

KaeMix Student Overview

KaeMix Documentation – V0.95

November 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 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 Baffles Gas Flow Sparger Solids Particles File Info

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):

Number of Impellers: 1 2

First Bottom Clearance (m): 0.4064 1.484

Last Bottom Clearance (m): 0.4064 2.563

Note:

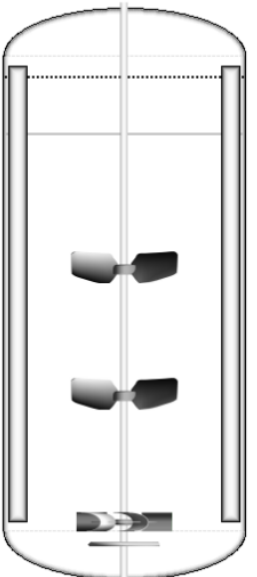
Diameter / Tank Ratio (D/T): 0.4 0.45

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



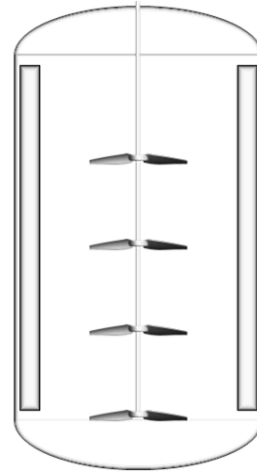
Design 5/8 Duplicate New Delete Move: Top Up Down Bottom Sort: rev/s 1.3 Tag: Gas Dispersion Comment: Turbine + 2 Up Pumping Impellers

ID	☑	Vessel	T (m)	Z (m)	V_i (m ³)	Bottom	Top	Impeller	rev/s	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N_p	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

