

Modern Dispersion Technology

A Primer in Dispersers



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Basics of Operation

Impeller Rotation is Clockwise:

In most cases, the blade tooth will have a defined “leading edge” that will contact the product first in a clockwise rotation. The majority of impellers will have a rotation arrow on them that can be viewed from the top of the tank.

Keep Machine Off Until Blade Is Below Liquid Level

The disperser should remain off while the initial liquid is added until the blade is below the liquid level. If the blade is turning while the liquid level is allowed to come “up” to the blade, it will skip, vibrate and possibly damage the blade, shaft or bearings.

Always Start And Stop At Low Speed

In addition to being a good safety habit, this will help your belts and bearings last longer.

Increase The Speed As The Level And Viscosity Increase:

Once the level is above the blade, and the disperser is running at a low speed, the speed should be increased slowly as materials are added or until the desired RPM is reached.

How Does The Impeller Work?

1. At dispersion speeds (4,000 - 6,000 fpm) the impeller imparts high velocity to the material. See Figure 1.

$$\text{RPM} \times .262 \times \text{blade diameter (in inches)} = \text{fpm}$$

2. The high velocity creates a turbulent zone of intense flow. See figure 2. Rapid hydraulic attrition is accomplished in this zone, utilizing shear and impact energy. This turbulent zone is normally within 1-2" of the blade diameter, and 75% of the kinetic energy is applied within this zone. The vortex should end where the shaft meets the blade.

Figure 1: Imparts High Velocity to Material

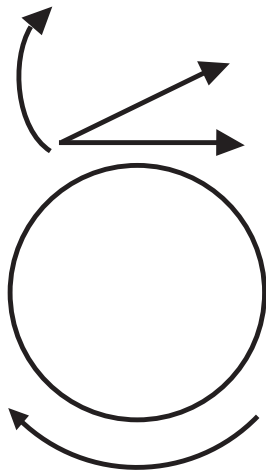


Figure 2: Creates Intense "Turbulent Zone"

