

KaeMix Overview

www.kaemixllc.com

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KaeMix FAQ

- **What is it?**

Software to design and evaluate industrial fluid mixing vessels

- **Where does it come from?**

Developed by Dr. Andre Bakker at KaeMix LLC, a well-known fluid dynamics expert

- **Who is it for?**

Process engineers to design new mixing systems, improve existing systems, and to evaluate proposed designs

- **What can it do?**

Performance prediction for single-phase and multiphase stirred reactors

- **What is it based on?**

Literature data and published correlations

- **Does it fit in my workflow?**

KaeMix complements your CAD and CFD software. In fact, by performing your mixer designs with KaeMix, you can save on CFD analyses because you will need fewer of them

- **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?**

Commercial companies: purchase full version from KaeMix LLC

Students and academics: free KaeMix Student (reduced feature set)

- **What does the full version have that KaeMix Student does not?**

Many additional impeller styles (glass lined, dispersers, viscous, counterflow, specialty), mechanical shaft design, easy design comparison mode, heat transfer, oxygen transfer, liquid dispersion, horizontal cylindrical vessels, conical and multilevel vessels, multiple drives and shafts, side entering impellers, additional sparger and baffle styles, draft tubes, stage dividers

How does it look?

KaeMix

FILE SEND 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 Mechanical Impellers Baffles Solids Particles Gas Flow Sparger Drawing Results Compare Report Loads Blending Suspension Gas Dispersion HT Rate Power Dimens

Impellers Edit Sets 1-4 Edit Sets 5-8

Connected To: Main Drive, Main Drive, Drive 2, Main Drive

Style: Viscous, General, Dispersers, Viscous

Type: Helical-Anchor, HFoil-Narrow, High Shear, Auger

Pump Direction: Up, Down

Diameter (m): 0.4618, 0.3078

Blade Width (m): 0.1463, 0.0031

Number of Blades: 2, 6, 1, 20

Blade Angle (degrees): 23.526, 1.77, 0.2309

Number of Impellers: 1, 1, 1, 1

First Bottom Clearance (m): 0.061, 0.3058

Last Bottom Clearance (m): 0.061, 0.3058

Note:

Diameter / Tank Ratio (D/T): 0.96

Clearance / Tank Ratio (C/T): 0.04

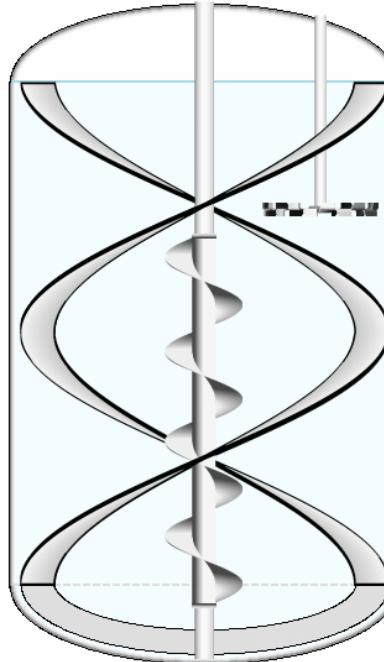
Blade Width Ratio (W/D): 0.1

Blade Pitch / Diameter (P/D): 1.368

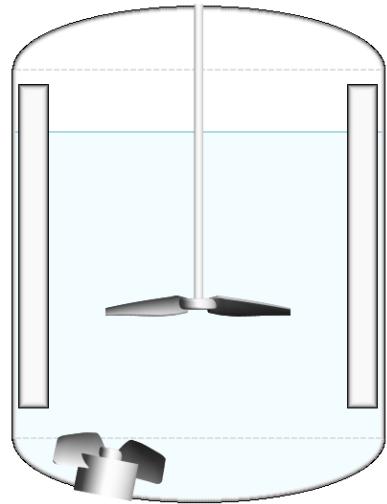
Design 2/16 Duplicate New Delete Move: Top Up Down Bottom Sort: RPM: 6 Tag: Helical Comment:

ID	Vessel	T (m)	Z (m)	V _t (m ³)	Bottom	Top	Impeller	RPM	P (kW)	Motor (kW)	Load (%)	Blend Time	N/N _s	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				Default design
2	Cylindrical	1.52	2.31	4.0193	Ellipse	Ellipse	HS	6.0	14.57	30.0	49%	00:25:59	2.5/10				Helical
3	Cylindrical	2.03	2.84	8.7836	Ellipse	Ellipse	SWPS	72.0	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	120.0	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	78.0	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	120.0	10.4	16.0	65%	00:01:09	4.3/10				Side Entering

Liquid Blending. M-Scale: 2.5/10. Laminar. Blendtime: 00:25:59 h:m:s.



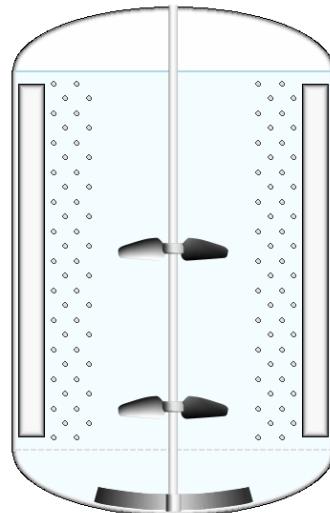
Design Examples



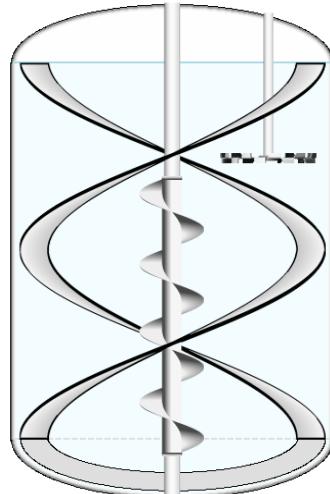
Magnetic impeller and hydrofoil



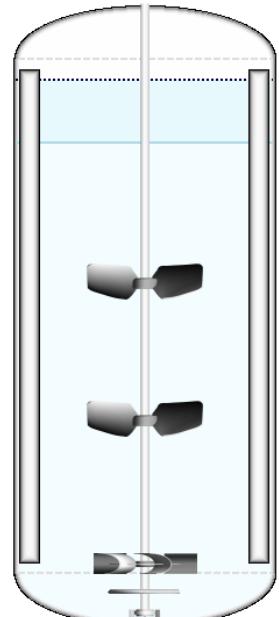
Multiple hydrofoils



Hydrofoils, a sweper, and helical coils



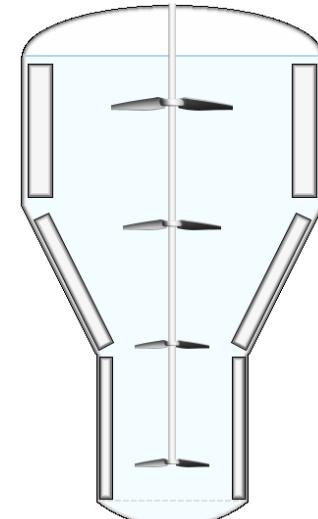
Two shafts, helical ribbon, auger, and disperser



