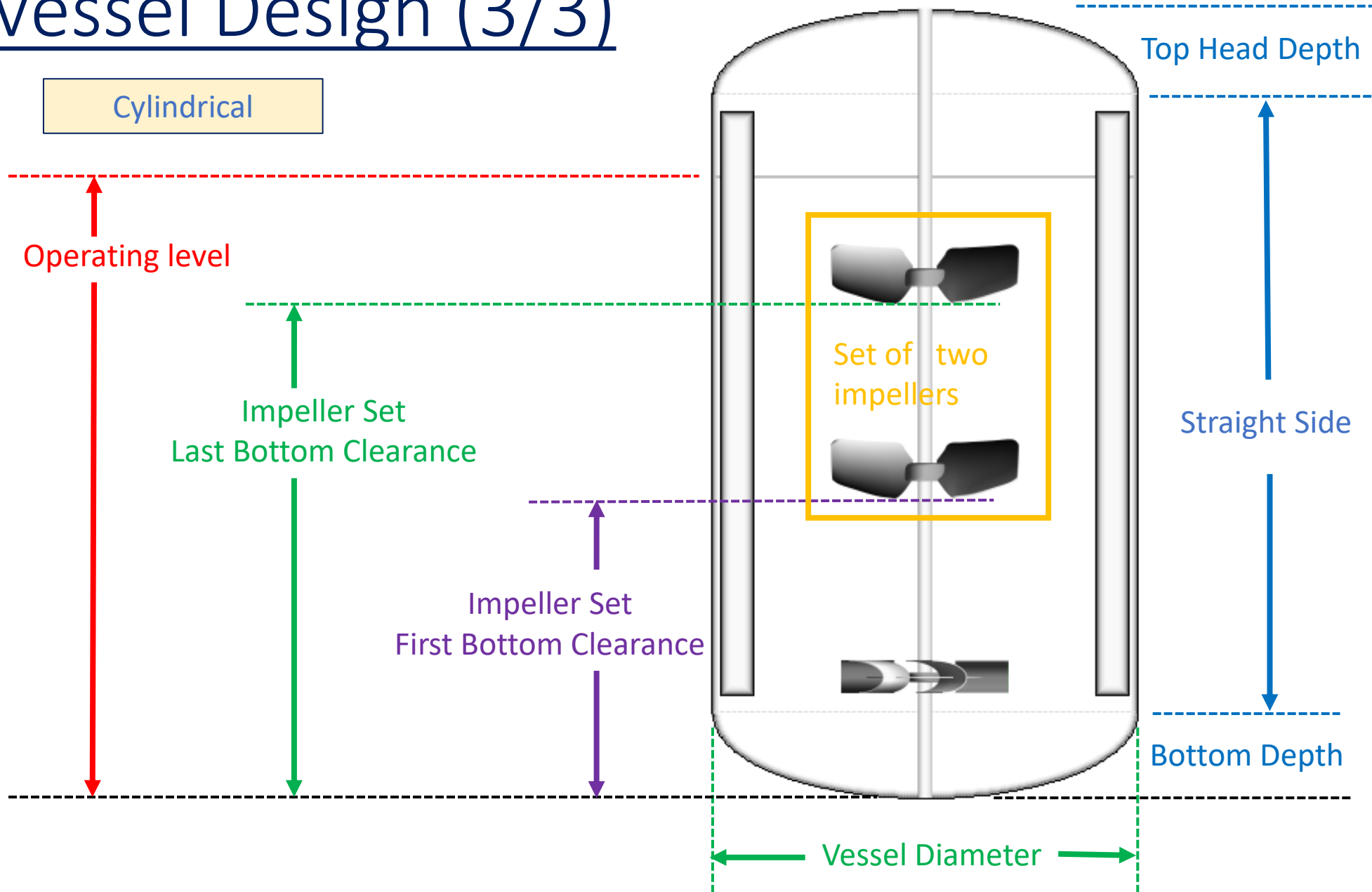
Angled Right to Left

Angled Back to Front

Angled Front to Back

Close the panel  
by clicking x-box  
or press Enter or  
Esc on keyboard

# Vessel Design (3/3)







# Process



# Process Operating Conditions

Design	Vessel	Process	Liquids	Drive	Mechanical	Impellers	Baffles	Solids
<b>Process Operating Conditions</b>								
Operating Level (m)	1		Operating level includes liquid and solids but excludes gas. Measured vertically from the deepest point in the bottom. Minimum level is the bottom depth. Maximum level is to the top of the straight side					
Gassed Operating Level (m)			Gassed operating level includes gas and is calculated by KaeMix					
Operating Volume (m <sup>3</sup> )	0.7303		Operating volume corresponding to operating level. You can specify either volume or level and the other is calculated					
Operating Temperature (°C)	15		Operating temperature					
Operating Pressure (Atm)	1		Operating pressure (in the head space)					
Average Pressure (Atm)	1.048		Average pressure in the liquid, and pressure at the deepest point at the bottom, in Atmosphere (or Bar depending on settings), calculated by KaeMix					
Pressure at Bottom (Atm)	1.097							
Liquid Weight (kg)	730.3							
Mixture Weight (kg)	730.3							
Additional Level Indicator (m)	0.4		Specify an additional level for in the drawing					
Liquid Flows	<input type="radio"/> Batch System <input checked="" type="radio"/> Continuous Flow		If you specify continuous flow and a flow rate, KaeMix will calculate the residence time					
Continuous Flow Rate (m <sup>3</sup> /s)	0.01							
Residence Time (h:m:s)	00:01:13							
Residence Time / Blend Time	2.48							

# Liquids (1/3)

<b>Primary Liquid</b>	Water (T-dependent) ▾
Density (kg/m <sup>3</sup> )	Water
Viscosity Model	Water (T-dependent)
Viscosity at 1/s (mPa.s)	Fermentation Broth
Flow Index n"	Acetic Acid (C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> )
Yield Stress (Pa)	Acetone ((CH <sub>3</sub> ) <sub>2</sub> CO)
Safety	Benzene (C <sub>6</sub> H <sub>6</sub> )
	Carbon Disulfide (CS <sub>2</sub> )
	Carbon Tetrachloride (CCl <sub>4</sub> )
	Castor Oil
	Chloroform (CHCl <sub>3</sub> )
	Decane (C <sub>10</sub> H <sub>22</sub> )
	Dodecane (C <sub>12</sub> H <sub>26</sub> )
	Ethanol (C <sub>2</sub> H <sub>5</sub> OH)
	Ethylene Glycol ((CH <sub>2</sub> OH) <sub>2</sub> )
	Glycerol (C <sub>3</sub> H <sub>8</sub> O <sub>3</sub> )
	Heptane (C <sub>7</sub> H <sub>16</sub> )
	Hexane (C <sub>6</sub> H <sub>14</sub> )
	Kerosene
	Linseed Oil
	Methanol (CH <sub>3</sub> OH)
	Octane (C <sub>8</sub> H <sub>18</sub> )
	Phenol (C <sub>6</sub> H <sub>5</sub> OH)
	Propanol (C <sub>3</sub> H <sub>8</sub> O)
	Propylene Glycol (C <sub>3</sub> H <sub>8</sub> O <sub>2</sub> )
	Toluene (C <sub>7</sub> H <sub>8</sub> )
	Turpentine (C <sub>10</sub> H <sub>16</sub> )

If you select a liquid from the dropdown list the physical properties will be set automatically. The properties are constant, except for *Water (T-dependent)* in which case density and viscosity vary with temperature.

**Important:** To specify your own liquid with your own physical properties, first enter a name that does not appear in the dropdown list!

# Liquids (2/3)

**Primary Liquid** Goopy Fluid  
 Density (kg/m<sup>3</sup>) 1000  
**Viscosity Model** Newtonian  
 Viscosity at 1/s (mPa.s) Newtonian  
 Flow Index n" Yield Stress

Newtonian, Power Law ("pseudo-plastic"), and Yield Stress ("Herschel-Bulkley") viscosity models are available

Newtonian Fluid:  $\mu_{\gamma} = \mu_{\gamma=1/s} = \text{constant}$   
 Power Law Fluid:  $\mu_{\gamma} = \mu_{\gamma=1/s} \gamma^{(n''-1)}$   
 Yield Stress Fluid:  $\mu_{\gamma} = \tau_{\text{yield}}/\gamma + \mu_{\gamma=1/s} \gamma^{(n''-1)}$   
 Fluid is stagnant if  $\tau < \tau_{\text{yield}}$

$\mu_{\gamma}$  Viscosity at shear rate  $\gamma$  (1/s)  
 $\mu_{\gamma=1/s}$  Viscosity at shear rate  $\gamma = 1$  (1/s) ("consistency", enter in mPa.s = cP)  
 $n''$  Flow Index  
 $\tau_{\text{yield}}$  Yield Stress (enter in Pa or Dyne/cm<sup>2</sup>)  
 $\tau$  Shear Stress (Pa)

**Primary Liquid** Goopy Fluid  
 Density (kg/m<sup>3</sup>) 1000  
**Viscosity Model** Yield Stress  
 Viscosity at 1/s (mPa.s) 12  
 Flow Index n" 0.8  
 Yield Stress (Pa) 3.4

**Safety**

- No Safety Concerns
- Acid (Low pH)
- Base (High pH)
- Biohazard
- Controlled Substance
- Corrosive
- Environmental Hazard
- Explosive
- Flammable
- Health Hazard
- Neurotoxic
- Poisonous
- Safety Hazard
- Toxic

You can select safety information from the dropdown list or enter your own text

# Liquids (3/3)

If there is insufficient agitation with a yield stress fluid, a cavern may form around the impeller in which fluid moves, while fluid outside the cavern remains stagnant. KaeMix calculates the approximate cavern size

Yield stress fluid specified

**Primary Liquid** Goop

Density (kg/m<sup>3</sup>) 1000

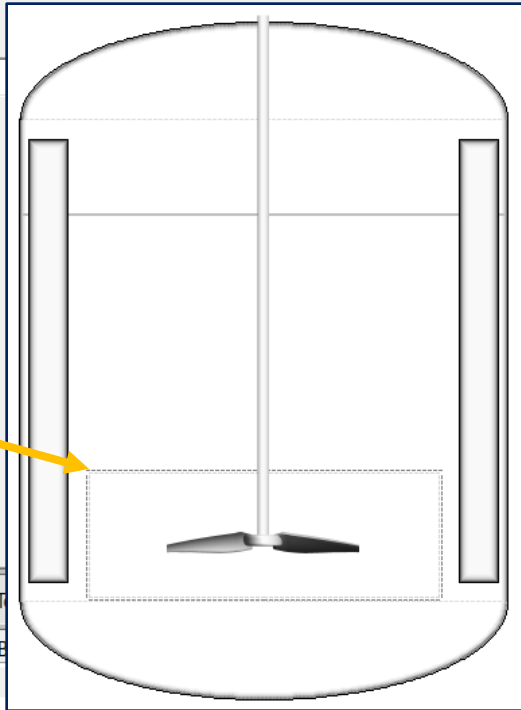
Viscosity Model Yield Stress

Viscosity at 1/s (mPa.s) 10000

Flow Index n" 1

Yield Stress (Pa) 80

Secondary Liquid



Approximate outline of cavern is shown in drawing

Baffles Heat Gas Flow Sparger Solids Particles Drawing Results Report Loads Blending Suspension Gas Dispersion HT Rate Power Dimensionless Guides

**Power Draw**

Total P<sub>v</sub> (kW) 3.0125

Total P<sub>s</sub> (kW)

P<sub>s</sub>/P<sub>v</sub>

**Main Impeller**

% Power Draw 100.0

Reynolds Re 116.3

Description Trans

Power Po 0.57

Shear Rate (1/s) 80

Eff. Visc. (mPa.s) 11000

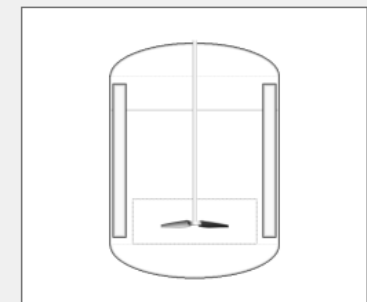
**M-Scale** 0/10 (None)

Blend Time (h:m:s) 00:08:41

Cavern Volume 10-20%

If cavern volume is less than 100% of the operating volume, M-Scale will be 0/10 and no other performance information will be calculated. Only when agitation is increased so that cavern volume = 100% will other information be calculated

Yield stress fluid. Cavern size < 100%



Design 1/13

Duplicate New Delete Move: ↑

ID	ⓧ	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	E
1	X	Cylindrical	1.00	1.00	0.733	

Motor (kW)	Load (%)	Blend Time	N/N <sub>j</sub>	M-Scale	M-Phase	Tag	Comment
10.0	30%	00:08:41		0.0/10			

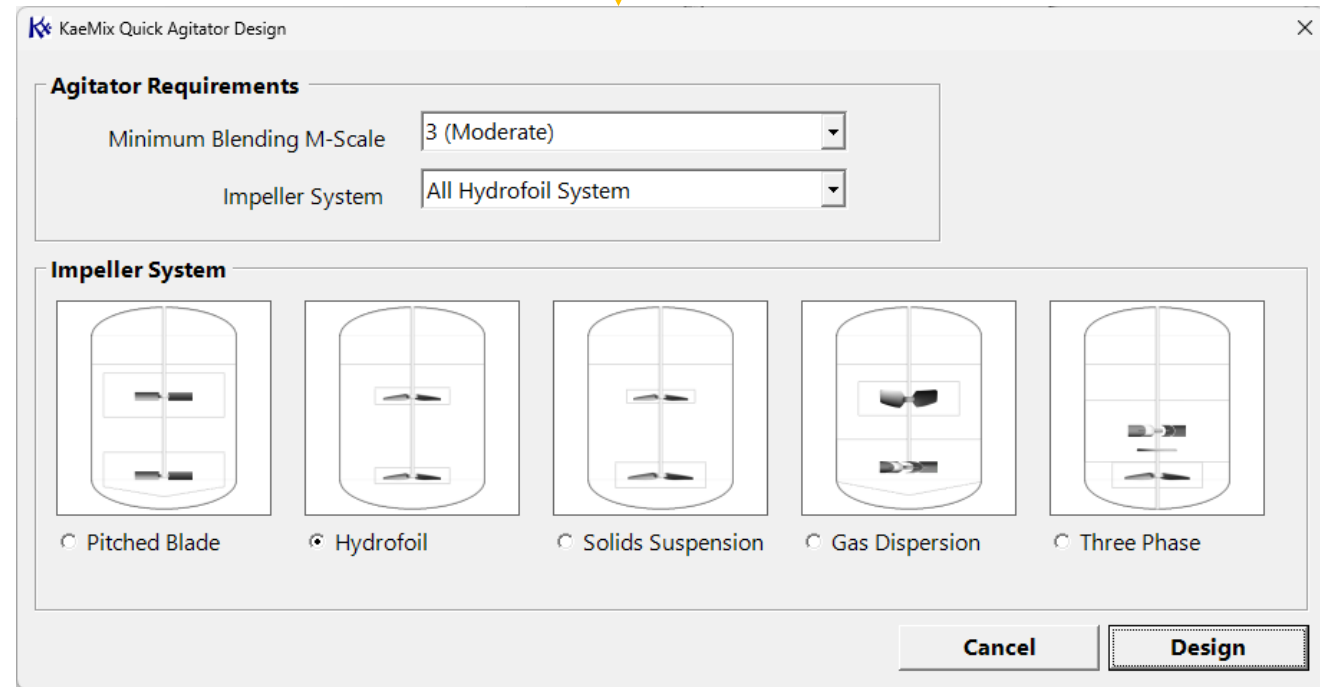
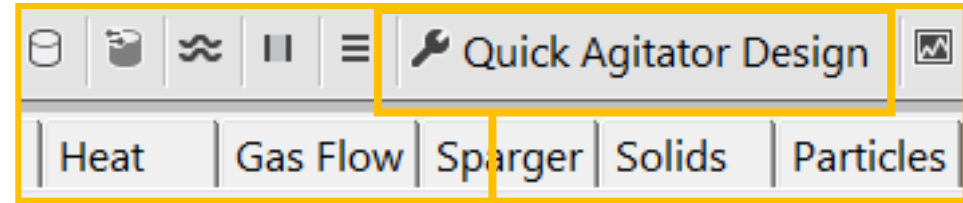


