

KaeMix Student Overview

KaeMix Documentation

V0.71 – March 9, 2023

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KaeMix Student FAQ

- **What is it?**
Software to design and evaluate stirred fluid mixing vessels
- **Where does it come from?**
It is developed by Dr. Andre Bakker, a well-known fluid dynamics expert
- **Who is it for?**
It is for students, educators, and engineers who study stirred fluid mixing problems
- **What can it do?**
Performance prediction for single-phase and multiphase stirred vessels
- **What is it based on?**
Literature data and published correlations
- **What is it not?**
It is not a CAD, CFD, or structural analysis program
- **What kind of computer do I need?**
A standard 64-bit Windows PC with a screen resolution of at least 1920x1080 suffices – no special hardware needed
- **Where can I get it?**
It is available for free from KaeMix LLC

User Interface

KaeMix - V0.72

FILE EDIT PROCESS DESIGN PERFORMANCE TOOLS SETTINGS WINDOW HELP

Save File Info Units Design Info Vessel Process Liquids Impellers Reposition Drive Load Motor Scale-Up Clipboard 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

Impellers (1-4) (5-8) Set 1 Set 2 Set 3 Set 4

Connected To: Main Drive Main Drive

Style: Disk Turbine General

Type: Bakker HFOil-Wide

Diameter (m): 0.8131 0.9147

Pump Direction: Radial Up

Number of Blades: 6 4

Blade Width (m): 0.1626

Blade Angle (degrees): 90

Number of Impellers: 1 2

First Bottom Clearance (m): 0.4064 1.484

Last Bottom Clearance (m): 0.4064 2.563

Note:

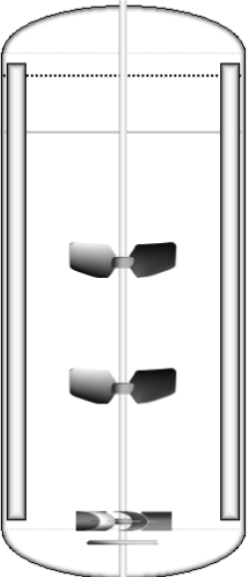
Diameter / Tank Ratio (D/T): 0.4 0.45

Clearance / Tank Ratio (C/T): 0.2 0.73

Blade Width Ratio (W/D): 0.2

Blade Pitch / Diameter (P/D):

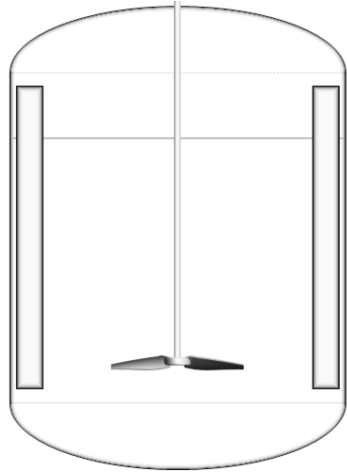
Liquid Blending, M-Scale: 7.9/10. Turbulent. Blendtime: 00:00:25 h:m:s.
Gas Dispersion, M-Phase: 3.0/10. Dispersing, k_a: 0.073 1/s



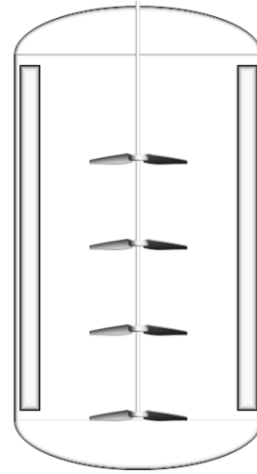
Design 8/11 Duplicate New Delete Move: Top Up Down Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	(i)	Vessel	T (m)	Z (m)	V _i (m ³)	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N _c	M-Scale	M-Phase	Tag	Comment
5	✓	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	1.2	6.3	7.9	80%	00:00:22		6.8/10			
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			
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	4.29	33.5	13%	00:00:24		7.9/10	3.0/10	Gas Dispersion	Turbine + 2 Up P
9	✓	Cylindrical	2.54	4.49	21.967	ASME	ASME	SWPS	1.5	10.03	57.7	17%	00:00:29	0.59	9.5/10	1.0/10		
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			
11	✓	Cylindrical	2.00	2.00	6.2832	Flat	Flat	RDT	0.63	1.36	10.0	14%	00:00:46		4.9/10			