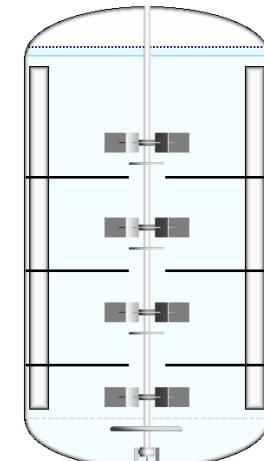
Hydrofoils, a disk turbine, and gas sparger



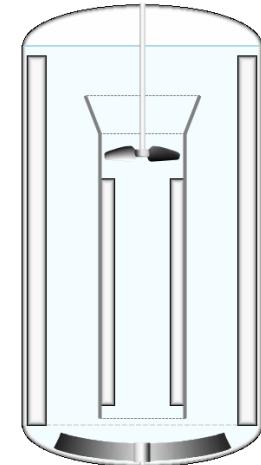
Two side entering impellers in rectangular vessel, angled bottom



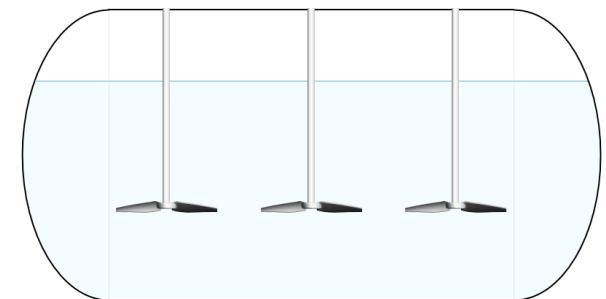
Multilevel vessel



Multiple stages, impellers, and spargers



Hydrofoil, a sweper, and draft tube

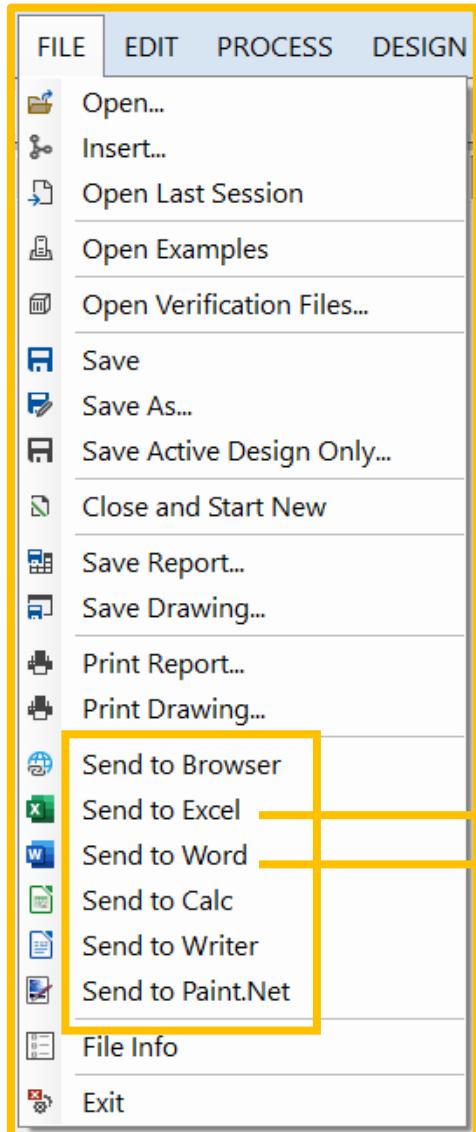


Horizontal cylindrical vessel with multiple shafts and impellers

Physics

- **General:** flow regime, dimensionless numbers, torque, power draw, flow rate, blend times, heat transfer, cavern size, surface vortex depth, turbulence details, etc.
- **Materials:** built-in properties for common liquids and gases, Newtonian, power law, yield stress fluids
- **Mechanical:** shaft moments and stresses, critical speed, sparger pressure drop
- **Gas dispersion:** dispersion regime, gas holdup, mass transfer
- **Solids suspension:** just suspended speed, settled solids, cloud height, floating solids, solid-liquid mass transfer, dissolving time
- **Liquid dispersion:** droplet size, dispersion time
- **Scale-up criteria:** blend time, M-Scale, Fr, Re, 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



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

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)

KaeMix Report in Excel

File Info

KaeMix™
August 13, 2022 - Build 0023
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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
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Bottom Pressure	1.306	Atm
Flow Rate		(m ³ /s)
Residence Time		(h:m:s)

Application

Industry: Fermentation
Application: Pharmaceuticals
Process: Aerobic fermentations, e.g. penicillins, streptococci, vitamins, etc. Scale-up from previous experience
in stirred tank 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.
Notes: Liquid flows Batch System
Gas: ✓
Dispersion: X
Solid: X
Suspension: X
Heat: X
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	(m ³)

Drives

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

KaeMix Report in Word

Available Equipment Styles

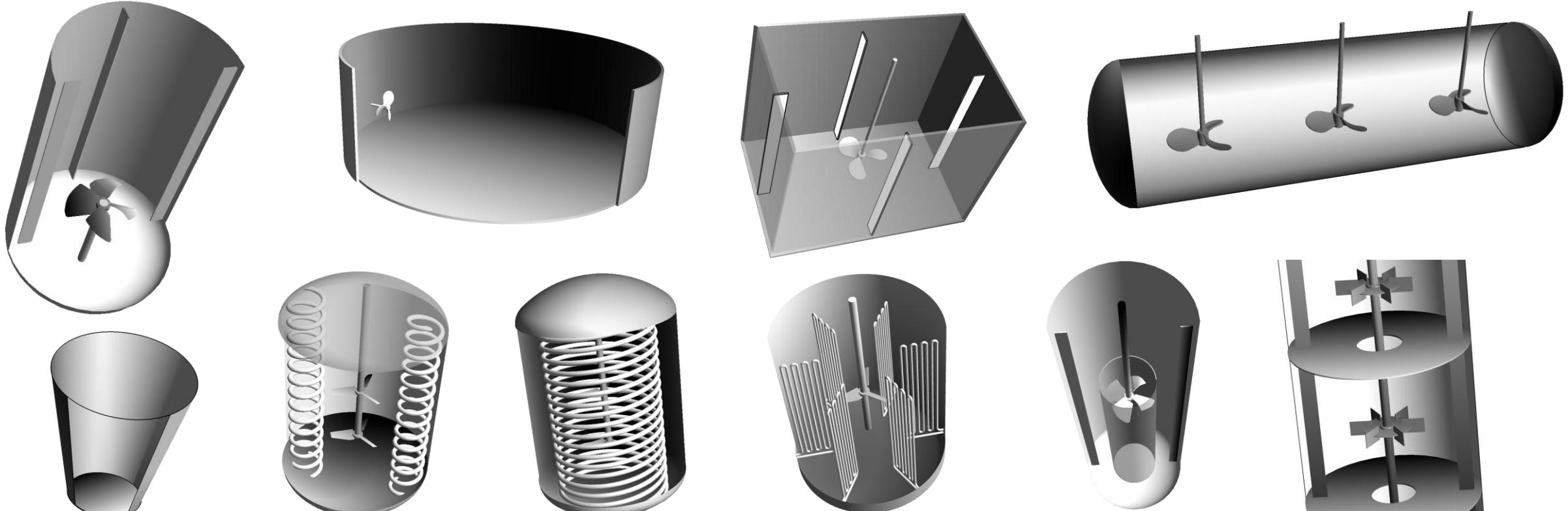
Vessels, baffles, gas spargers, impellers