# Design Tools



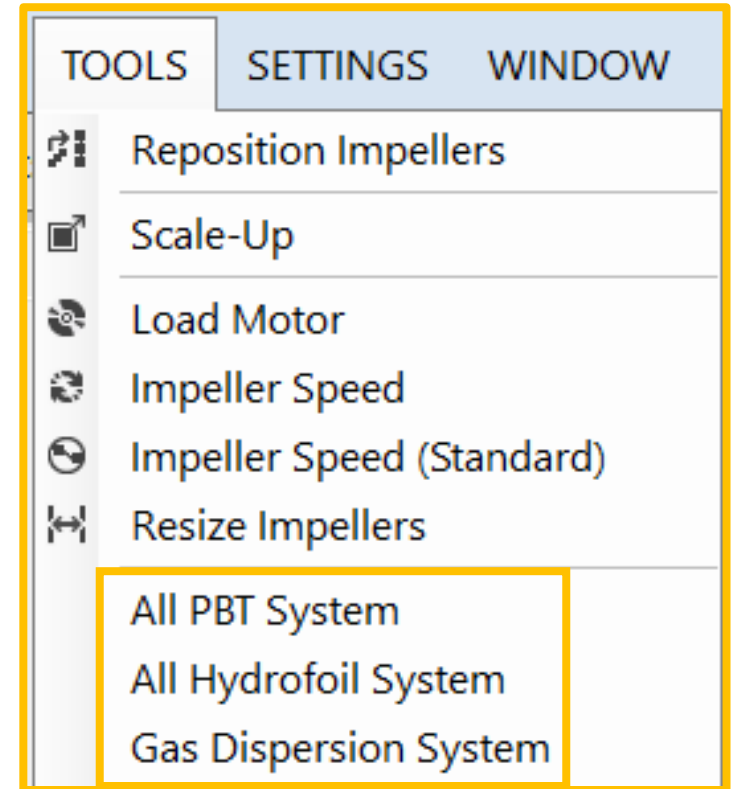
# Quick Agitator Design

- After specifying the vessel, process, and liquids, the fastest way to create an initial agitator design is using the Quick Agitator Design panel
- Specify the impeller system and required M-Scale, click Design, and KaeMix will design the agitator



# Tools Menu

- *Reposition Impellers*: spaces the impellers evenly over the height of the vessel
- *Scale Up*: opens the Scale Up panel
- *Load Motor*: adjust speed and diameter to load the motor
- *Impeller Speed*: adjusts speed only to load the motor
- *Impeller Speed (Standard)*: sets the highest standard RPM that does not overload the motor
- *Resize Impellers*: adjusts impeller diameters to load motor
- *All PBT System*: designs system with Pitched Blade Turbines
- *All Hydrofoil System*: designs system with Hydrofoils
- *Gas Dispersion System*: designs system with lower disk turbine, upper hydrofoils

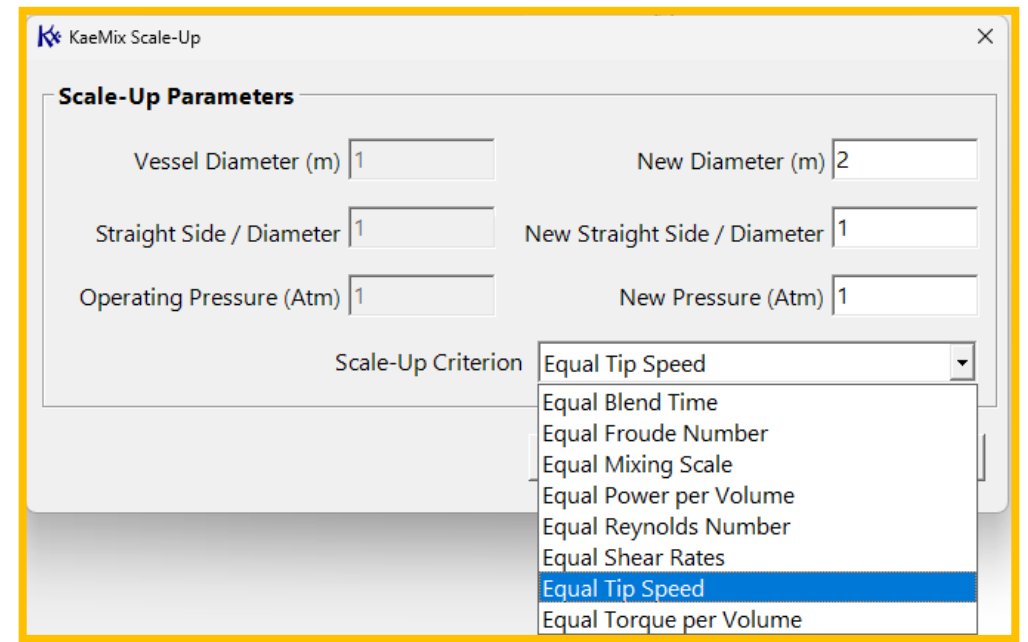
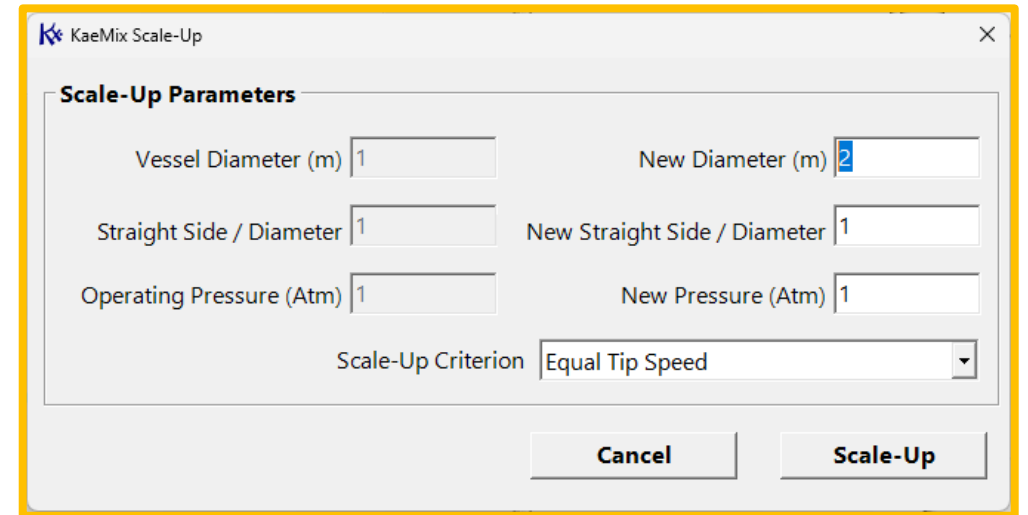


**Tip:** use these impeller system options to initialize your impeller design before refining it on the Impellers page



# Scale-Up

- *Tools* → *Scale-Up*
- You can scale up or down
- You can change the aspect ratio of the vessel by modifying the ratio between Straight Side and Vessel Diameter
- Available Scale Up criteria:
  - Equal Blend Time
  - Equal Froude Number
  - Equal Mixing Scale (M-Scale)
  - Equal Power per Volume
  - Equal Reynolds Number
  - Equal Shear Rates
  - Equal Tip Speed
  - Equal Torque per Volume
- Clicking *Scale-Up* adds a new design





# Drives and Shafts



# Drives

**A drive consists of a motor-gearbox and a shaft**

Design | Vessel | Process | Liquids | Drive | Impellers | Baffles | Heat | Gas Flow | Sparger | Solids | Particles | Drawing | Results | Report | Loads | Blending | Suspension | Gas Dispersion | HT Rate | Power | Dimensionless | Guides

**Drives** Main Drive  Drive 2  Drive 3  Drive 4

Style: Top Entering

Drive Name: \_\_\_\_\_

Motor (kW): 10 **Enter motor power here**

Maximum Load (%): 80

Speed (RPM): 78 **Enter shaft rotational speed here**

Speed (rev/s): 1.3

Rotation: Clockwise

Mounting Height (m): 0

Shaft Support:  Steady Bearing

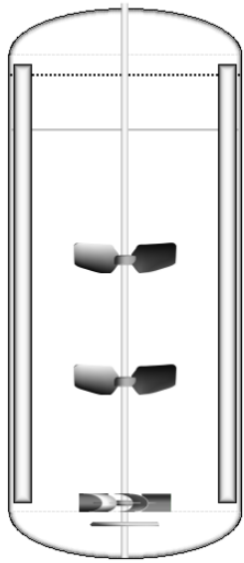
Shaft Design:  Automatic

Shaft Diameter (m): 0.0711

Shaft Off Bottom (m): 0

Offcenter distance (m): 0

Liquid Blending, M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
Gas Dispersion, M-Phase: 3.0/10. Dispersing,  $k_a$ : 0.073 1/s



Design 5/8 Duplicate New Delete Move: Top Up Down Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	⓪	Vessel	T (m)	Z (m)	$V_L$ (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		7.6/10		Single Hydrofoil - Narrow	
2	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.15	9.2/10	4.0/10	Suspension	Fully suspended
3		Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		4.1/10		Multiple spargers	Multiple Rushton
4		Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPS	1.2	6.36	7.9	81%	00:00:21		7.3/10		Sweeper	Conical bottom
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	10.0	43%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
6	✓	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.3	0.4	76%	00:00:18		5.1/10		Angled Bottom	Rectangular vessel
7	X	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	7.0	2.18	25.0	9%	00:12:13		0.0/10		Cavern Size	Yield stress fluid

# Drives – Shaft Design

KaeMix Student

FILE SEND EDIT PROCESS DESIGN PERFORMANCE

Open Save File Info Units

Design Vessel Process Liquids Drive Impellers Baffles

**Drives** Main Drive

Style Top Entering

Drive Name

Motor (kW) 10

Maximum Load (%) 80

Speed (RPM) 180

Speed (rev/s) 3

Rotation Clockwise

Shaft Design  Automatic

Shaft Support  Steady Bearing

Shaft Length  Automatic

Shaft Length (m) 1.3387

Shaft Off Bottom (m) 0

Shaft Type Solid

Shaft Diameter (m) 0.027

Shaft Inside Diameter (m)

Shaft Design can be set to Automatic or the shaft can be specified by the user.  
Shafts can be solid or hollow.

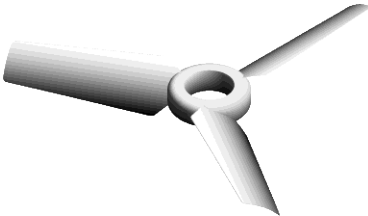
Shaft Length is calculated as follows:  
Length = Top Head Depth  
+ Vessel Straight Side  
+ Bottom Depth  
- Shaft Off Bottom