Design Examples



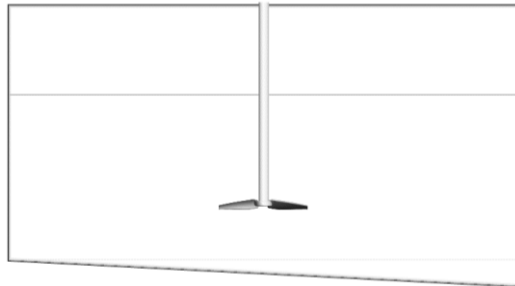
Default design:
single hydrofoil



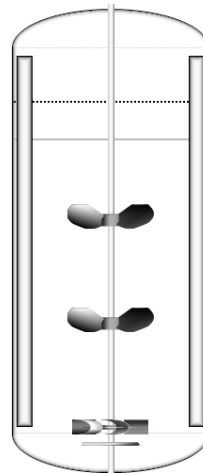
Multiple hydrofoils



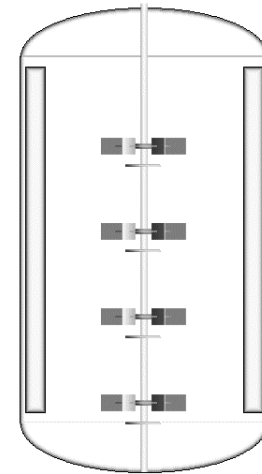
Hydrofoils and a sweeper



Rectangular vessel with
sloped bottom

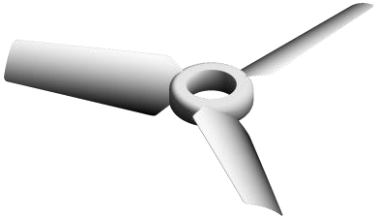


Hydrofoils, a disk
turbine, and gas sparger

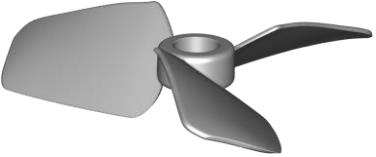


Multiple impellers and
spargers

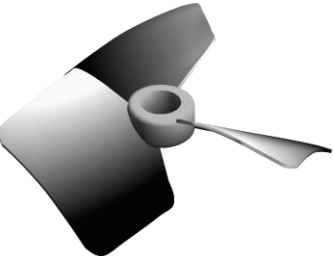
Available Impellers



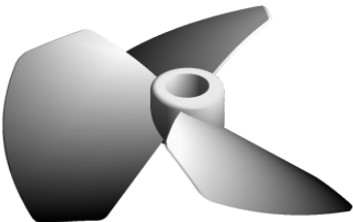
Hydrofoil Narrow



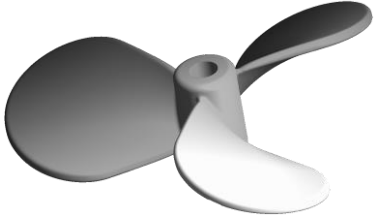
Hydrofoil Medium



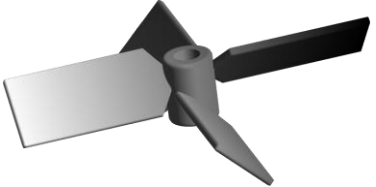
Hydrofoil Wide



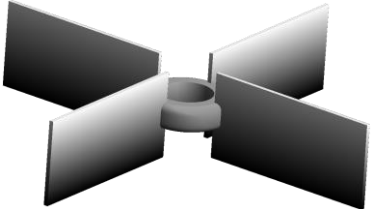
HF Extra Wide



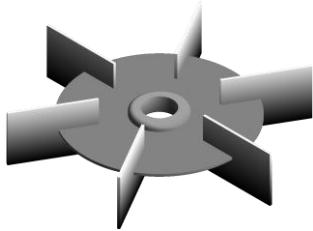
Propeller



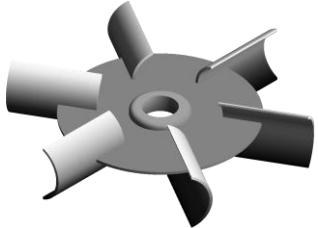
Pitched Blade



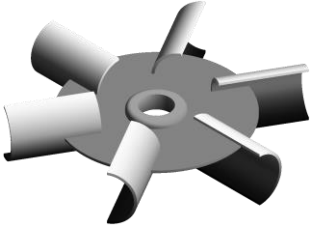
Straight Blade



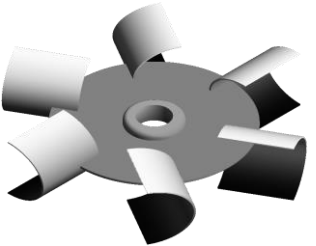
Rushton Turbine



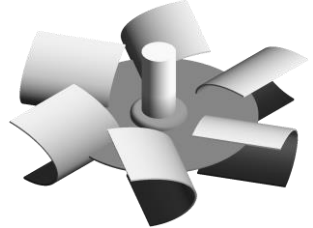
Van't Riet Turbine



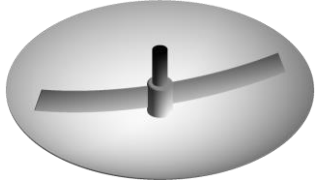
Smith Turbine



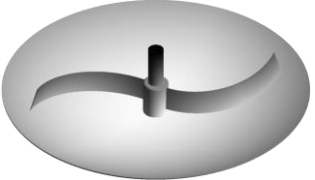
Middleton Turbine



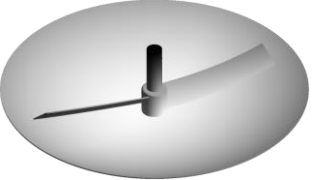
Bakker Turbine



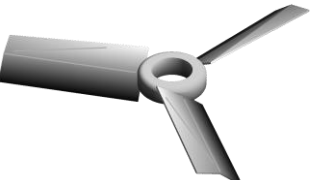
Sweeper Straight



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

FILE EDIT PROCESS DESIGN

- Open...
- Insert...
- Open Last Session
- Open Examples
- Open Verification Files...
- Save
- Save As...
- Save Active Design Only...
- Close and Start New
- Save Report...
- Save Drawing...
- Print Report...
- Print Drawing...
- Send to Browser
- Send to Excel
- Send to Word
- Send to Calc
- Send to Writer
- Send to Paint.Net
- File Info
- Exit

KaeMix Report in Excel

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		
Style	Top Entering	
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

File Info

Project Name: August 13, 2022 - Build 0023
 Location: 8/13/2022 7:50:36 PM
 Customer:
 Designer:
 Vessel Manufacturer:
 Mixer Manufacturer:
 Project Description:
 Design:
 Tag: Gas Dispersion ✓
 Comment: Turbine + 2 Up Pumping Impellers

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

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)

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
 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: ✓

END