Vessels

Vessel styles: cylindrical, rectangular, horizontal, conical, multi-level

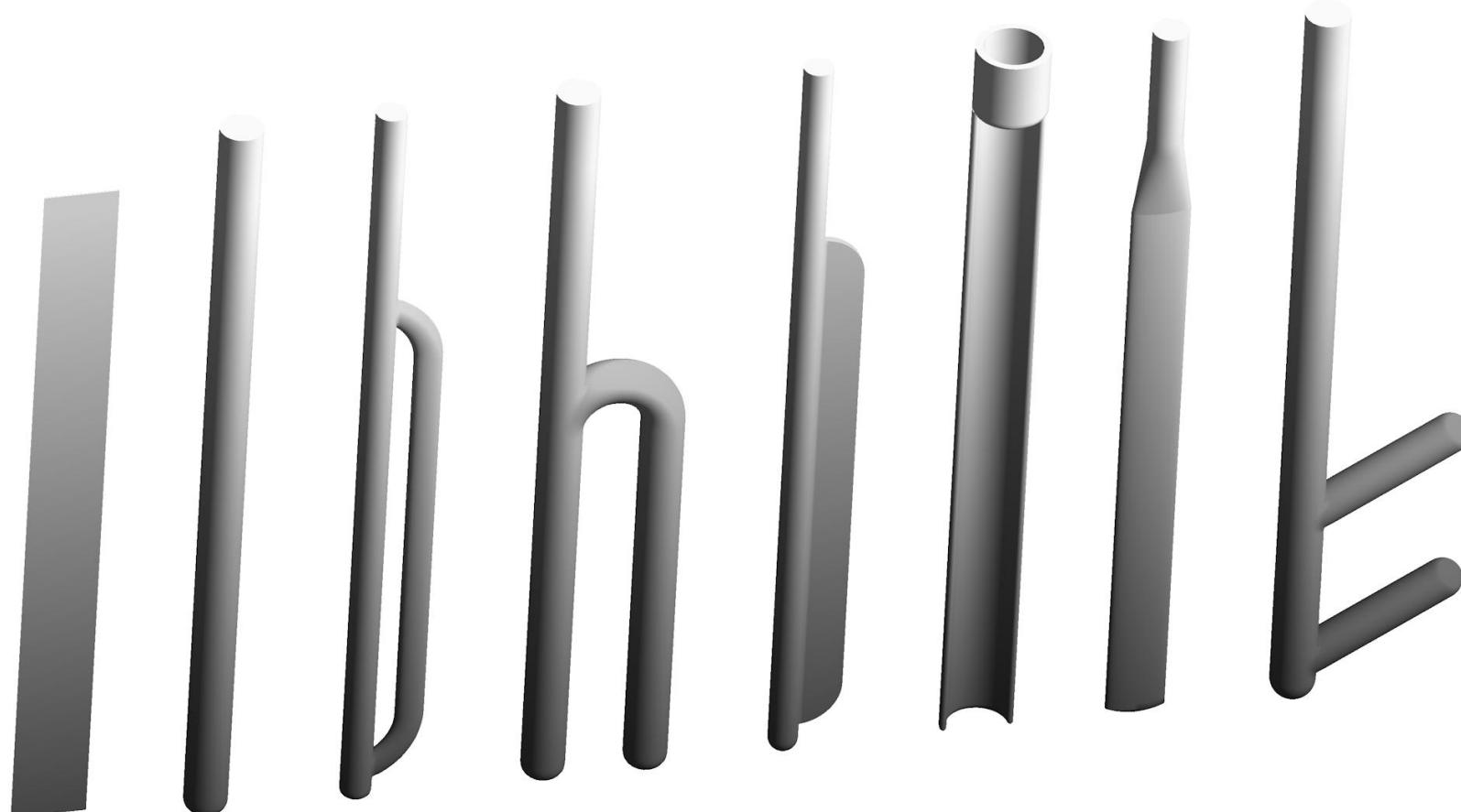
Bottom and head styles: flat, dish, elliptical, angled, conical, ASME, DIN

Internals: baffles, spargers, heat exchangers, draft tubes, stage dividers



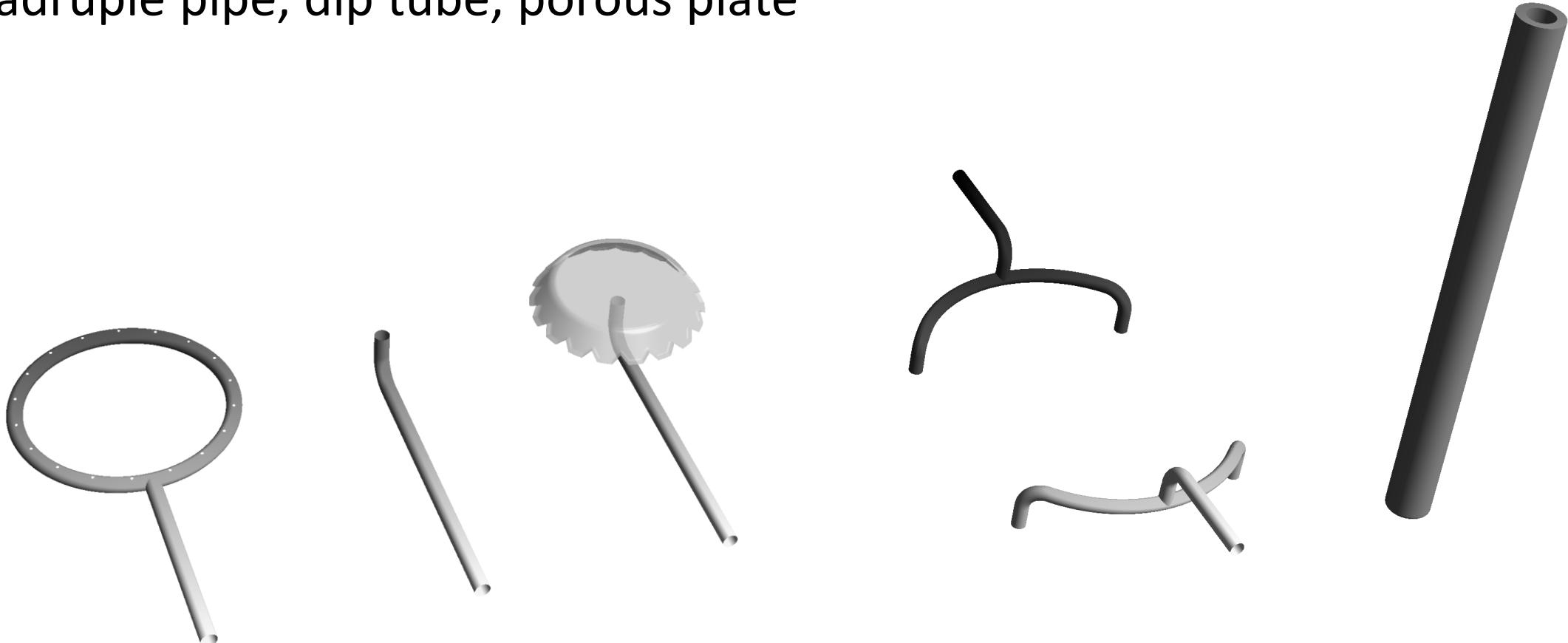
Baffles

Available styles: flat, pipe / dip tube, D-style, h-style, fin, concave / C-style, flattened pipe / beavertail, finger baffle (2, 3, 4 fingers)