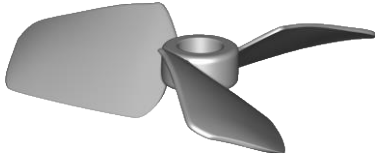
# Impellers



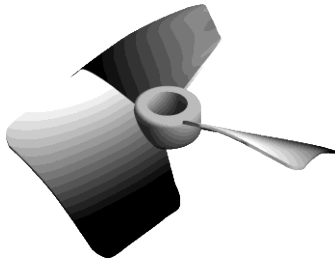
# Available Impellers



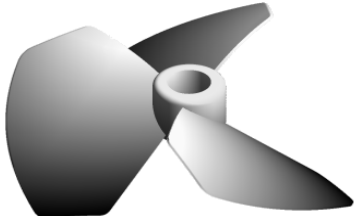
Hydrofoil Narrow



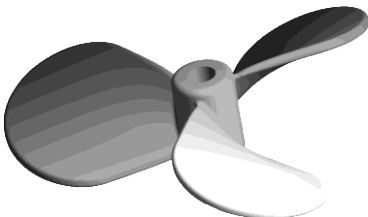
Hydrofoil Medium



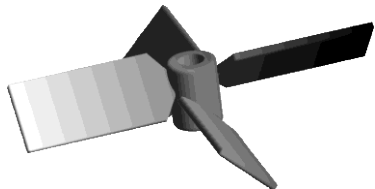
Hydrofoil Wide



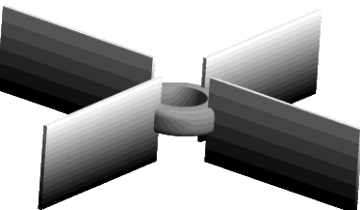
HF Extra Wide



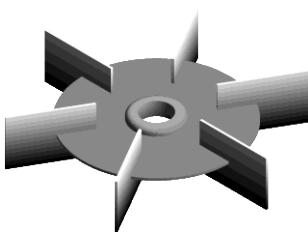
Propeller



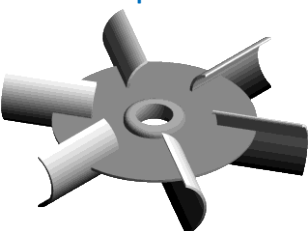
Pitched Blade



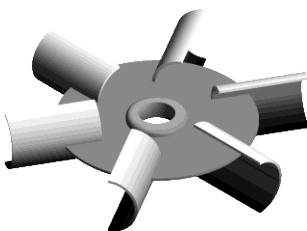
Straight Blade



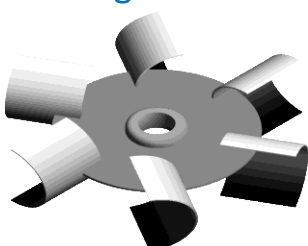
Rushton Turbine



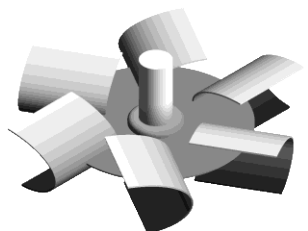
Van't Riet Turbine



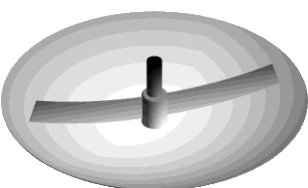
Smith Turbine



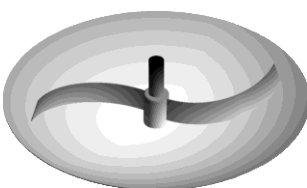
Middleton Turbine



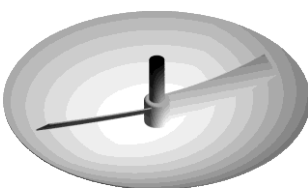
Bakker Turbine



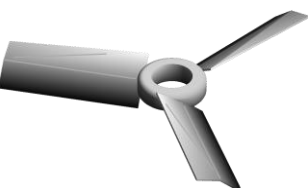
Sweeper Straight



Sweeper Curved



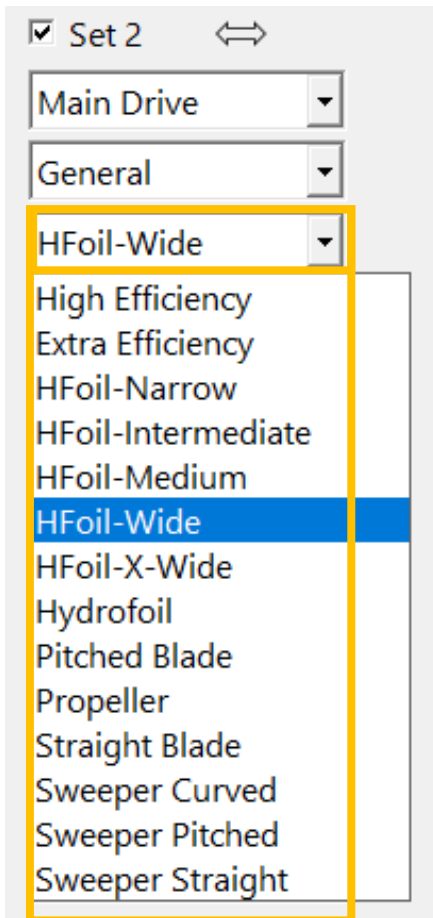
Sweeper Angled



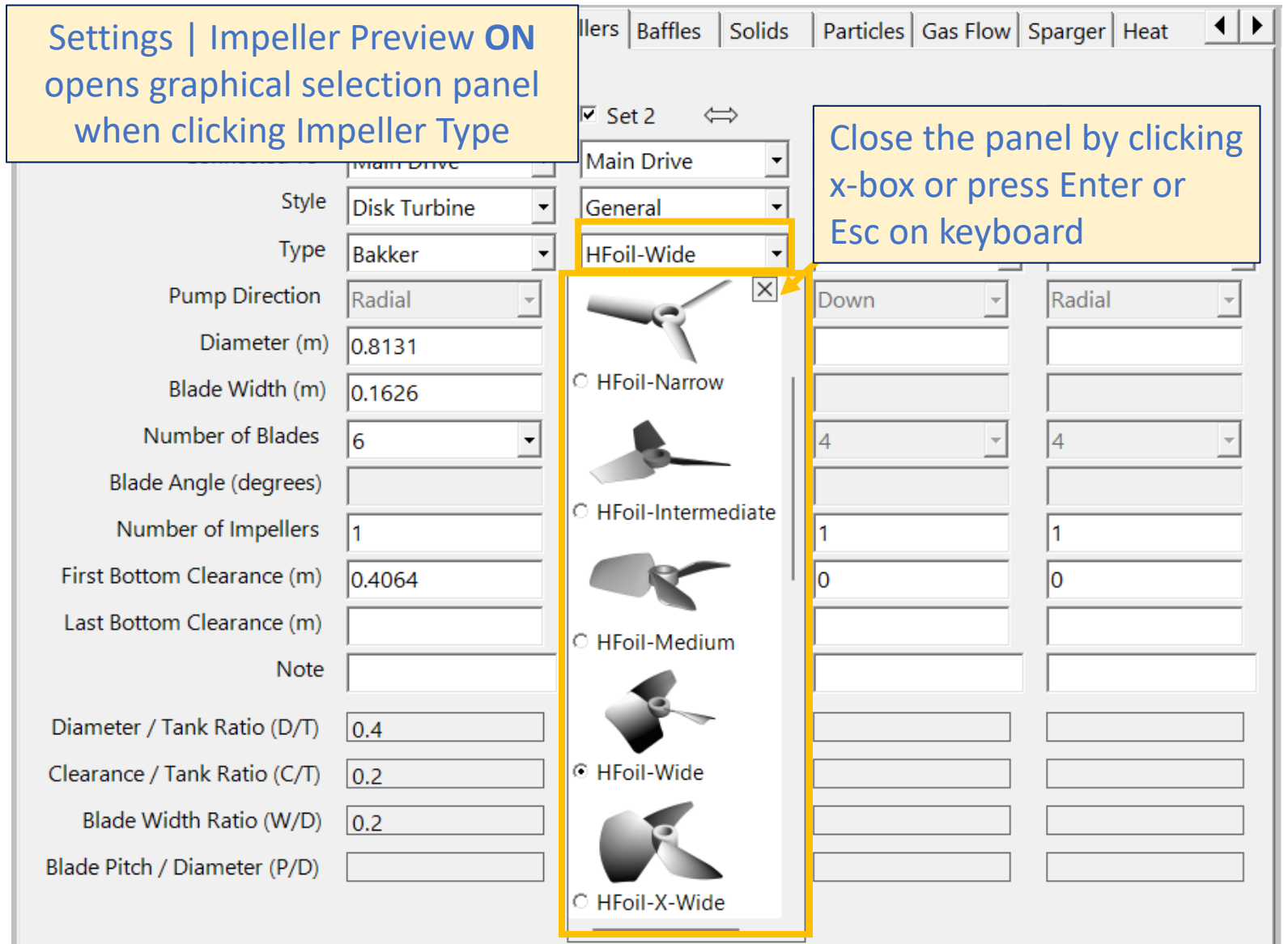
High-Efficiency

# Select Impeller Type

Settings | Impeller Preview **OFF**  
Standard dropdown when clicking  
Impeller Type

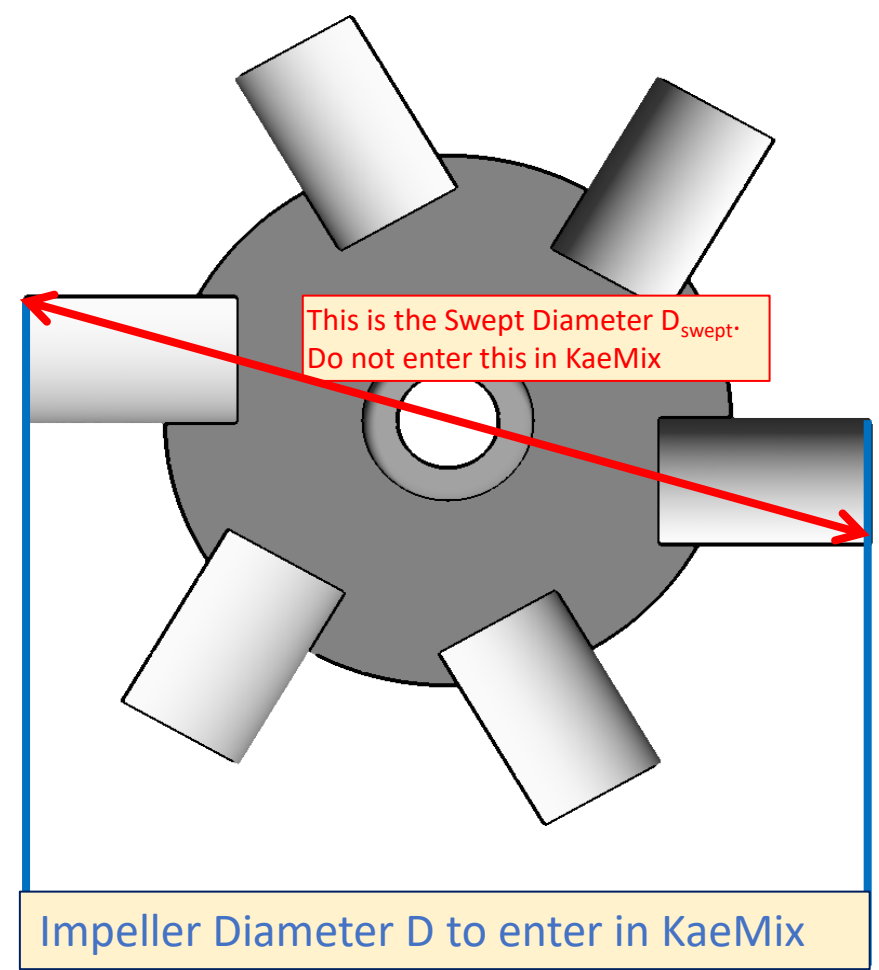
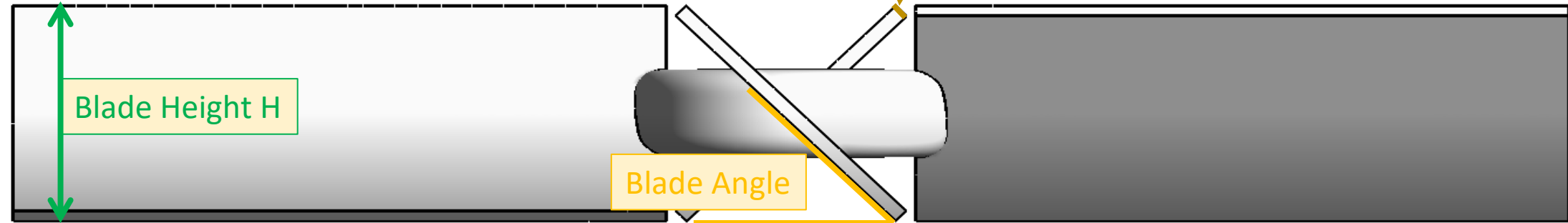
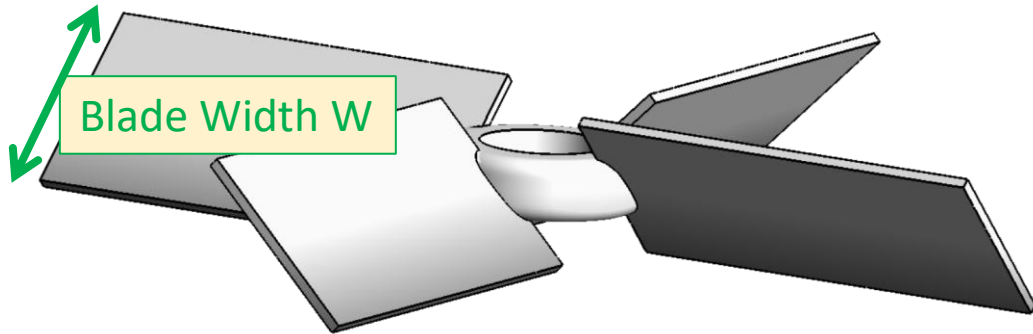
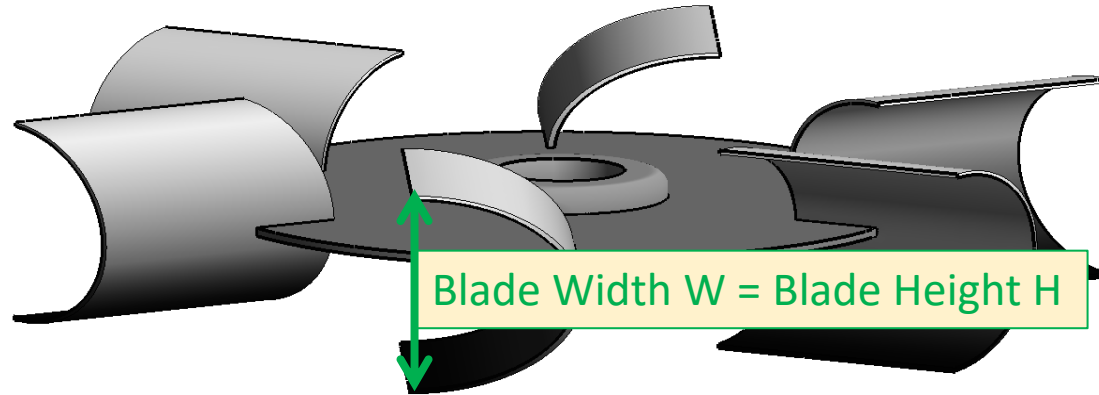


Settings | Impeller Preview **ON**  
opens graphical selection panel  
when clicking Impeller Type



Close the panel by clicking  
x-box or press Enter or  
Esc on keyboard

# Impeller Dimensions





# Multiple Impellers of Different Type

**You can have up to eight different impeller sets.**

**Enable or disable sets using the check boxes.**

**To specify an impeller, select Style first, then Type.**

**You can swap /order impeller sets with the buttons.**

**A single drive and shaft with multiple different impellers. Impeller Set 1 is a disk turbine. Impeller Set 2 consists of two wide-blade hydrofoils.**

ID	Φ																
5																	
6	✓																
7		Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size

# Multiple Impellers of Same Type

The screenshot displays the KaeMix software interface. On the left, the 'Drives' panel is set to 'Main Drive' with a 'Top Entering' style, a 10 kW motor, 80% maximum load, 120 RPM speed, 2 rev/s, and clockwise rotation. The 'Shaft Design' is set to 'Automatic' with a 0.02 m diameter and 0.4064 m off-bottom distance. The 'Impellers' panel shows 'Set 1' selected, connected to the 'Main Drive', with a 'General' style and 'HFoil-Narrow' type. The diameter is 0.8128 m, pump direction is 'Down', and there are 3 blades. The 'Number of Impellers' is set to 4, with a 'First Bottom Clearance' of 0.4064 m and a 'Last Bottom Clearance' of 2.54 m. The vessel diagram on the right shows a vertical shaft with four impellers. A table at the bottom left lists components 1 through 7, with 1-6 checked.

**Single Drive**

**One set of four impellers connected to Main Drive**

**Drives** Main Drive

Style Top Entering

Drive Name

Motor (kW) 10

Maximum Load (%) 80

Speed (RPM) 120

Speed (rev/s) 2

Rotation Clockwise

Mounting Height (m) 0

Shaft Support  Steady Bearing

Shaft Design  Automatic

Shaft Diameter (m) 0.02

Shaft Off Bottom (m) 0.4064

Offcenter distance (m) 0

**Impellers** (1-4) (5-8)  Set 1  Set 2

Connected To Main Drive

Style General

Type HFoil-Narrow

Diameter (m) 0.8128

Pump Direction Down

Number of Blades 3

Blade Width (m)

Blade Angle (degrees)

Number of Impellers 4

First Bottom Clearance (m) 0.4064

Last Bottom Clearance (m) 2.54

Note

Diameter / Tank Ratio (D/T) 0.4

Clearance / Tank Ratio (C/T) 0.2

Blade Width Ratio (W/D)

Design 3/11

ID	①	
1	<input checked="" type="checkbox"/>	Cyli
2	<input checked="" type="checkbox"/>	Cyli
3	<input checked="" type="checkbox"/>	Cyli
4	<input type="checkbox"/>	Cyli
5	<input type="checkbox"/>	Cyli
6	<input checked="" type="checkbox"/>	Recta
7	<input type="checkbox"/>	Cyli

Four impellers are specified as well as the off-bottom clearance of the first and last impeller. The impellers are then equally spaced along the shaft.