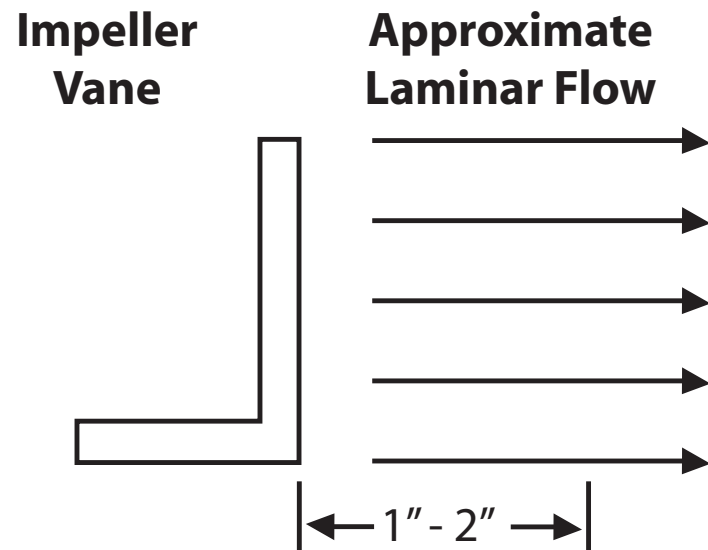


Figure 3: Concentrates energy close to impeller

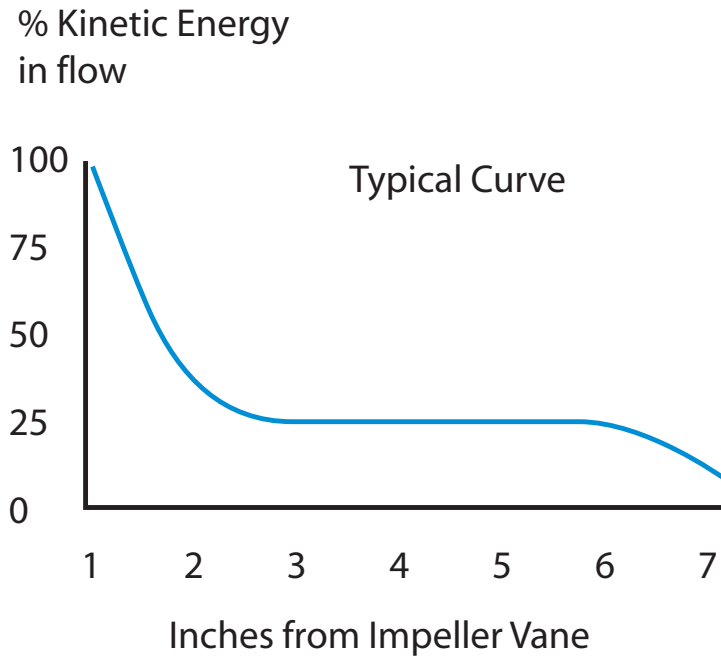


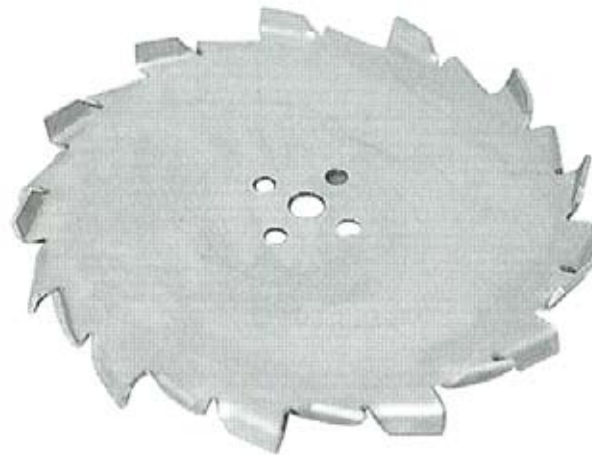
Figure 4: Causes laminar flow for "total motion"



1. Beyond the turbulent zone, the movement becomes laminar. This flow divides at the vessel wall, assuring complete circulation of the entire batch. Turbulence does not interrupt flow pattern. The laminar flow is what causes the vortex seen in the process. See Figure 4.

Various Blade Tooth Configurations

1. **High Shear** blades are the most common tooth design of the past 40+ years and are appropriate for most mixing and dispersing applications. Because of its leading edge, it is the most efficient tooth configuration for good, rapid dispersions. Several manufacturers produce a variety of designs.
 - 304 SS, 316 SS, Chrome Plated and Tungsten Carbide Coated
 - Easily Removed from Shafts
 - Self Cleaning, Non-clogging Design
 - Sizes from 2" to 36" Diameter
 - Standard and Custom Drill Patterns to Fit All Equipment (see page 22)

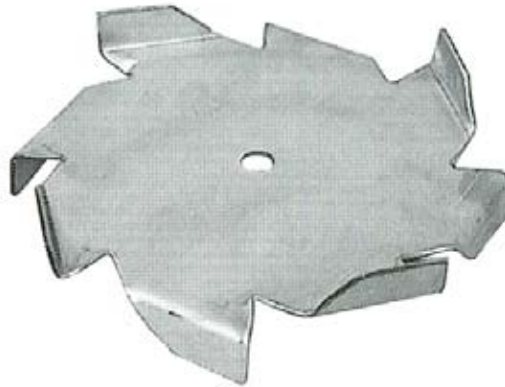


2. The **Poly-peller** is one of the few non-metal blades on the market today. Designed for abrasive dispersing applications, it is proven to last many times longer than metal blades. This blade can be installed with either side up.
- Up to 10 times longer life than standard stainless blades
 - Can be flipped to increase life
 - Easily removed from shafts
 - Self Cleaning, non-clogging and spark-free operation
 - Sizes from 2" to 36" diameter
 - Standard and Custom Drill Patterns to Fit All Equipment (see page 22)



3. **High Vane**, or pumping blades have teeth that are larger than the high shear blades. Larger teeth, cuts, bends or protrusions allow your product to move more with less shear, perfect for blending applications. This blade is an excellent choice for the intermediate range between low-speed mixing and high-speed dispersions.