Gas Spargers

Available styles: ring, pipe, pipe with bottle cap, quadruple pipe, dip tube, porous plate

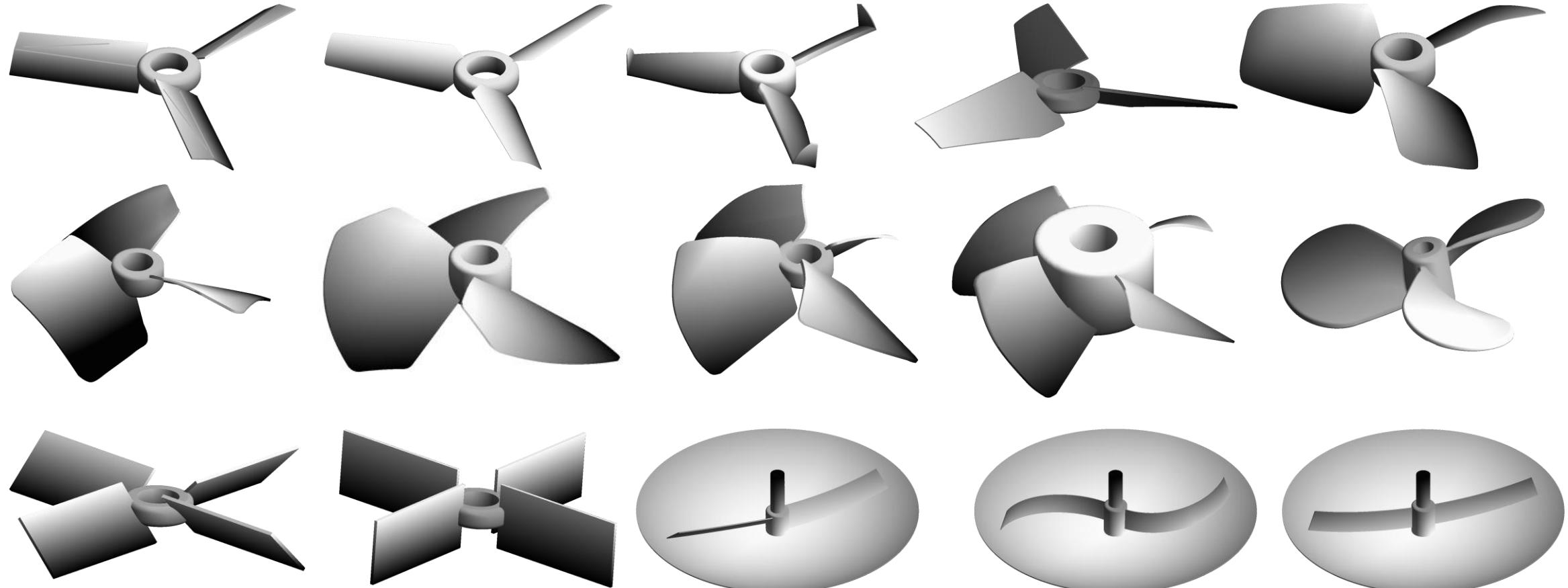


Impeller Types

- **General:** High-Efficiency, Hydrofoil (Narrow, Intermediate, Wing Tip, Medium, Wide, MaxFlo, X-Wide Blade), Pitched Blade, Propeller, Straight Blade, Sweeper (Curved, Pitched, Vertical Blade)
- **Disk Turbine:** Van't Riet, Smith, Middleton, Bakker, Conical Disk, Full Disk, Vertical Curve, Rushton, Rushton 45°, Rushton 60°
- **Glass Lined:** Angled, Concave, Curved, Disk, Hydrofoil, Opti Blades, Retreat Curve, Ring, Pitched and Vertical Blades
- **Viscous:** Anchor, Auger, Frame, Gate, Helical Ribbon, ParaFlow
- **Dispersers:** Bar Turbine, Cowles, Dissolver, High Shear, Solids Breaker, Rotor-Stator
- **Counterflow:** Mig, InterMig, Wide, JT
- **Specialty:** Magnetic, Aerator Disk, Aerator Pitched, Antiragging, Banana Blade, Brumagin, Clean Edge, Combi Blade, Cup Blade, Curved Blade, Deep Concave, Elephant Ear, Foam Breaker, Gas Inducer, Long Blade, LowVisc, MaxBlend, PBT Stabilizer, Open PBT, Open SBT, Ring Blade, Pumper Curved, Pumper Straight, Spiral Spring, U-Z Blades