Bottom clearance is defined as the vertical distance from the bottom of the impeller to the lowest part in the vessel bottom.



# Baffles



# Baffle Design

In the Baffles tab you can choose Automatic design or Manual design. Here Automatic is selected, and this follows these rules in this order:

- Rectangular → no baffles
- All impellers  $Re < 100$  → no baffles
- All impellers  $Re < 300$  → two flat baffles (T/12 at T/72)
- All other configurations → four flat baffles (T/12 at T/72)

The screenshot shows the KaeMix software interface. The 'Baffles' tab is active, and 'Automatic' design is selected. The 'Baffle Geometry' section is expanded, showing the following settings:

- Baffle Style: Standard Flat
- Number of Baffles: 4
- Baffle Width (m): 0.1693
- Baffle Thickness (m): 0.0051
- Baffle to Wall (m): 0.0282
- Baffle to Bottom Straight Side (m): 0.0847
- Baffle to Top Straight Side (m): 0.0847

To the right, a 3D model of a vessel is shown with a sweeper impeller at the bottom. An arrow points from the text box to the sweeper impeller.

The bottom of the interface shows a table with the following data:

ID	(i)	Vessel	T (m)	Z (m)	V <sub>1</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		6/10		Single Hydrof
2	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.01	10/10	3/10	Suspension
3	✓	Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		5/10		Multiple sparg
4	✓	Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPV	1.2	4.02	7.9	51%	00:00:23		7/10		Sweeper
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.69	10.0	37%	00:00:24		8/10	3/10	Gas Dispersio
6	✓	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.24	0.4	61%	00:00:18		5/10		Angled Bottom
7	✗	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	1.15	10.0	11%			0/10		Cavern Size

A sweeper is an impeller that matches the shape of the bottom and is close to it. Blades can be vertical / straight, pitched, or curved.

# Baffle Design – Manual

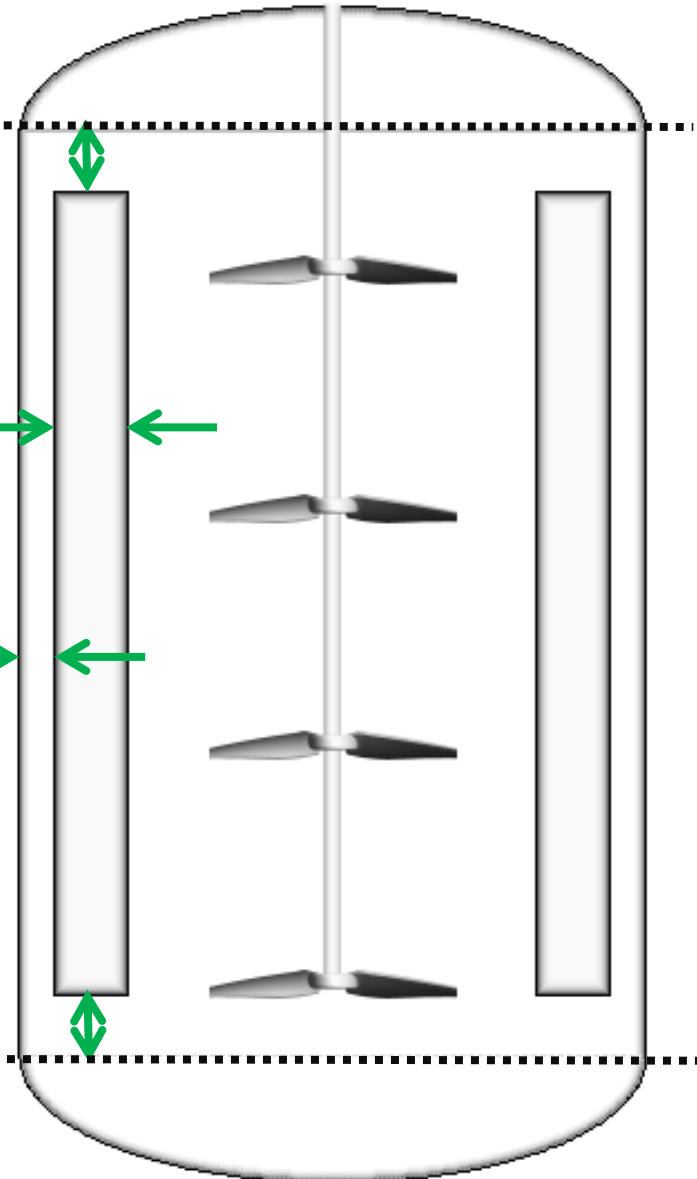
*Baffle type  
"Standard – Flat"  
allows you to  
prescribe the  
location and size of  
the baffles in detail*

Baffle to Top Straight Side

Baffle Width

Baffle to Wall

Baffle to Bottom Straight Side



# Gas Dispersion

# Gas Dispersion

The screenshot shows the KaeMix Student software interface. The 'Gas Flow' tab is active, displaying various input fields for gas dispersion parameters. The 'Sparger Design' tab is also visible, showing settings for sparger style, diameter, and number of holes. The 'Gas Dispersion Results' tab is highlighted, showing calculated values for gas dispersion and mass transfer coefficients.

**Gas Flow Tab:**

- Process Gas: Air
- Mole Fraction O<sub>2</sub>: 0.2095
- Gas Flow Unit: Vol/Vol/Minute (VVM)
- Molecular Weight: 28.97
- Gas Flow: 1
- Diffusion Coeff. (m<sup>2</sup>/s): 2.05E-09
- Gas C<sub>p</sub>/C<sub>v</sub> ratio: 1.4
- Coalescence Behavior: Non-Coalescing
- Viscosity model (k<sub>a</sub>): Liquid (k<sub>a</sub> ∝ viscosity<sup>-1/2</sup>)
- Safety: No Safety Concerns

**Gas Flow Rate:**

- Mass Flow (kg/s): 0.2912
- Actual Conditions (m<sup>3</sup>/s): 0.1677
- Mass Flow (kg/hr): 1048.3
- Standard Conditions (m<sup>3</sup>/s): 0.2377

**Sparger Design Tab:**

- Sparger Design: Automatic (selected)
- Gas Spargers: Set 1 (checked)
- Style: Ringsparger
- Fraction of Gas Flow: 1
- Sparger Diameter (m): 0.6096
- Number of Holes: [Empty]
- Hole Diameter (m): [Empty]
- Direction: Down
- Number of Spargers: 1
- Off Bottom First Sparger (m): 0.2845
- Off Bottom Last Sparger (m): [Empty]
- Offcenter Distance (m): [Empty]

**Gas Dispersion Results Tab:**

- Main Gas Dispersion Impeller: 1: Bakker
- Flow Regime: Dispersing
- Gas Holdup:
  - Process / Actual Conditions: 12.5%
  - Water / Standard Conditions: 12.4%
- Mass Transfer Coefficient (1/s):
  - k<sub>a</sub> Process / Actual Conditions: 0.0665
  - k<sub>a</sub> Water / Standard Conditions: 0.0774

**Design Table:**

ID	Des	Motor (kW)	Load
2		4.0	75%
3	Cylindrical	4.0	59%
4	Cylindrical	7.9	81%
5	✓ Cylindrical	10.0	43%
6	✓ Rectangular	0.4	76%
7	X Cylindrical	25.0	9%
8	✓ Cylindrical	25.0	79%

Enable gas dispersion here

Gas Dispersion

Sparger Design

Gas Dispersion Results

Open the Gas Flow tab to enter the gas dispersion related information. Here you can also access the Sparger Design and Gas Dispersion Results tab.

# Gas Dispersion – Process Gas

The screenshot shows the KaeMix Student interface. The 'Process Gas' dropdown menu is open, displaying a list of gases. The 'Air' option is selected and highlighted in blue. A yellow arrow points from the 'Air' option in the dropdown to the 'Process Gas' field in the main configuration panel. The main panel shows the following properties for 'Air':

Mole Fraction O <sub>2</sub>	0.2095
Molecular Weight	28.97
Diffusion Coeff. (m <sup>2</sup> /s)	2.05E-09
Actual Conditions (m <sup>3</sup> /s)	0.1677
Standard Conditions (m <sup>3</sup> /s)	0.2377
Superficial Velocity (m/s)	0.0611

The dropdown list includes the following gases: Acetylene (C<sub>2</sub>H<sub>2</sub>), Air, Air (O<sub>2</sub> Enriched), Ammonia (NH<sub>3</sub>), Argon (Ar), Carbon Dioxide (CO<sub>2</sub>), Carbon Monoxide (CO), Chloroform (CHCl<sub>3</sub>), Chloromethane (CH<sub>3</sub>Cl), Ethane (C<sub>2</sub>H<sub>6</sub>), Ethanol (C<sub>2</sub>H<sub>5</sub>OH), Ethylene (C<sub>2</sub>H<sub>4</sub>), Helium (He), Hydrogen (H<sub>2</sub>), Hydrogen Chloride (HCl), Methane (CH<sub>4</sub>), Methanol (CH<sub>3</sub>OH), Nitric Oxide (NO), Nitrogen (N<sub>2</sub>), Nitrous Oxide (N<sub>2</sub>O), Oxygen (O<sub>2</sub>), Sulfur Dioxide (SO<sub>2</sub>), and Toluene (C<sub>7</sub>H<sub>8</sub>).

**Specify process gas**

**Process Gas** Air

**Gas Dispersion**

**Process Gas** Acetylene (C<sub>2</sub>H<sub>2</sub>)  
Air  
Air (O<sub>2</sub> Enriched)  
Ammonia (NH<sub>3</sub>)  
Argon (Ar)  
Carbon Dioxide (CO<sub>2</sub>)  
Carbon Monoxide (CO)  
Chloroform (CHCl<sub>3</sub>)  
Chloromethane (CH<sub>3</sub>Cl)  
Ethane (C<sub>2</sub>H<sub>6</sub>)  
Ethanol (C<sub>2</sub>H<sub>5</sub>OH)  
Ethylene (C<sub>2</sub>H<sub>4</sub>)  
Helium (He)  
Hydrogen (H<sub>2</sub>)  
Hydrogen Chloride (HCl)  
Methane (CH<sub>4</sub>)  
Methanol (CH<sub>3</sub>OH)  
Nitric Oxide (NO)  
Nitrogen (N<sub>2</sub>)  
Nitrous Oxide (N<sub>2</sub>O)  
Oxygen (O<sub>2</sub>)  
Sulfur Dioxide (SO<sub>2</sub>)  
Toluene (C<sub>7</sub>H<sub>8</sub>)

Mole Fraction O<sub>2</sub> 0.2095  
Molecular Weight 28.97  
Diffusion Coeff. (m<sup>2</sup>/s) 2.05E-09

Actual Conditions (m<sup>3</sup>/s) 0.1677  
Standard Conditions (m<sup>3</sup>/s) 0.2377  
Superficial Velocity (m/s) 0.0611

**If process gas is selected from dropdown list the physical properties are set automatically.**

**Important:** To specify your own properties, first type in a name for the process gas that does not appear in the dropdown list!



# Gas Dispersion – Flow Rate (1/2)

**Specify gas flow**

To enter the gas flow rate, first select the Gas Flow Unit, then enter the Gas Flow in that unit

Specify bubble coalescence behavior. If unsure, select *coalescing*.

For viscosity model select *Liquid, Fermentation Broth, or Fine Suspension* as appropriate.

*None* is for situations where you specified the value of the diffusion coefficient that you want to be used without additional corrections.

Note: if both the process liquid and the process gas are selected from the dropdown lists then the viscosity model setting is disabled and KaeMix automatically selects the best model

# Gas Dispersion - Flow Rate (2/2)

## Gas Flow Rate

Mass Flow (kg/s)	<input type="text" value="0.2824"/>	Actual Conditions (m <sup>3</sup> /s)	<input type="text" value="0.1714"/>
Mass Flow (kg/hr)	<input type="text" value="1016.7"/>	Standard Conditions (m <sup>3</sup> /s)	<input type="text" value="0.2305"/>
Vol/Vol/Minute (VVM)	<input type="text" value="1"/>	Superficial Velocity (m/s)	<input type="text" value="0.0611"/>

VVM and superficial gas velocities are calculated based on average gas temperature and average pressure

*Actual Conditions* are defined as the temperature and the pressure at the bottom

VVM is gas volumetric flow rate / operating volume per minute

*Standard Conditions* mean the *International Standard Metric Conditions: 15°C / 59°F at 1 Atm*

Gas flow rates in USA units are shown if KaeMix is set to USA units

Here, CFM is Cubic Feet per Minute. Standard is 59°F at 1 Atm

**Tip:** it is best to enter gas flow as a mass flow rate because not everyone uses the same definitions for standard or actual conditions used in volumetric flow rate calculations

## Gas Flow Rate

Mass Flow (lb/s)	<input type="text" value="0.6226"/>	Actual CFM	<input type="text" value="363.25"/>
Mass Flow (lb/hr)	<input type="text" value="2241.4"/>	Standard CFM	<input type="text" value="488.41"/>
Vol/Vol/Minute (VVM)	<input type="text" value="1"/>	Superficial Velocity (ft/s)	<input type="text" value="0.2004"/>

# Gas Dispersion - Results

Main impeller: the lowest impeller that is directly gassed

Flow Regime: *Flooded* means the gas rises through the impeller system without being driven to the wall. *Coarse Dispersion* means gas is driven direction vessel wall but may not completely reach it and there is no recirculation. *Dispersing* means that gas is driven to the vessel wall and some smaller bubbles may recirculate. *Complete dispersion* means that gas is also driven down at the vessel wall and part of the gas recirculates through the impeller system

Gas holdup and mass transfer coefficient  $k_{1a}$  are shown for the process / actual conditions; for water / standard conditions (15°C/ 59°F and atmospheric pressure); and for the custom correlations

The following is not included in holdup and  $k_{1a}$  calculations:

- o Power input by impellers below the lowest sparger
- o Gas input from spargers above the highest impeller
- o Impellers and spargers located above the user specified operating level (which is ungassed)

Dip tube spargers work less well than other spargers and a reduced efficiency is assigned to them

## Gas Dispersion

Main Gas Dispersion Impeller

Flow Regime

## Gas Holdup

Holdup  $\alpha$  (Process / Actual Conditions)

Holdup  $\alpha$  (Water / Standard Conditions)

## Mass Transfer Coefficient (1/s)

$k_{1a}$  (Process / Actual Conditions)

$k_{1a}$  (Water / Standard Conditions)

# Sparger Design

**Sparger Design** Automatic Manual

**Gas Spargers**

Style: Ringsparger

Sparger Diameter (m): 0.2667

Number of Holes: [ ]

Hole Diameter (m): [ ]

Direction: Down

Number of Spargers: 4

Off Bottom First Sparger (m): 0.35

Off Bottom Last Sparger (m): 2.223

Here a set of four spargers is specified

Liquid Blending. M-Scale: 5/10. Turbulent. Blendtime: 00:00:20 h:m:s.