Design Examples



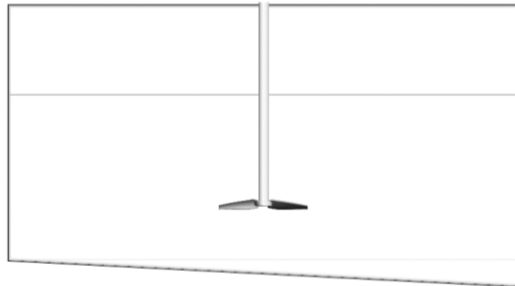
Default design:
single hydrofoil



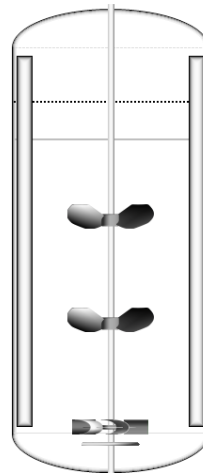
Multiple hydrofoils



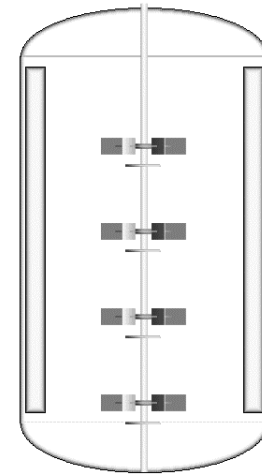
Hydrofoils and a sweeper



Rectangular vessel with
sloped bottom

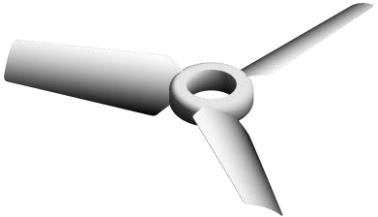


Hydrofoils, a disk
turbine, and gas sparger

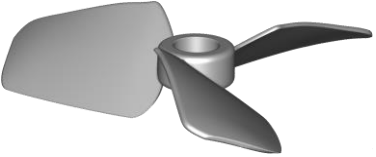


Multiple impellers and
spargers

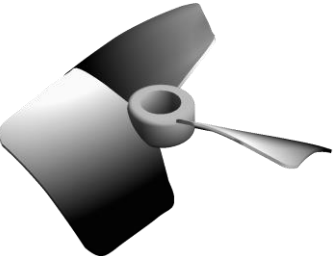
Available Impellers



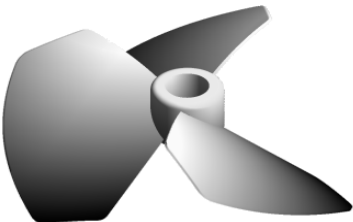
Hydrofoil Narrow



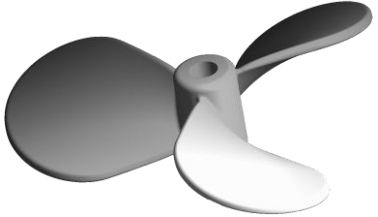
Hydrofoil Medium



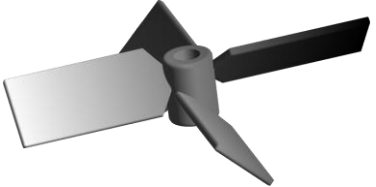
Hydrofoil Wide



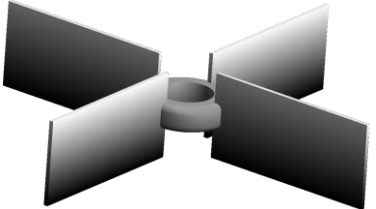
HF Extra Wide



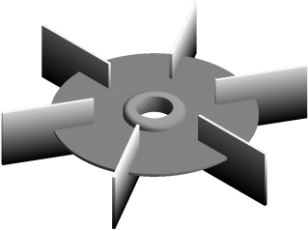
Propeller



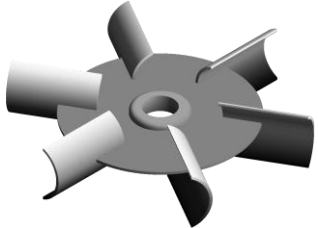
Pitched Blade



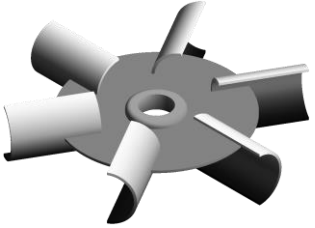
Straight Blade



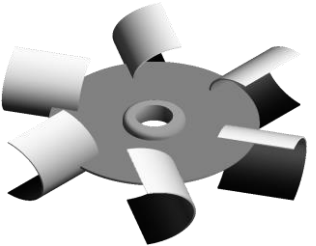
Rushton Turbine



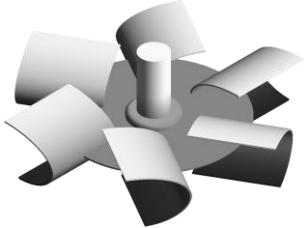
Van't Riet Turbine



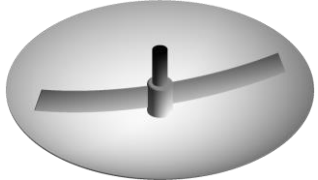
Smith Turbine



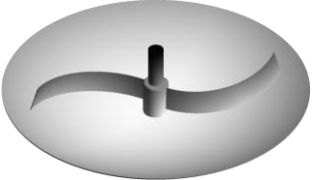
Middleton Turbine



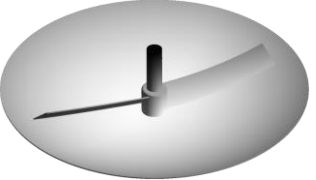
Bakker Turbine



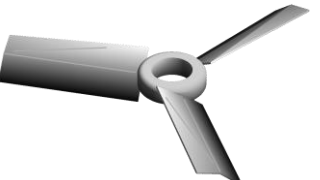
Sweeper Straight



Sweeper Curved



Sweeper Angled



High-Efficiency

Physics

- **General:** flow regime, dimensionless numbers, torque, power draw, flow rate, blend times, cavern size, etc.
- **Materials:** built-in properties for common liquids and gases, Newtonian, power law, yield stress fluids
- **Gas dispersion:** dispersion regime, gas holdup, mass transfer
- **Solids suspension:** just suspended speed, settled solids, cloud height
- **Scale-up:** by blend time, M-Scale, Froude, Reynolds, shear rates, tip speed, Power / Volume, Torque / Volume
- **M-Scale:** a 1 to 10 scale of agitation for liquid blending
- **M-Phase:** a 1 to 10 scale of agitation for multiphase applications
- **Application guide:** impeller and scale of agitation recommendations

Reporting

KaeMix

FILE EDIT PROCESS DESIGN