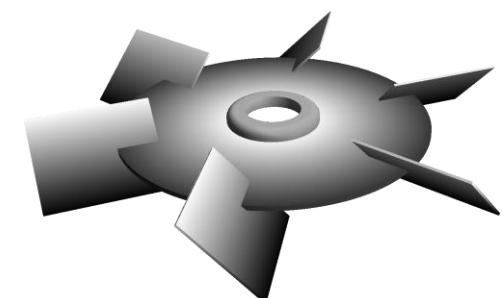
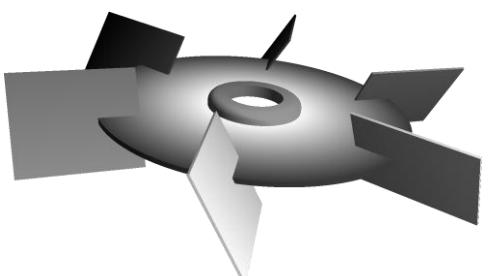
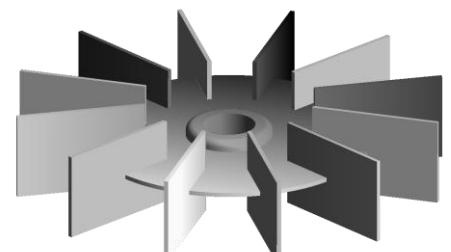
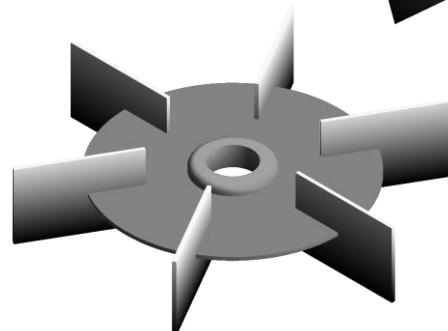
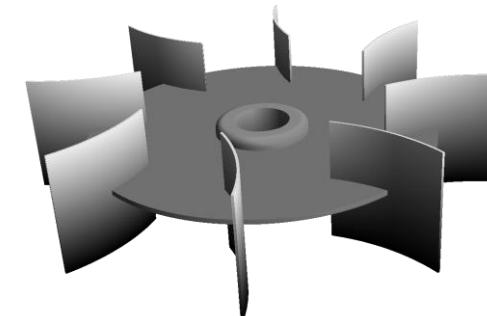
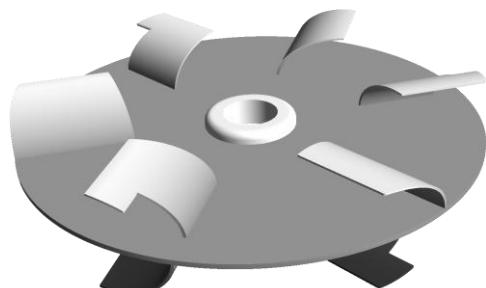
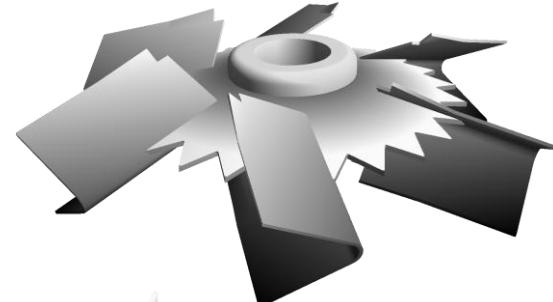
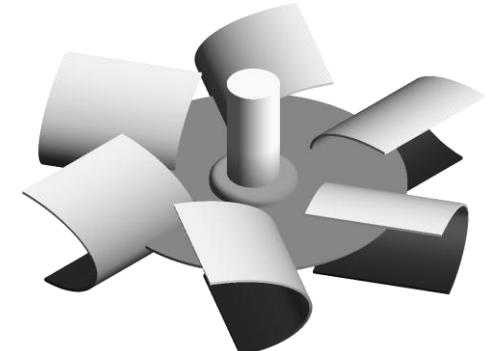
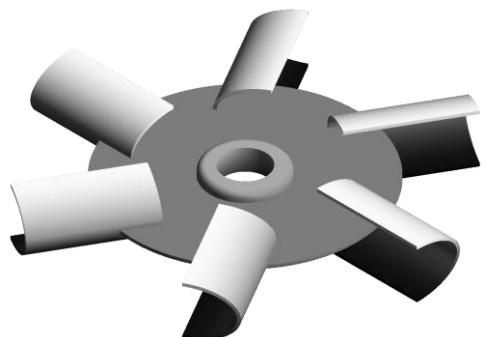
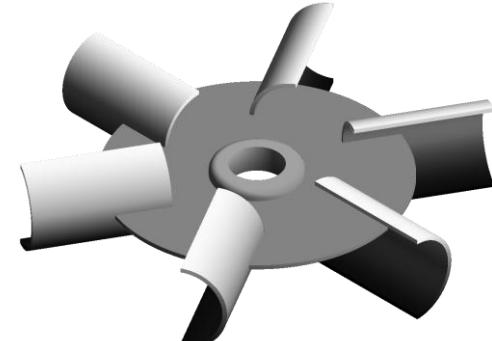
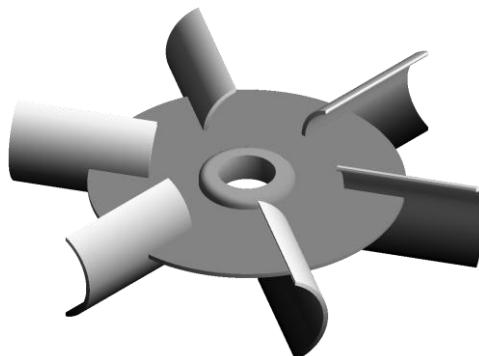
General

General: High-Efficiency, Hydrofoil (Narrow, Wing Tip, Intermediate, Medium, Wide, X-Wide, MaxFlo, and Wide Hub), Propeller, Pitched Blade, Straight Blade, Sweeper (Curved, Pitched, Vertical Blade)



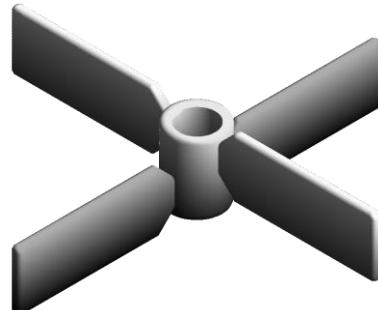
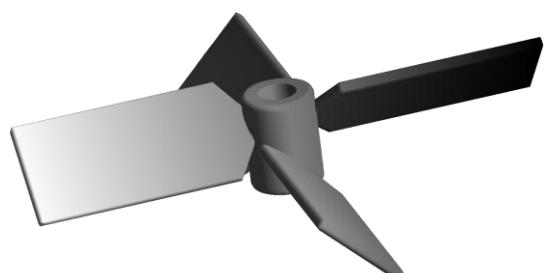
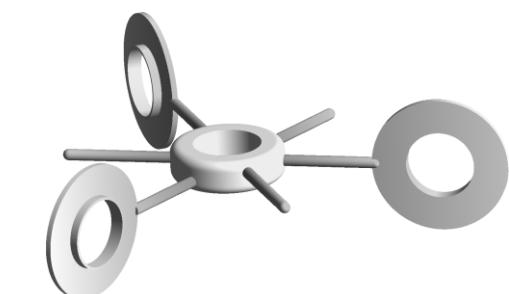
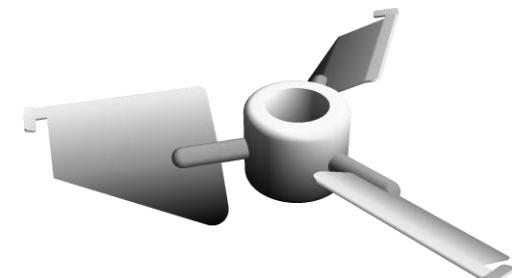
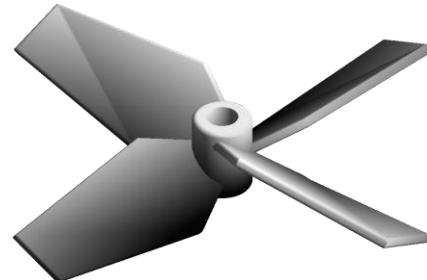
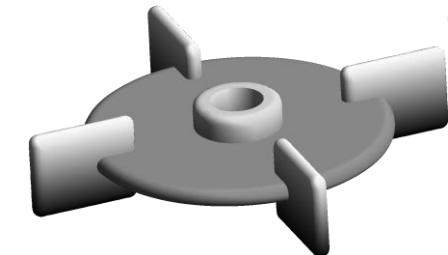
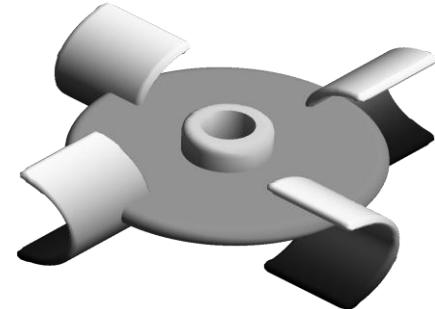
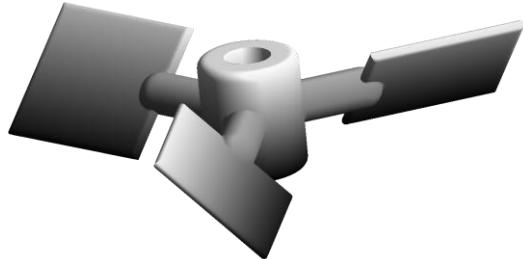
Disk Turbine