Spargers

ID	(i)	Vessel	T (m)	Z (m)	V <sub>1</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>μ</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		6/10		Single Hydrofoil - Narrow	
2	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.01	10/10	3/10	Suspension	Fully suspended
3	✓	Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		5/10		Multiple spargers	Multiple Rushton
4	✓	Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPV	1.2	4.02	7.9	51%	00:00:23		7/10		Sweeper	Conical bottom
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.69	10.0	37%	00:00:24		8/10	3/10	Gas Dispersion	Turbine + 2 Up Pump
6	✓	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.24	0.4	61%	00:00:18		5/10		Angled Bottom	Rectangular vessel
7	X	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	1.15	10.0	11%			0/10		Cavern Size	Yield stress fluid

# Solids Suspension

# Solids Suspension

The screenshot displays the KaeMix Student software interface. The 'Solids' tab is selected in the top navigation bar. On the left, the 'Solids Suspension' settings are visible, including fields for Solids Material (PET), Solids Density (1380 kg/m³), Particle Diameter (1.73E-03 m), and various settling velocities. A 3D model of a stirred tank reactor is shown on the right. The 'Results' tab is also visible, showing suspension parameters like M-Phase (4.0/10) and 100% Suspended.

**Enable solids suspension here**

**Open the Solids tab to enter the solids suspension related information. Here you can also access the Suspension Results tab.**

**Tip: particle diameter can be:**

- entered directly,
- or calculated from mesh, e.g., enter size as "100 mesh" or "1/4 mesh"

ID	Φ	Vessel	T (m)	Z (m)	V <sub>L</sub> (m³)	Bottom	Top	Impeller	RPM	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>s</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.7303	ASME	ASME	HF-N	300.0	0.38	10.0	4%	00:00:23		7.6/10		Single Hydrofoil - Narrow	
2	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	114.0	3.0	4.0	75%	00:00:20	1.15	9.2/10	4.0/10	Suspension	Fully suspended
3	✓	Cylindrical	1.78	2.80	6.6577	Ellipse	Ellipse	RDT	60.0	1.67	4.0	42%	00:00:19		3.8/10	3.8/10	Multiple spargers	Multiple Rushton
4	✓	Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPS	72.0	6.19	7.9	78%	00:00:22		7.2/10		Sweeper	Conical bottom
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	78.0	4.29	10.0	43%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impellers
6	✓	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	240.0	0.1	0.4	25%	00:00:54		2.6/10		Angled Bottom	Rectangular vessel

# Solids Suspension Results (1/3)

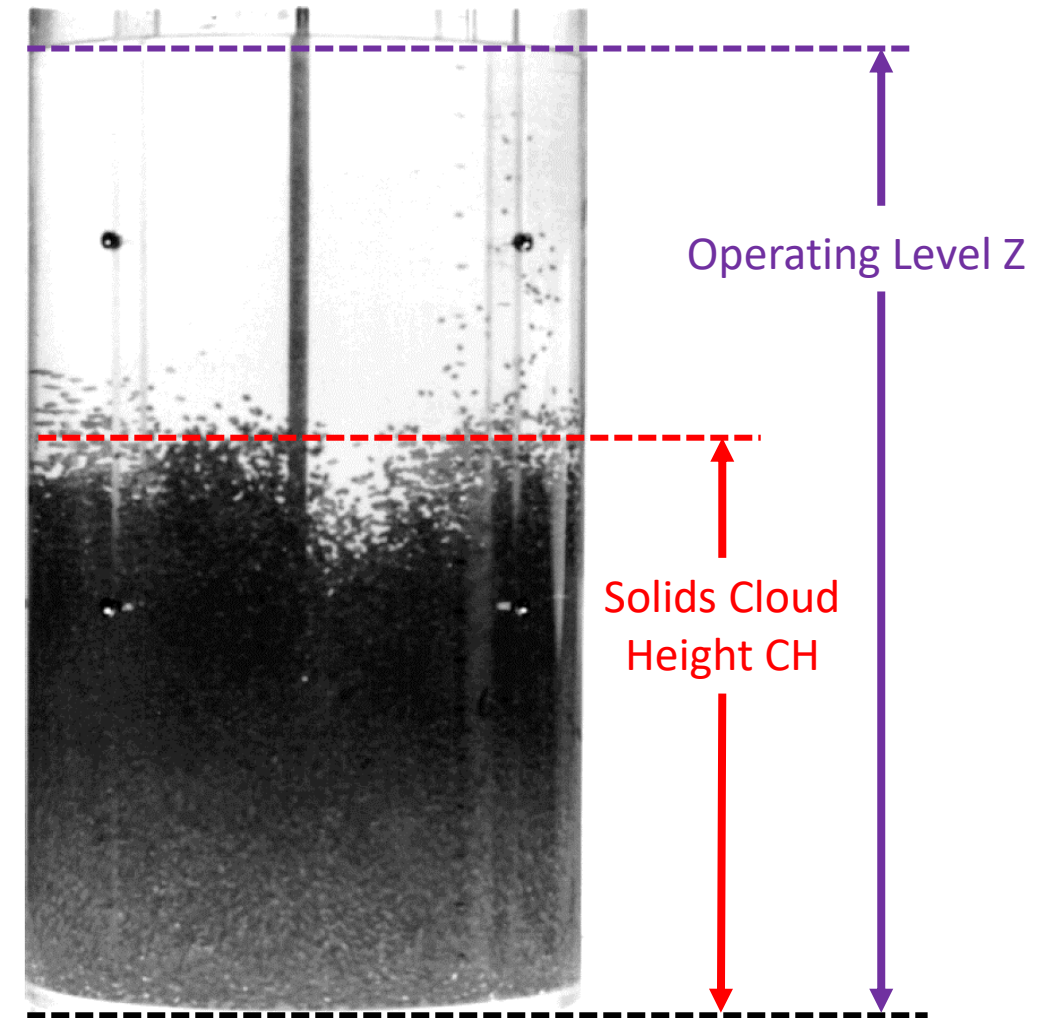
- $N_{js}$  is the just-suspended speed
- Main impeller is name of impeller that contributes most to the off-bottom suspension process
- Three methods are used to calculate this:
  1.  $N_{js}$  GMB: Grenville-Mak-Brown (2015). Down pumping axial flow impellers. Scaleup exponent is -0.67
  2.  $N_{js}$  CFM: Corpstein-Fasano-Myers (1994). Both down and up pumping axial flow impellers. Scaleup exponent depends on particle properties.
  3.  $N_{js}$  Zwietering: Zwietering (1958). Radial and axial flow impellers. Scaleup exponent is -0.85.
- $N_{js}$  is reported as the average of these calculations
- The percentage of unsuspended (settled on the bottom) solids, the percentage of suspended solids, and the Cloud Height / Z (operating level) ratio are reported also for conditions where these can be calculated

## Solids Suspension Results

	Ungassed
Main Suspension Impeller	1: H Foil-Narrow
<b><math>N_{js}</math> (RPM)</b>	<b>99.1</b>
$N_{js}$ (rev/s)	1.65
$N/N_{js}$	1.21
N (RPM)	120
N (rev/s)	2.00
$P_{js}$ (kW)	1.9708
Unsuspended	0%
Suspended	100%
Cloud Height / Z	97%

# Solids Suspension Results (2/3)

- The Cloud Height / Z (operating level) ratio is reported also for conditions where this can be calculated
- A cloud height CH/Z of 100% means that the solids cloud reaches the liquid surface
  - Note that this does not mean that the solids are 100% uniformly distributed throughout the liquid: there may still be concentration gradients
- Cloud height calculations are based on Hicks M.T., Myers K.J., Bakker A. (1997) *Cloud Height in Solids Suspension Agitation*, Chem. Eng. Comm., Vol. 160, pp 137-155.



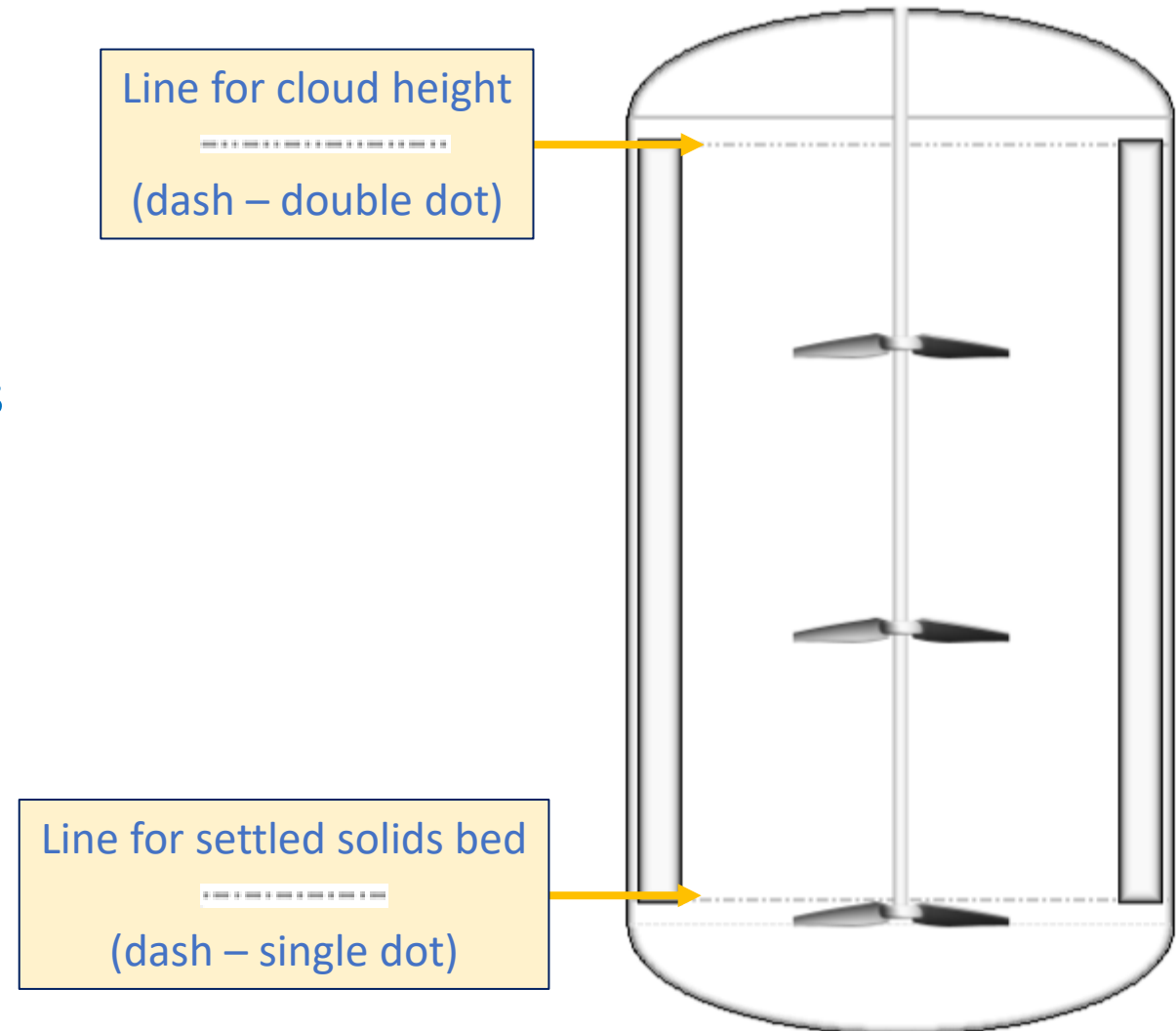
In this experiment, cloud height CH / Z  $\approx$  60%



# Solids Suspension Results (3/3)

- If Settings | Draw Solids Levels is On then KaeMix will draw lines at the predicted cloud height and at the height of the solids bed if all solids were settled
- Limitations: only for cylindrical and rectangular vessels for which solids suspension calculations can be performed. Solids bed level only drawn if it is greater than the bottom depth. Cloud height only drawn if able to be calculated. If  $CH/Z = 100\%$  then operating level and cloud height are the same and the line for cloud height is not visible

Liquid Blending. M-Scale: 8.2/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
Solids Suspension. M-Phase: 4.0/10. 100% Suspended. CH/Z: 97%





# Results



# Blend Time

**Primary Liquid** Fermentation Broth  
 Density (kg/m<sup>3</sup>) 1200  
 Viscosity Model Newtonian  
 Viscosity at 1/s (mPa.s) 75

**Blend Time (h:m:s)**

Uniformity	Ungassed	Gassed
80%	00:00:05	00:00:06
85%	00:00:06	00:00:07
90%	00:00:08	00:00:09
95%	00:00:10	00:00:11
96%	00:00:11	00:00:12
97%	00:00:12	00:00:13
98%	00:00:13	00:00:15
99%	00:00:16	00:00:18
100%	00:00:24	00:00:27

**Design 5/7** Duplicate New Delete Move: ↑ Top ↑ Up ↓ Down ↓ Bottom Sort: [icon] rev/s: 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	(i)	Vessel	T (m)	Z (m)	V <sub>1</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	2.0	19%	00:00:23		6/10		Single Hydrofoil - Narrow	
2	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	1.9	3.0	4.0	75%	00:00:19	1.01	10/10	3/10	Suspension	Fully suspended
3	✓	Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	4.0	59%	00:00:20		5/10		Multiple spargers	Multiple Rushton
4	✓	Cylindrical	2.03	2.84	8.2344	Conical	Ellipse	SWPV	1.2	4.02	7.9	51%	00:00:23		7/10		Sweeper	Conical bottom
5	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	3.69	10.0	37%	00:00:24		8/10	3/10	Gas Dispersion	Turbine + 2 Up Pump
6	✓	Rectangular	1.60	0.75	1.4042	Angled	Flat	HF-N	4.0	0.24	0.4	61%	00:00:18		5/10		Angled Bottom	Rectangular vessel
7	X	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	1.15	10.0	11%			0/10		Cavern Size	Yield stress fluid

Blend times required to reach a certain degree of uniformity are presented. Both ungassed and gassed blend times are shown.

# Drive Loads

The screenshot displays the KaeMix Student software interface. The 'Drive' tab is active, showing various drive configuration options on the left. A yellow box highlights the 'Drive Loads' section on the right, which contains a table of power draw and motor load data. Another yellow box highlights a row in the 'Design List' table at the bottom, specifically the row for design ID 3, which shows RPM, Power (P), Motor capacity, and Load percentage.