- Open...
- Insert...
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- Open Examples
- Save
- Save As...
- Save Active Design Only...
- Close
- Info
- Print...
- Send to Browser
- Send to Excel
- Send to Word
- Send to Calc
- Send to Writer
- Send to Paint.Net
- Exit

AutoSave Off KaeMixReport.HTML - Read-Only Andre Bakker

File Home Insert Page Layout Formulas Data Review View Help

A1 KaeMix™

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 ³)
Top Head Style	Elliptical	
Top Head Depth	0.4064	(m)
Top Head Volume	0.8786	(m ³)
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 ²)
Operating Level	3	(m)
Gassed Operating Level	3.328	(m)
Operating Volume	9.289	(m ³)
Operating Pressure	0.987	Atm
Average Pressure	1.147	Atm
Bottom Pressure	1.306	Atm
Flow Rate		(m ³ /s)
Residence Time		(h:m:s)

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

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

KaeMix Report in Excel

AutoSave Off Document1 - Word Andre Bakker

File Home Insert Draw Design Layout References Mailings Review View Help Table Design Layout

Search (Alt+Q)

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

File Info

Project Name
Location
Customer
Designer
Vessel Manufacturer
Mixer Manufacturer
Project Description
Design
Tag
Comment

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.

Mixer A concave-blade, gas-dispersing disk turbine with up-pumping high solidity hydrofoils is recommended.
Design
Liquid Flows Batch System
Gas
Dispersion
Solid
Suspension
Heat
Transfer

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 (m³)

Top Head Style Elliptical
Top Head Depth 0.4064 (m)
Top Head Volume 0.8786 (m³)
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/m²)
Operating Level 3 (m)
Gassed Operating Level 3.328 (m)
Operating Volume 9.289 (m³)
Operating Pressure 0.987 Atm
Average Pressure 1.147 Atm
Bottom Pressure 1.306 Atm
Flow Rate (m³/s)
Residence Time (h:m:s)

Liquids

Primary Liquid Fermentation Broth
Density 1100 (kg/m³)
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

END