Disk Turbine: Van't Riet, Smith, Middleton, Bakker, Conical Disk, Full Disk, Vertical Blade Curve, Rushton, Rushton 45°, Rushton 60°



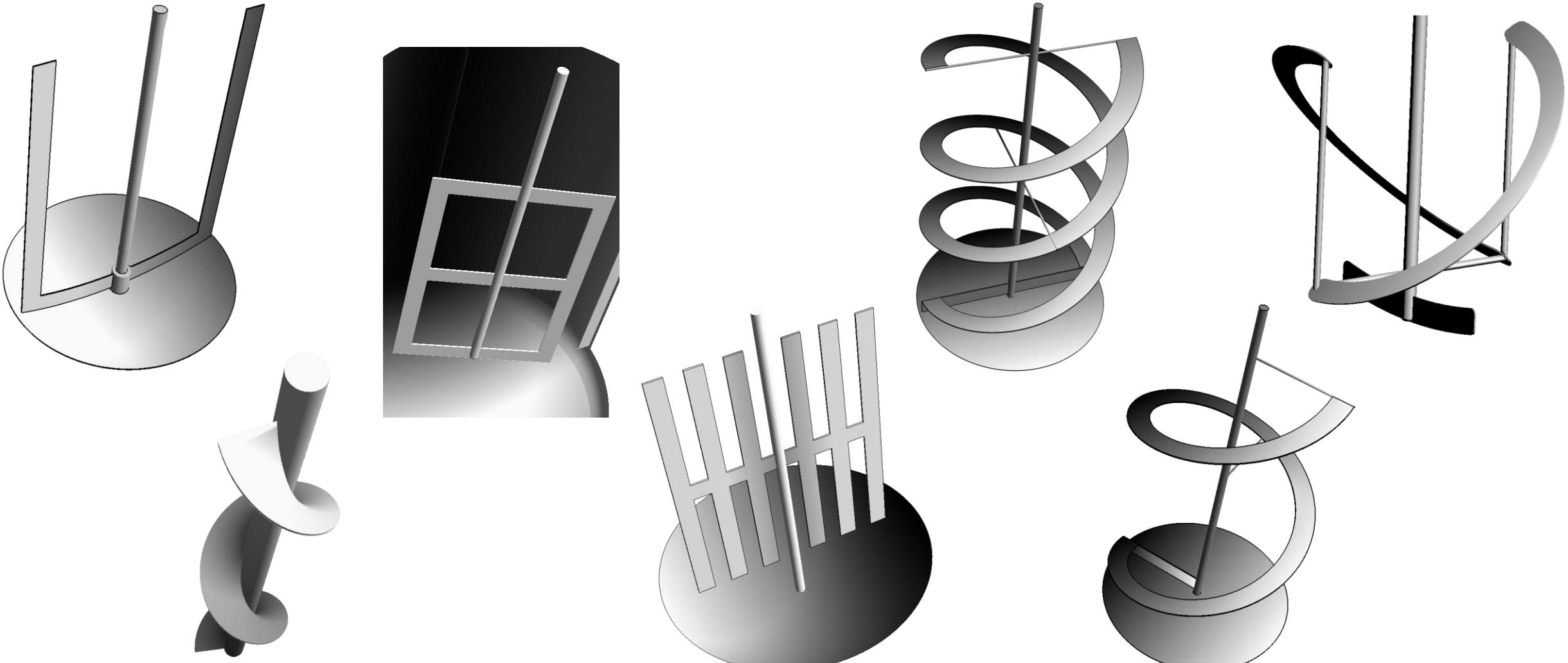
Glass Lined

- **Glass Lined:** Angled, Concave, Curved, Disk, Hydrofoil, Opti Blades, Retreat Curve, Ring, Pitched and Vertical Blades



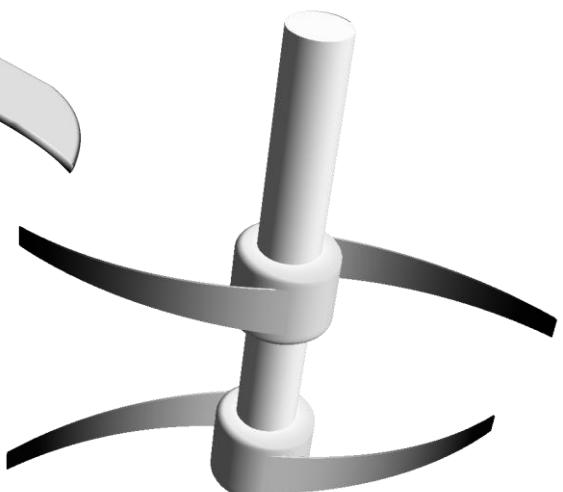
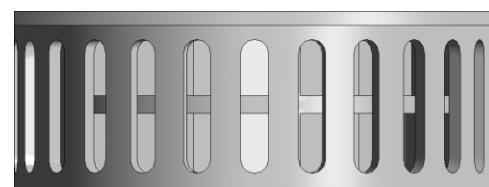
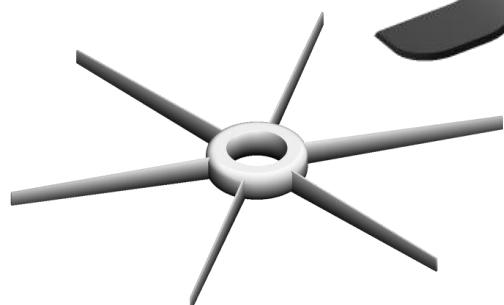
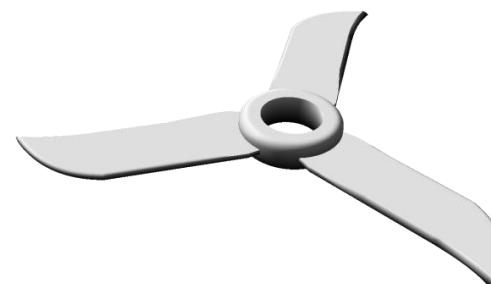
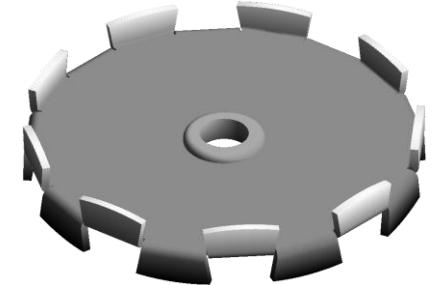
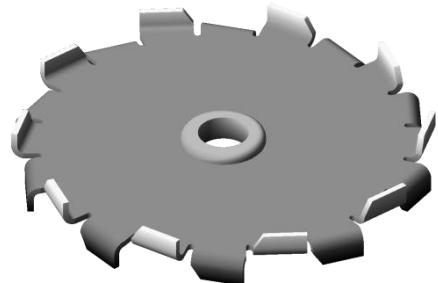
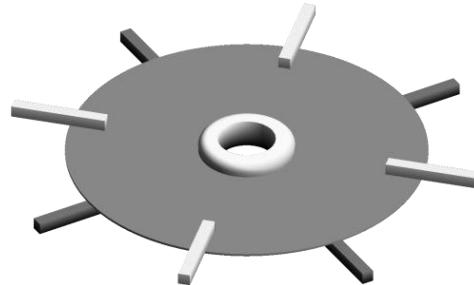
Viscous