**Drive Loads Table:**

	Power Draw	Ungassed	Gassed
Total Power Draw (kW)	0.0027		
$P_g/P_u$			
$P/V$ (kW/m <sup>3</sup> )	0.0796		
P/Mass (W/kg)	0.0783		
Total Flow Rate (m <sup>3</sup> /s)	0.0079		
<b>Motor Load</b>			
Main Drive (10kW)	0.0%		

**Design List Table:**

ID	⊕	Vessel	T (m)	Z (m)	$V_r$ (m <sup>3</sup> )	Bottom	Top	Impeller	RPM	P (kW)	Motor (kW)	Load (%)	Blend Time	$N/N_p$	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	0.29	0.51	0.0337	Flat	Flat	HF-N	480.0	1.3E-03	10.0	0%	00:00:26	1.01	1.3/10	3.0/10	Single Impeller	CH/Z = 46%
2	✓	Cylindrical	0.29	0.51	0.0337	Flat	Flat	HF-N	480.0	2.7E-03	10.0	0%	00:00:13	1.01	2.0/10	3.0/10	Two Impellers S/D = 3.0	CH/Z = 95%
3	✓	Cylindrical	0.29	0.51	0.0337	Flat	Flat	HF-N	480.0	2.7E-03	10.0	0%	00:00:13	1.01	2.0/10	3.0/10	Two Impellers S/D = 3.7	CH/Z = 46%

Power draw and motor load are shown

The design list shows for each design, for the main drive: the speed, the power draw, the motor capacity, and the motor load

# Power Draw Details

**Ungassed torque M, flow / pumping rate Q, and power P per impeller**

**Ungassed totals for the impeller set**

**Gassed values per impeller**

**Gassed totals for the impeller set**

Power Draw	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8
Type	BDT	HF-W						
Nr Blades	6	4						
Drive	1	1						
Speed N (rev/s)	1.3	1.3						
Torque M (Nm)	268	159						
Flow Q (m <sup>3</sup> /s)	0.475	0.746						
Power P (kW)	2.19	1.3						
Nr Impellers	1	2						
Total M (Nm)	268	319						
Total Q (m <sup>3</sup> /s)	0.475	1.49						
Total P (kW)	2.19	2.6						
Gassed M <sub>g</sub> (Nm)	250	137						
Gassed Q <sub>g</sub> (m <sup>3</sup> /s)	0.465	0.711						
Gassed P <sub>g</sub> (kW)	2.05	1.12						
Total M <sub>g</sub> (Nm)	250	275						
Total Q <sub>g</sub> (m <sup>3</sup> /s)	0.465	1.42						
Total P <sub>g</sub> (kW)	2.05	2.25						

ID	⊕	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
5	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	HF-N	1.2	0.34	7.9	4%	00:00:58		4.2/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering	
7	✓	Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal	
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size	

# Dimensionless Numbers

The screenshot shows the KaeMix software interface. On the left, the 'Impellers' configuration panel is visible, showing settings for Set 1 and Set 2. A yellow callout box highlights the text: "Dimensionless numbers are shown for each impeller set". Below this, another yellow callout box lists the formulas for Reynolds Re, Froude Fr, Power Number Po, Pumping Number Nq, and Gas Flow Number Fl.

On the right, the 'Dimensionless' tab is active, displaying a table of dimensionless numbers for each impeller set. The table has columns for 'Dimensionless', 'Set 1', 'Set 2', 'Set 3', 'Set 4', 'Set 5', 'Set 6', 'Set 7', and 'Set 8'. The 'Type' column lists various dimensionless numbers, and the 'Set 1' and 'Set 2' columns contain numerical values.

Dimensionless	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8
Type	BDT	HF-W						
Nr Blades	6	4						
Reynolds Re	1.38E+04	1.74E+04						
Froude Fr	0.14	0.158						
Power Po	2.33	0.771						
Pumping Nq	0.68	0.75						
Gas Flow Fl	0.248	0.202						
P <sub>g</sub> /P <sub>u</sub>	0.935	0.863						
Po <sub>g</sub>	2.18	0.665						
Nq <sub>g</sub>	0.665	0.714						
D/T	0.4	0.45						
W/D								
Pitch/D								
C <sub>1</sub> /T	0.2	0.73						
C <sub>2</sub> /T	0.2	1.26						
Nr Impellers	1	2						
Cavern D/T								

At the bottom of the interface, a table lists design parameters for 11 different vessels. The table has columns for ID, Vessel, T (m), Z (m), V<sub>1</sub> (m<sup>3</sup>), Bottom, Top, Impeller, rev/s, P (kW), Motor (kW), Load (%), Blend Time, N/N<sub>p</sub>, M-Scale, M-Phase, Tag, and Comment.

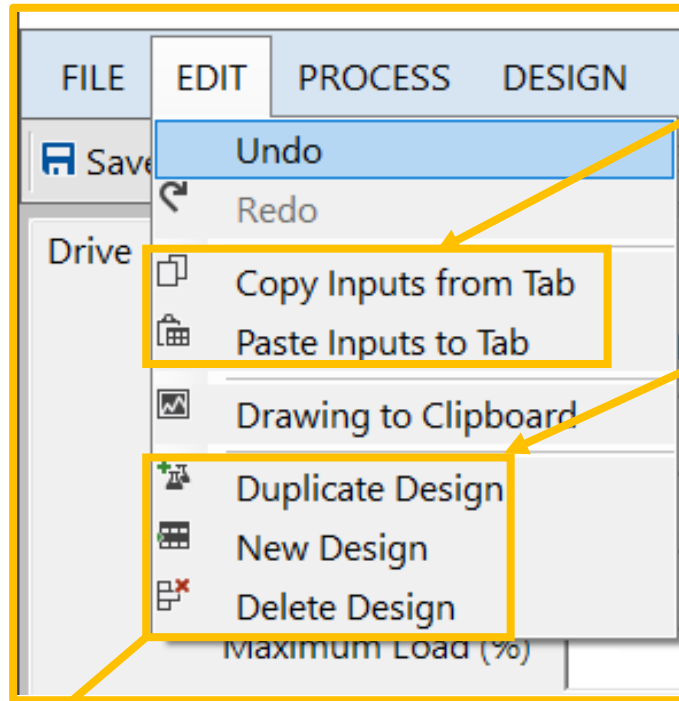
ID	⊕	Vessel	T (m)	Z (m)	V <sub>1</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
5	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	HF-N	1.2	0.34	7.9	4%	00:00:58		4.2/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering	
7		Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.15	57.7	18%	00:00:29	0.59	9.8/10	1.0/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.1529	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		5.8/10		Horizontal	
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10		Droplet Size	



# Managing Designs



# Managing Designs – Design List



Use Copy and Paste to Tab if you want to copy inputs from one design to another. In the first design, click on Copy Inputs from Tab and the inputs from the active tab will be stored. Go to the second design, and click Paste Inputs to Tab and the inputs will be pasted in this design

To add another design, click New or Duplicate. New will add a default design. Duplicate creates a copy of the active design. You can also delete designs you no longer need

The ✓ and ✗ indicate if a design passed or failed basic design checks

You can edit the speed for the Main Drive here

You can add a Tag (e.g., a name, label, or keyword) and a Comment to each design

ID	(i)	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
4		Cylindrical	1.78	3.02	7.211	Ellipse	Ellipse	RDT	1.0	2.35	2.4	97%	00:00:20		5/10		Stages	
5	✓	Cylindrical	2.03	2.84	8.784	Ellipse	Ellipse	SWPV	1.2	3.97	7.9	50%	00:00:23		7/10		HTR Coils	
6		Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	6.4	3.0	213%	00:01:12		3/10		Side Entering	
7	✓	Cylindrical	1.78	2.27	5.362	ASME	ASME	PUMPS	1.4	7.65	24.6	31%	00:00:21		7/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.88	Ellipse	Ellipse	BDT	1.3	3.76	33.5	9%	00:00:25		8/10	3/10	Gas Dispersion	Turbine + 2 Up P
9	✓	Cylindrical	2.54	4.49	21.97	ASME	ASME	SWPV	1.5	6.35	57.7	11%	00:00:31	0.44	7/10	1/10	Draft Tube	
10	✓	Horizontal	1.00	0.75	1.153	Ellipse	Ellipse	HF-N	4.0	0.3	0.9	34%	00:00:10		7/10		Horizontal	



# Managing Designs - Sorting

You can reorder the design list by moving designs up, down, to the top, or the bottom

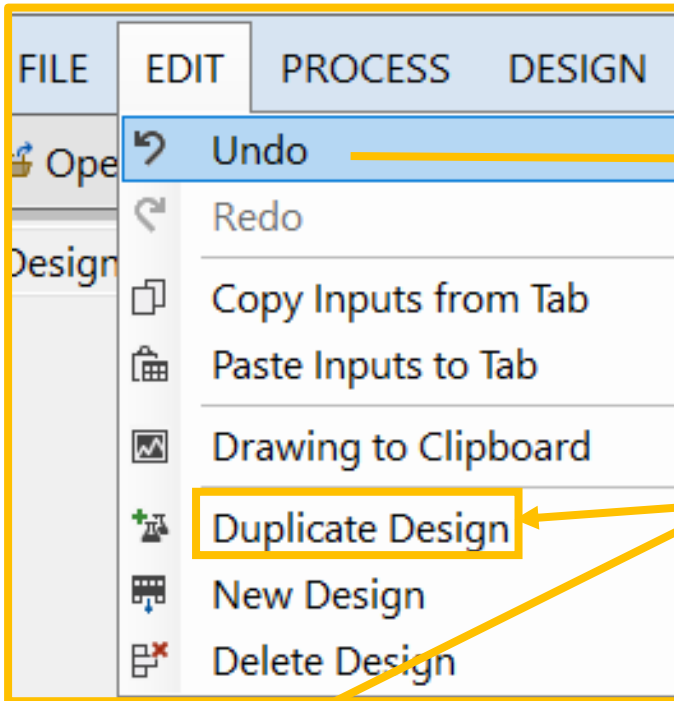
To sort the whole list, click on the Sort A→Z or Z→A buttons in the list commands. This will bring up the list of variables that you can use to sort

Move: Top Up Down Bottom    Sort:

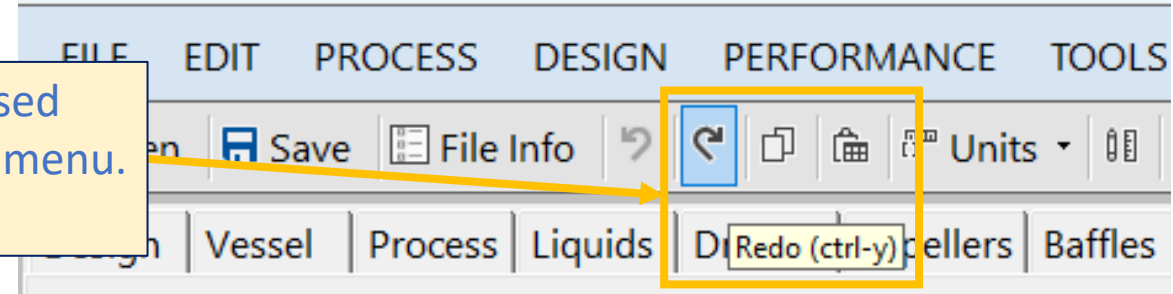
Tag  
M-Scale  
Blend Time  
Motor Load  
Motor Size  
Power Draw  
Rotation Speed  
Volume  
Liquid Level  
Vessel Diameter  
M-Phase  
N/N<sub>js</sub>  
Mass Transfer k<sub>1a</sub>

ID	(i)	Vessel	T (m)	Z (m)	V <sub>l</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>js</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	10.0	4%	00:00:23		6/10			
2		Cylindrical	1.52	2.31	4.019	Ellipse	Ellipse	COW	0.1	16.06	2.7	605%	02:07:26		2/10		Helical	
3	✓	Cylindrical	2.03	3.45	10.76	Ellipse	Ellipse	HF-N	1.67	1.97	3.6	55%	00:00:22	0.96	10/10	3/10	Suspension	Fully Suspended
4		Cylindrical	1.78	3.02	7.211	Ellipse	Ellipse	RDT	1.0	2.35	2.4	97%	00:00:20		5/10		Stages	
5	✓	Cylindrical	2.03	2.84	8.784	Ellipse	Ellipse	SWPV	1.2	3.97	7.9	50%	00:00:23		7/10		HTR Coils	
6		Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	6.4	3.0	213%	00:01:12		3/10		Side Entering	
7	✓	Cylindrical	1.78	2.27	5.362	ASME	ASME	PUMPS	1.4	7.65	24.6	31%	00:00:21		7/10		Pumper	
8	✗	Cylindrical	2.03	3.00	9.289	Ellipse	Ellipse	BDT	1.3	3.76	33.5	11%			0/10	0/10	Gas Dispersion	Turbine + 2 Up Pumping Impellers
9	✓	Cylindrical	2.54	4.49	21.97	ASME	ASME	SWPV	1.5	6.11	57.7	11%	00:00:31	0.41	7/10	1/10	Draft Tube	

# Managing Designs - Undo and Redo



Undo and Redo can be accessed from the ribbon and the Edit menu. There is one Undo level



If you are going to make a lot of changes, it's a good idea to first Duplicate Design so that you still have a copy from before the changes

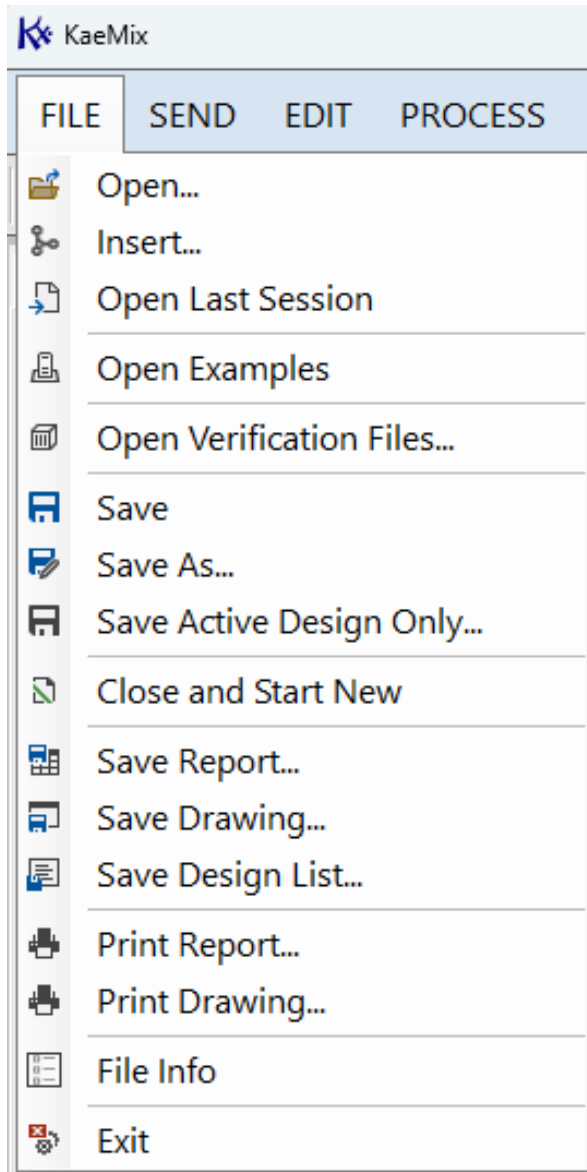
ID	(i)	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>p</sub>	M-Scale	M-Phase	Tag	Comment
1	✓	Cylindrical	1.00	1.00	0.733	Ellipse	Ellipse	HF-N	5.0	0.38	10.0	4%	00:00:23		6/10			
2		Cylindrical	1.52	2.31	4.019	Ellipse	Ellipse	COW	0.1	16.06	2.7	605%	02:07:26		2/10		Helical	
3	✓	Cylindrical	2.03	3.45	10.76	Ellipse	Ellipse	HF-N	1.67	1.97	3.6	55%	00:00:22	0.96	10/10	3/10	Suspension	Fully Suspended
4		Cylindrical	1.78	3.02	7.211	Ellipse	Ellipse	RDT	1.0	2.35	2.4	97%	00:00:20		5/10		Stages	
5	✓	Cylindrical	2.03	2.84	8.784	Ellipse	Ellipse	SWPV	1.2	3.97	7.9	50%	00:00:23		7/10		HTR Coils	
6		Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	6.4	3.0	213%	00:01:12		3/10		Side Entering	
7	✓	Cylindrical	1.78	2.27	5.362	ASME	ASME	PUMPS	1.4	7.65	24.6	31%	00:00:21		7/10		Pumper	
8	✗	Cylindrical	2.03	3.00	9.289	Ellipse	Ellipse	BDT	1.3	3.76	33.5	11%			0/10	0/10	Gas Dispersion	Turbine + 2 Up Pumping Impellers
9	✓	Cylindrical	2.54	4.49	21.97	ASME	ASME	SWPV	1.5	6.11	57.7	11%	00:00:31	0.41	7/10	1/10	Draft Tube	



# Menus



# File Menu



Only one file can be open at a time. So, if you *Open* a file, it will close the current file and then open the new file

If you *Insert* a file, the current file will stay open, and all the designs from the file you select will be copied into the current file

*Open Last Session* opens the file that was automatically saved when you exited KaeMix previously

*Open Examples* opens a file with several helpful examples

*Save* and *Save As* save all the designs in the file

*Save Active Design Only* saves a new file with only the active design (the design selected in the Design List). Then if you open another existing file and insert the file you just saved you have in effect copied that design into your existing file

*Close and Start New* closes the open file and starts a new file

*Save Report* saves the HTML report for the active design. *Tip: the HTML report can also be read into Excel, Word, Calc, and Writer*

# Help Menu

The screenshot displays the KaeMix software interface. The 'HELP' menu is open, showing options: About KaeMix, License Key, License Agreement, KaeMix Overview, KaeMix Installation Guide, KaeMix User Guide, and KaeMix Verification Guide. A yellow box highlights the 'Documentation' section, which includes 'KaeMix Overview', 'KaeMix Installation Guide', 'KaeMix User Guide', and 'KaeMix Verification Guide'. A yellow arrow points from this box to the 'About KaeMix' dialog box, which contains the following information:

**KaeMix™**  
Author: Andre Bakker  
E-mail: support@kaemixllc.com  
© 2023-2024 KaeMix LLC  
KaeMix™ is a trademark of KaeMix LLC

The main software window shows a 3D visualization of a vessel with various components. A yellow box highlights the 'Documentation' section in the bottom left corner. A yellow arrow points from this box to the 'License Agreement' option in the Help menu. The 'License Agreement' dialog box is open, displaying the following text:

**Clickwrap License Agreement**

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ID	⊕	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Lo
2	✓	Cylindrical	1.52	2.31	4.0193	Ellipse	Ellipse	COW	0.1	16.89	30.0	
3	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	2.0	3.5	5.0	
4	✓	Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	3.0	
5	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	HF-N	1.2	0.34	7.9	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	
7	✓	Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	

# Window Menu

The screenshot displays the KaeMix software interface. The 'WINDOW' menu is open, showing options for 'Refresh' and 'Standard Layout'. A yellow box highlights the 'WINDOW' and 'HELP' menu titles. Another yellow box highlights the 'Refresh' button and the 'Standard Layout' button. A callout box explains that 'Refresh recalculates everything and redraws the screen'. Another callout box explains that 'Standard Layout restores the KaeMix window layout to its default'. The main window shows a 3D model of a vessel with two impellers. The bottom of the interface features a table with the following data:

ID	①	Vessel	T (m)	Z (m)	V <sub>i</sub> (m <sup>3</sup> )	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N <sub>s</sub>	M-Scale	M-Phase	Tag	Comment
2	✓	Cylindrical	1.52	2.31	4.0193	Ellipse	Ellipse	COW	0.1	16.89	30.0	56%	00:23:03		2.3/10		Helical	
3	✓	Cylindrical	2.03	3.45	10.759	Ellipse	Ellipse	HF-N	2.0	3.5	5.0	70%	00:00:18	1.21	9.7/10	4.0/10	Suspension	Fully Suspended
4		Cylindrical	1.78	3.02	7.2114	Ellipse	Ellipse	RDT	1.0	2.35	3.0	78%	00:00:20		4.1/10		Stages	
5	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	HF-N	1.2	0.34	7.9	4%	00:00:58		4.2/10		HTR Coils	
6	✓	Rectangular	5.17	3.50	71.4	Angled	Flat	HF-W	2.0	10.4	16.0	65%	00:01:08		4.3/10		Side Entering	
7	✓	Cylindrical	1.78	2.27	5.3617	ASME	ASME	PUMPS	2.0	5.44	24.6	22%	00:00:26		2.4/10		Pumper	
8	✓	Cylindrical	2.03	3.80	11.884	Ellipse	Ellipse	BDT	1.3	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up Pumping Impeller



Send



# Send to Office Applications

The 'SEND' menu in KaeMix includes the following options:

- Report to Excel
- Report to Word
- Report to Calc
- Report to Writer
- Report to Browser
- Drawing to Paint.Net
- Design List to Excel
- Design List to Calc

KaeMix checks if these applications are installed, and if so, enables Send To functionality:

- Microsoft Office ("C:\Program Files\Microsoft Office")
- LibreOffice ("C:\Program Files\LibreOffice\program")
- Paint.Net ("C:\Program Files\paint.net"). If Paint.Net is not found it will enable Microsoft Paint instead

**Vessel Design**

Vessel Style	Cylindrical	
Straight Side	3	(m)
Diameter	2.032	(m)
Bottom Style	Elliptical	
Bottom Depth	0.4064	(m)
Bottom Volume	0.8786	(m <sup>3</sup> )
Top Head Style	Elliptical	
Top Head Depth	0.4064	(m)
Top Head Volume	0.8786	(m <sup>3</sup> )
Vessel Material	Stainless Steel	
Wall Thickness		(m)
Bottom Thickness		(m)
Wetted Parts Material	Stainless Steel	
Sealing	Mechanical Seal - Double	

**Operating Conditions**

Operating Temperature	20	(°C)
Operating Pressure	100000	(N/m <sup>2</sup> )
Operating Level	3	(m)
Gassed Operating Level	3.328	(m)
Operating Volume	9.289	(m <sup>3</sup> )
Operating Pressure	0.987	Atm
Average Pressure	1.147	Atm
Bottom Pressure	1.306	Atm
Flow Rate		(m <sup>3</sup> /s)
Residence Time		(h.m.s)

**Liquids**

Primary Liquid	Fermentation Broth	
Density	1100	(kg/m <sup>3</sup> )
Viscosity Model	Newtonian	
Viscosity	2	(mPa.s)
Safety	No Safety Concerns	

**Drives**

Set 1	Top Entering	
Style		
Drive Name		
Motor	33.46	(kW)
Maximum Load	80	(%)
Speed	78	(RPM)
Speed	1.3	(rev/s)
Rotation	Clockwise	
Mounting Height	0	(m)
Steady Bearing	✓	

KaeMix Report in Excel

**File Info**

KaeMix™  
August 13, 2022 - Build 0023  
8/13/2022 7:50:36 PM

**Application**

Industry: Fermentations  
Application: Pharmaceuticals  
Process: Aerobic fermentations, e.g. penicillin, steroids, vitamins, etc. Scale-up from previous experience strongly influences design. Fluids are often non-Newtonian because of suspended cells. Gas dispersion. Design variable: gas flow rate. Typical scale of agitation: 9 to 10.

**Vessel Design**

Vessel Style	Cylindrical	(m)
Straight Side	3	(m)
Diameter	2.032	(m)
Bottom Style	Elliptical	(m)
Bottom Depth	0.4064	(m)
Bottom Volume	0.8786	(m <sup>3</sup> )

**Operating Conditions**

Operating Temperature	20	(°C)
Operating Pressure	100000	(N/m <sup>2</sup> )
Operating Level	3	(m)
Gassed Operating Level	3.328	(m)
Operating Volume	9.289	(m <sup>3</sup> )
Operating Pressure	0.987	Atm
Average Pressure	1.147	Atm
Bottom Pressure	1.306	Atm
Flow Rate		(m <sup>3</sup> /s)
Residence Time		(h.m.s)

**Liquids**

Primary Liquid	Fermentation Broth	
Density	1100	(kg/m <sup>3</sup> )
Viscosity Model	Newtonian	
Viscosity	2	(mPa.s)
Safety	No Safety Concerns	

**Drives**

Set 1	Top Entering	
Style		
Drive Name		
Motor	33.46	(kW)
Maximum Load	80	(%)
Speed	78	(RPM)
Speed	1.3	(rev/s)
Rotation	Clockwise	
Mounting Height	0	(m)
Steady Bearing	✓	

KaeMix Report in Word



# Send Drawing to Paint or Paint.Net

**SEND** FILE EDIT PROCESS DESIGN

- Report to Excel
- Report to Word
- Report to Calc
- Report to Writer
- Report to Browser
- Drawing to Paint.Net**
- Design List to Excel
- Design List to Calc
- Comparison Table to Excel
- Comparison Table to Calc
- CSV File to Excel
- CSV File to Calc

**PERFORMANCE TOOLS SETTINGS WINDOW HELP**

Units Quick Agitator Design **Copy Drawing** Scale-Up Reposition Load Motor Speed Standard Speed Resize Refresh

Gas Flow Sparger Solids Particles Draft Tube Stages File Info Drawing Results Report Loads Blending Suspension Gas Dispersion HT Rate

Liquid Blending. M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.  
Gas Dispersion. M-Phase: 3.0/10. Dispersing. ka: 0.073 1/s

**KaeMixDrawing.png - paint.net 4.3.11**

File Edit View Image Layers Adjustments Effects

Brush width: 2 Hardness: 75% Fill: Solid Color

To... x

Left click to draw with primary color, right click to dr

**KaeMix drawing in Paint.Net**

Notes

ID	①	Vessel	T (m)	Z (m)
2	✓	Cylindrical	1.52	2.31
3	✓	Cylindrical	2.03	3.45
4		Cylindrical	1.78	3.02
5	✓	Cylindrical	2.03	2.84
6	✓	Rectangular	5.17	3.50
7		Cylindrical	1.78	2.27
8	✓	Cylindrical	2.03	3.80

1-Phase	Tag	Comment
	Helical	
4.0/10	Suspension	Fully Suspended
	Stages	
	HTR Coils	
	Side Entering	
	Pumper	
	Gas Dispersion	Turbine + 2 Up Pumping Impelle

C:\KaeMix\Examples.kaemix

To edit or print the drawing send it to Paint.Net (or Paint)

You can also click the Copy Drawing button or Edit → Drawing to Clipboard. This will copy the drawing to the Windows clipboard. You can then paste it into other programs (e.g., PowerPoint)

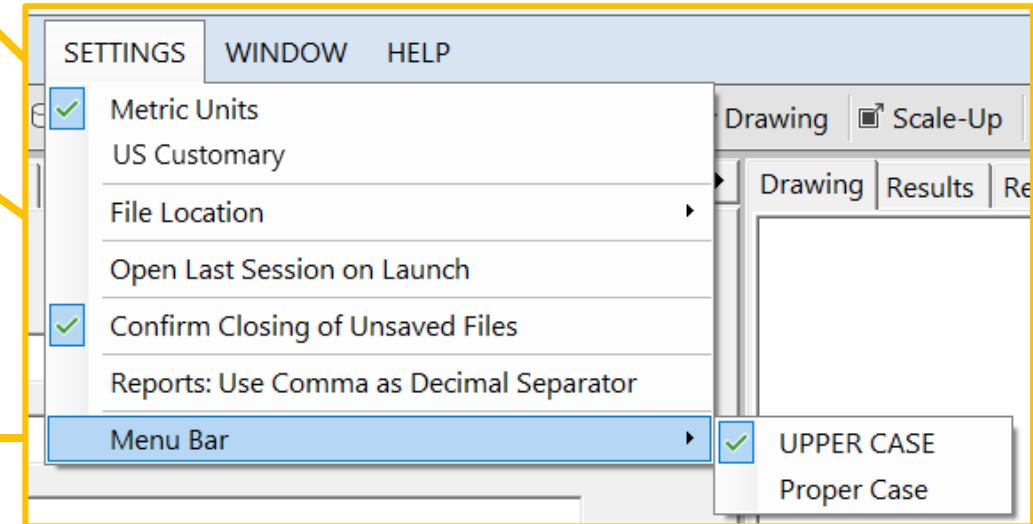
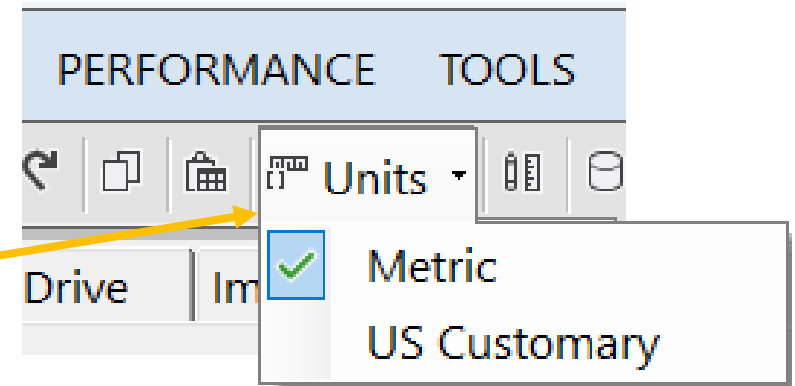