Viscous: Anchor, Auger, Frame, Gate, Helical Ribbon, ParaFlow



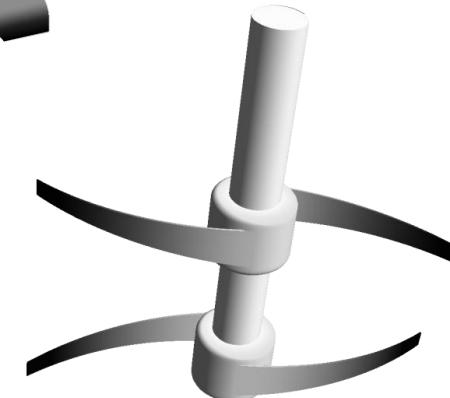
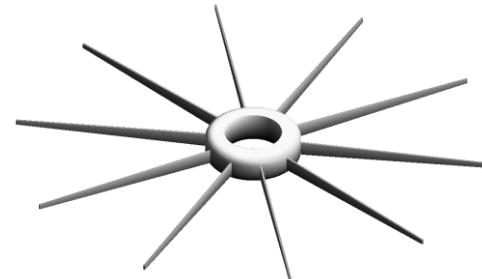
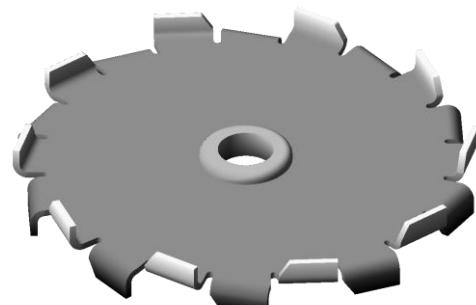
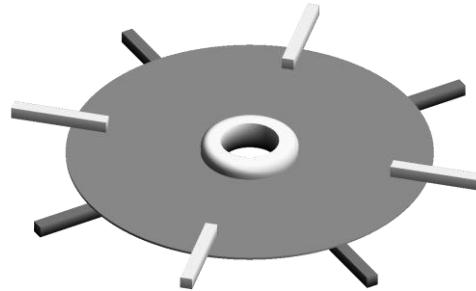
Dispersers

Dispersers: Bar Turbine, Cowles, Cowles-Wide, Dissolver, High Shear, Extractor, Extractor-Slicer, Slicer, Solids Breaker, Rotor-Stator, Colloid Mill



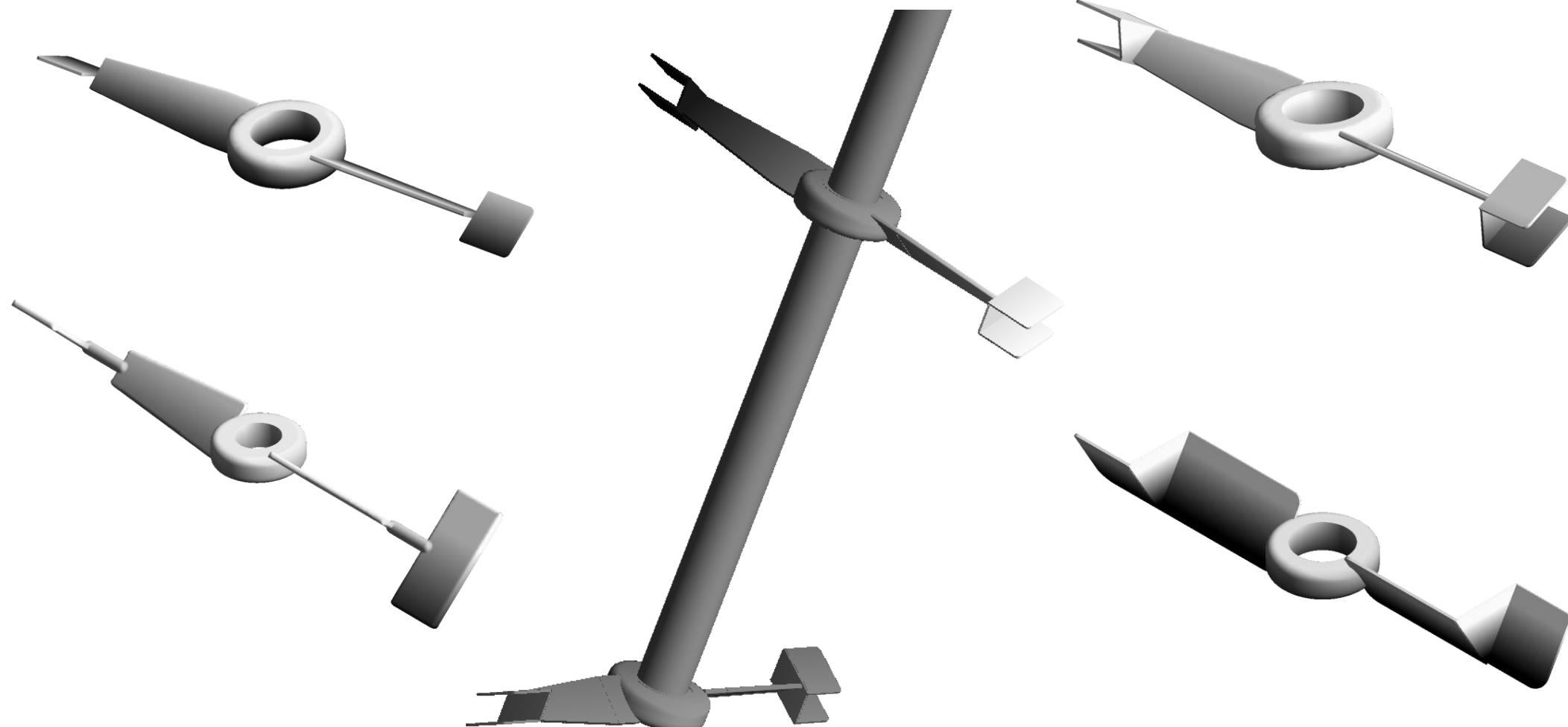
Dispersers

Dispersers: Bar Turbine, Cowles, Dissolver, High Shear, Solids Breaker, Rotor-Stator, Colloid Mill