# Settings



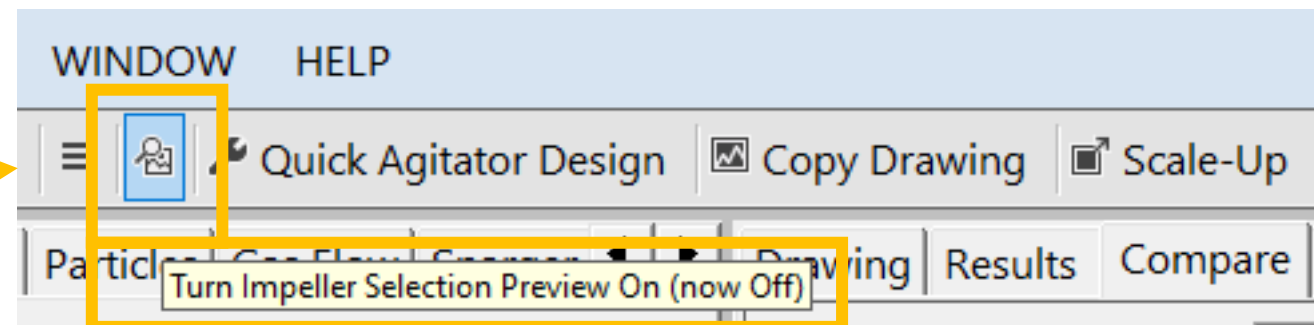
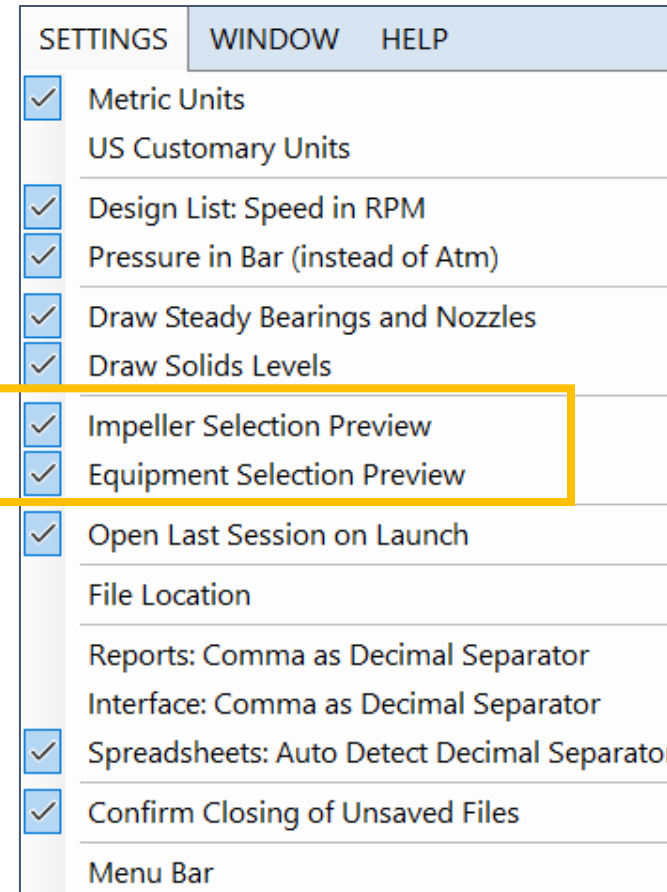
# Settings

- You can easily switch between Metric and USA units using the Units button in the ribbon or the Settings menu
- If you want your last session automatically restored when you launch KaeMix then select the *Open Last Session on Launch* setting
  - Note, you can also do this manually from *File* → *Open Last Session*
- The text in the menu bar is by default in upper case font. If you prefer proper case, you can select this in the Settings menu



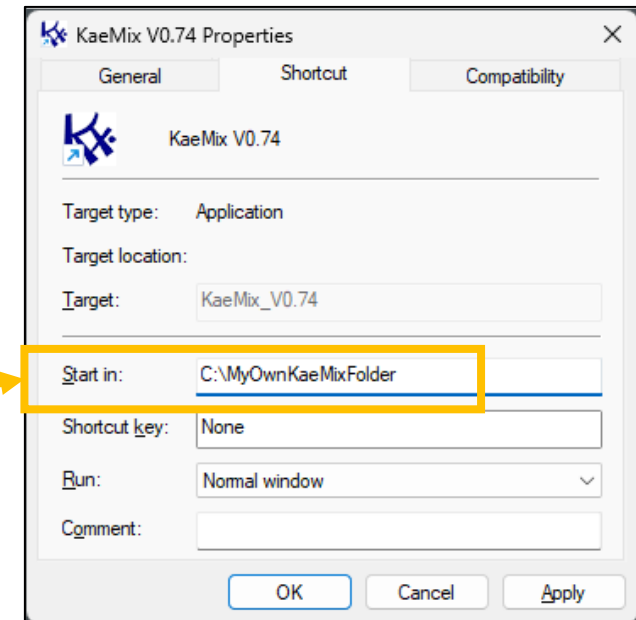
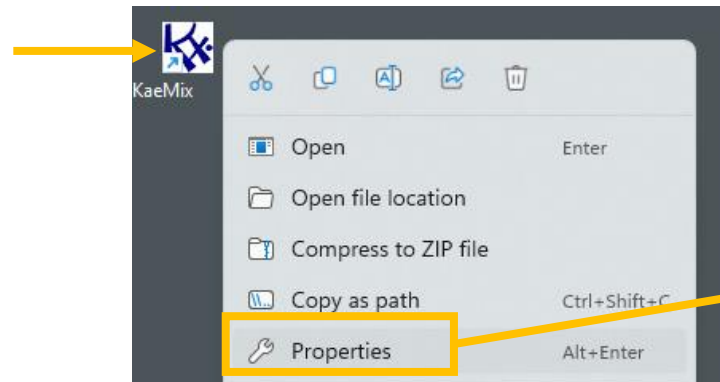
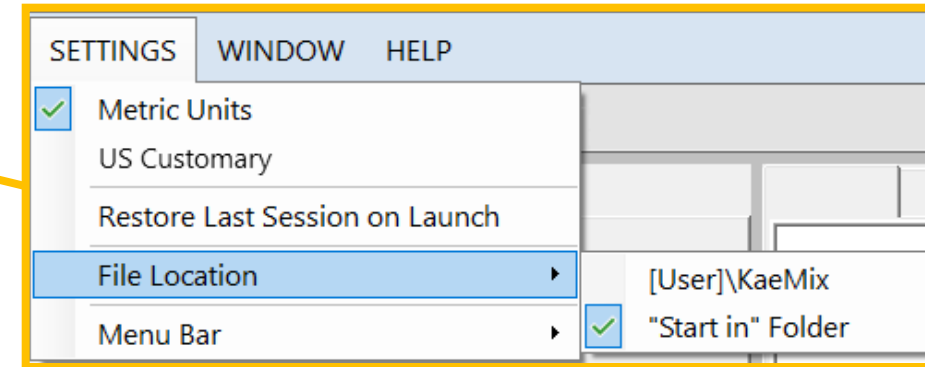
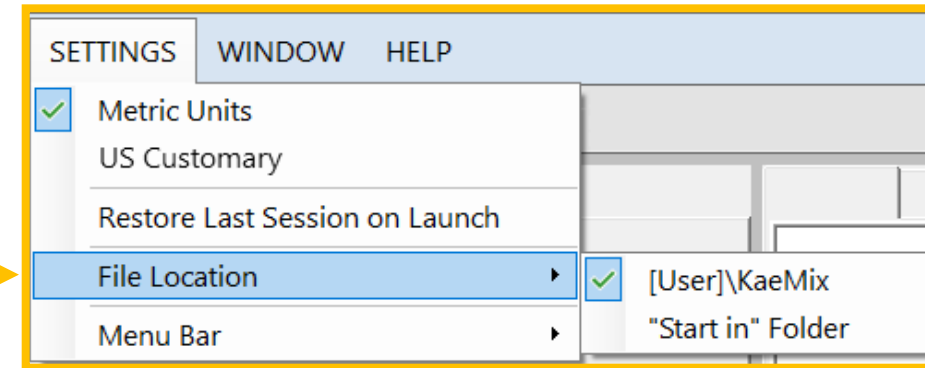
# Settings - Previews

- Equipment and impeller selections can be made graphically using Previews or using standard text dropdowns
- This feature is enabled from the Settings menu. There is one setting for Equipment (bottoms, heads, baffles, spargers) and one for impellers
- Previews can also be enabled or disabled from the corresponding icon in the ribbon



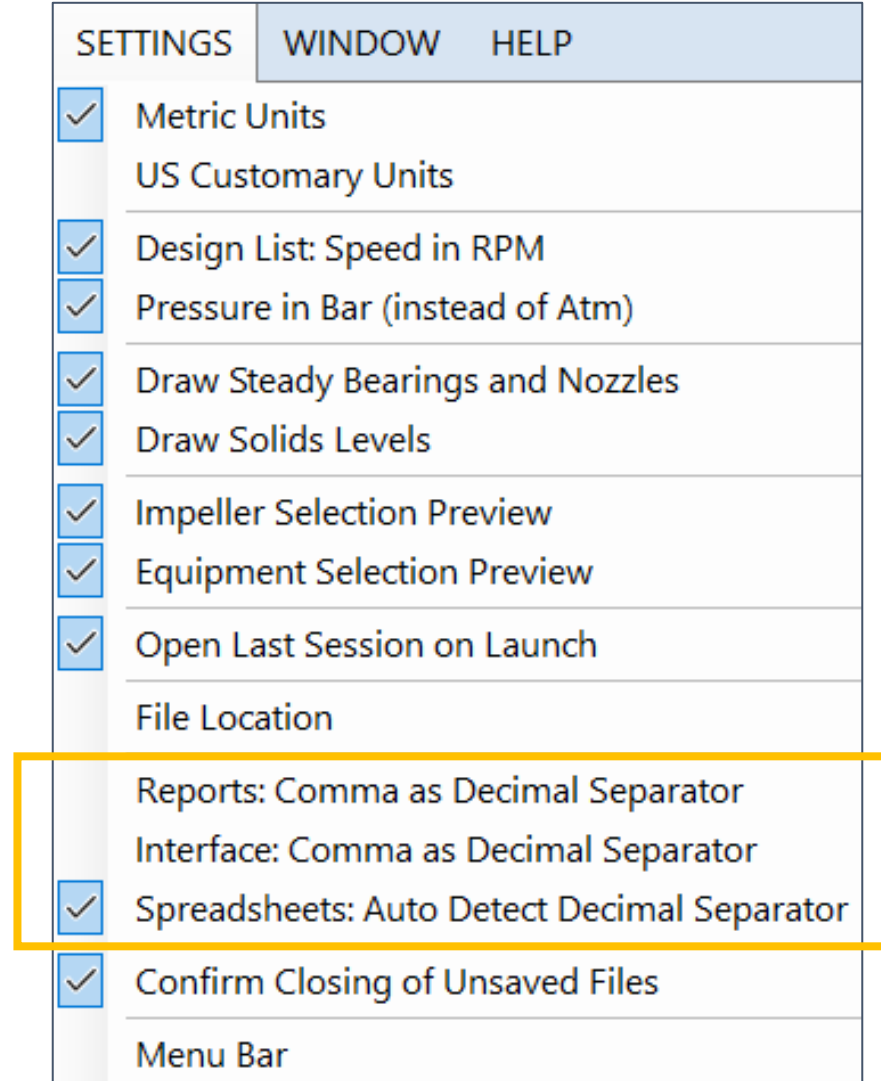
# Settings – File Location

- You can control where KaeMix files are saved by default
- Default is [User]\KaeMix folder and usually looks like this: “C:\Users\yourname\KaeMix”
- To change the default, select “Start in” Folder instead
- Specify the “Start in” Folder as follows
  - Right click on the KaeMix icon on the desktop and then click on Properties
  - Then specify the “Start In” folder and click Apply. Next time you launch KaeMix it will default to the “Start In” folder that you specified here



# Settings: Decimal Separator

- By default, KaeMix uses the decimal point as the decimal separator, e.g. “3.14”
- This can be changed to the decimal comma, e.g. “3,14” from the Settings menu



# Settings: Pressure in Bar (instead of Atm)

Setting: “Pressure in Bar (instead of Atm)”  
Atmosphere is KaeMix default  
This can be changed to Bar

FILE SEND EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Open Save File Info Units

Design Vessel Process Liquids Drive Mechanical Impellers Baffl

**Process Operating Conditions**

Operating Level (m) 0.9693

Gassed Operating Level (m)

Operating Volume (m<sup>3</sup>) 0.7062

Operating Temperature (°C) 15

Operating Pressure (Atm) 1

Average Pressure (Atm) 1.06

Pressure at Bottom (Atm) 1.108

Liquid Weight (kg) 706.18

Mixture Weight (kg) 706.18

Additional Level Indicator (m)

Liquid Flows  Batch System  Continuous Flow

SETTINGS WINDOW HELP

- Metric Units
- US Customary Units
- Design List: Speed in RPM
- Pressure in Bar (instead of Atm)
- Draw Steady Bearings and Nozzles
- Draw Solids Levels
- Impeller Selection Preview
- Equipment Selection Preview
- Open Last Session on Launch
- File Location
- Reports: Comma as Decimal Separator
- Interface: Comma as Decimal Separator
- Spreadsheets: Auto Detect Decimal Separator
- Confirm Closing of Unsaved Files
- Menu Bar

FILE SEND EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Open Save File Info Units

Design Vessel Process Liquids Drive Mechanical Impellers Baffl

**Process Operating Conditions**

Operating Level (m) 0.9693

Gassed Operating Level (m)

Operating Volume (m<sup>3</sup>) 0.7062

Operating Temperature (°C) 15

Operating Pressure (Bar) 1.0133

Average Pressure (Bar) 1.047

Pressure at Bottom (Bar) 1.094

Liquid Weight (kg) 706.18

Mixture Weight (kg) 706.18

Additional Level Indicator (m)

Liquid Flows  Batch System  Continuous Flow

SETTINGS WINDOW HELP

- Metric Units
- US Customary Units
- Design List: Speed in RPM
- Pressure in Bar (instead of Atm)
- Draw Steady Bearings and Nozzles
- Draw Solids Levels
- Impeller Selection Preview
- Equipment Selection Preview
- Open Last Session on Launch
- File Location
- Reports: Comma as Decimal Separator
- Interface: Comma as Decimal Separator
- Spreadsheets: Auto Detect Decimal Separator
- Confirm Closing of Unsaved Files
- Menu Bar

# Settings: Design List Speed in RPM

Setting: “Design List: Speed in RPM.”

**OFF:** KaeMix switches between rev/s for metric units and RPM for US units

**ON:** Always uses RPM

Design List: Speed in RPM

Pressure in Bar (instead of Atm)

Confirm Closing of Unsaved Files

Menu Bar

**OFF: rev/s for metric units**

↓ Down ↓ Bottom Sort:  $\frac{M}{Z}$  ↓  $\frac{Z}{M}$  ↓ rev/s: 5 Tag:

Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)
Ellipse	RDT	1.0	2.35	3.0	78%

Design List: Speed in RPM

Pressure in Bar (instead of Atm)

Confirm Closing of Unsaved Files

Menu Bar

**ON: always RPM**

↓ Down ↓ Bottom Sort:  $\frac{M}{Z}$  ↓  $\frac{Z}{M}$  ↓ RPM: 300 Tag:

Top	Impeller	RPM	P (kW)	Motor (kW)	Load (%)
Ellipse	RDT	60.0	2.35	3.0	78%



**END**