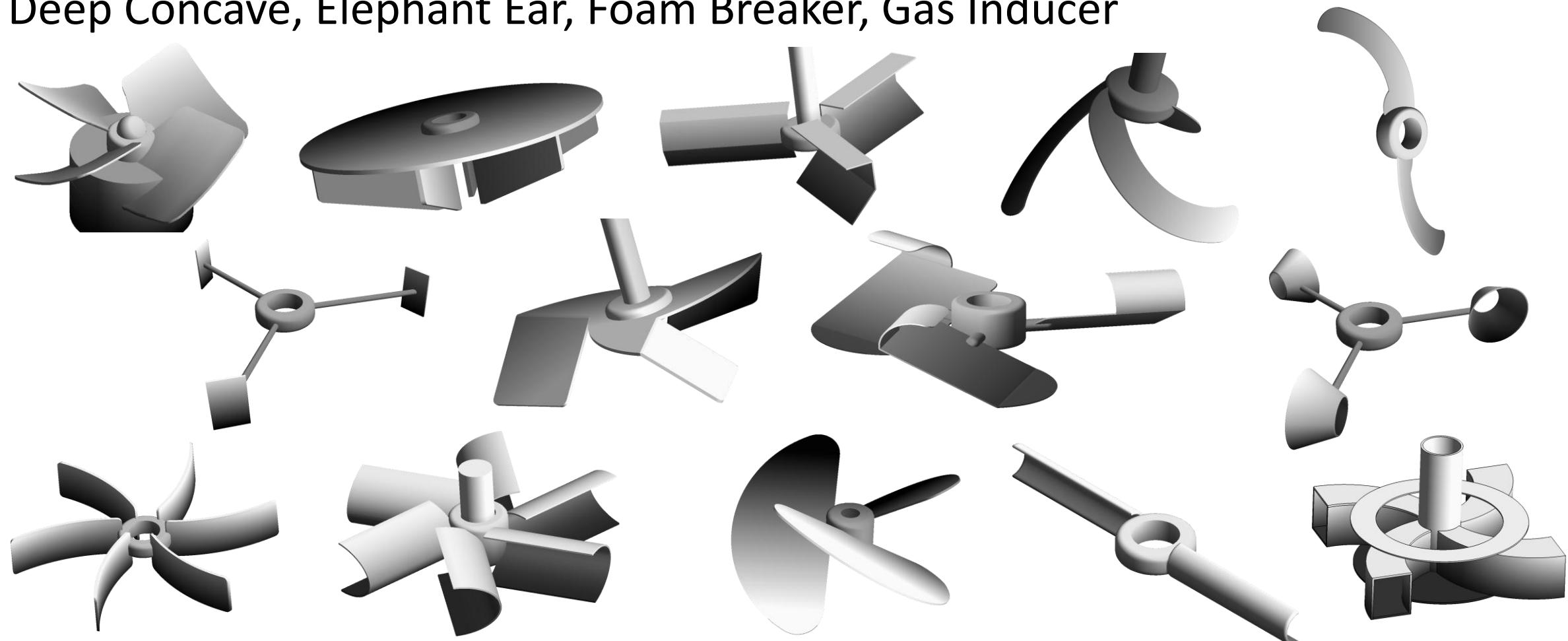
Counterflow

Counterflow: Mig, InterMig, Wide, JT



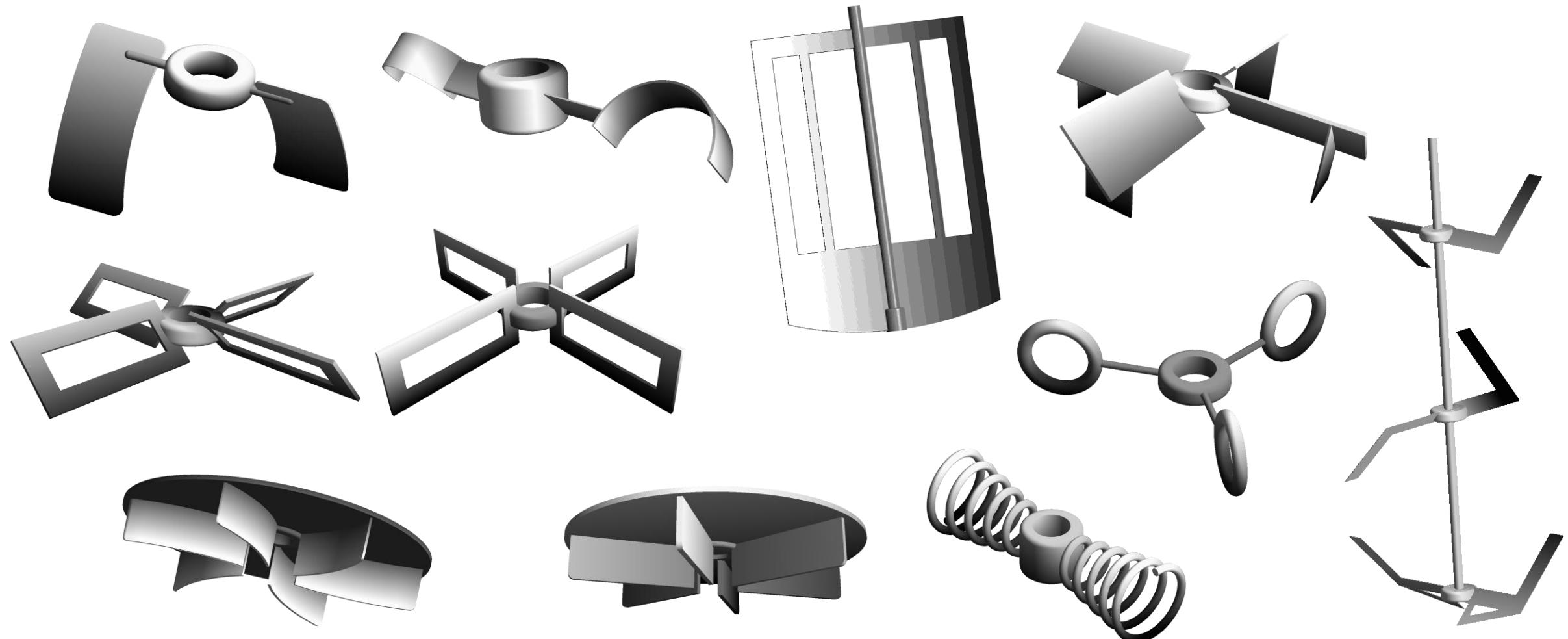
Specialty (1/2)

Specialty: Magnetic, Aerator Disk, Aerator Pitched, Antiragging, Banana Blade, Brumagin, Clean Edge, Combi Blade, Cup Blade, Curved Blade, Deep Concave, Elephant Ear, Foam Breaker, Gas Inducer



Specialty (2/2)

Specialty: Long Blade, LowVisc, MaxBlend, PBT Stabilizer, Open PBT, Open SBT, Ring Blade, Pumper Curved, Pumper Straight, Spiral Spring, U-Z Blades



END