- High pumping action and radial flow promote better blending, and low shear keeps the heat down
- Easily removed from shafts
- Self cleaning, non-clogging
- Sizes from 4" to 36" diameter
- Standard and custom drill patterns to fit all equipment (see page 22)



4. **Pick** blades are designed to chop, cut or break up large chunks or agglomerates. Typically, these blades are in very tough applications, and will be chrome plated or Tungsten Carbide coated.

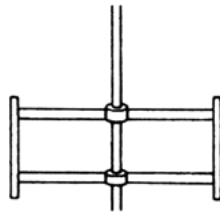
- Sharp blades are incorporated between regular vanes and extend 3/4" beyond the edge of the regular vanes.
- 304 SS, 316 SS, chrome plated and Tungsten Carbide coated
- Easily removed from shafts
- Self cleaning, non-clogging
- Sizes from 2" to 32" diameter
- Standard and custom drill patterns to fit all equipment (see page 22)



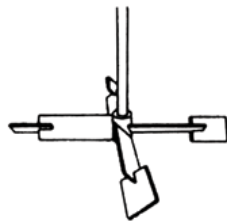
Impeller Designs

Product viscosity, vessel size and shape, horsepower, baffles and blade material all impact the optimum impeller design for application requirements. The blades below are 15 of the most widely used designs.

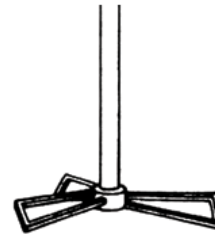
Figure 5: Impeller Designs



Gate Blade



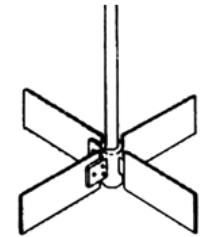
Pitched Blade



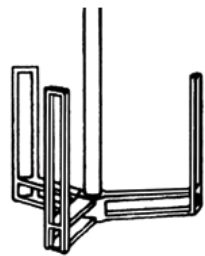
Bow



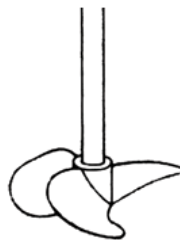
Curved Radial



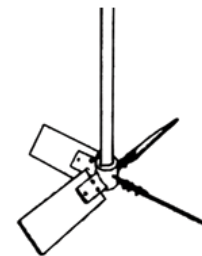
Hub Mounted



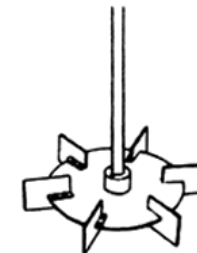
Sweep Blade



Propeller



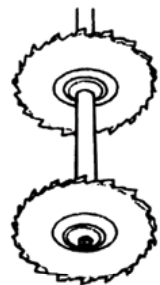
Axial Turbine



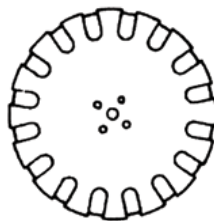
Dis-Mounted



Auger Shaft



Dual Hi-Speed



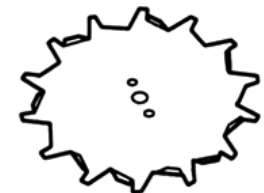
Poly Peller



Hi-Shear



Hi-Vane



Pick

Rules of Thumb

Questions for Proper Blade Selection

To help in proper blade selection, here are some questions that will help in making the appropriate recommendation:

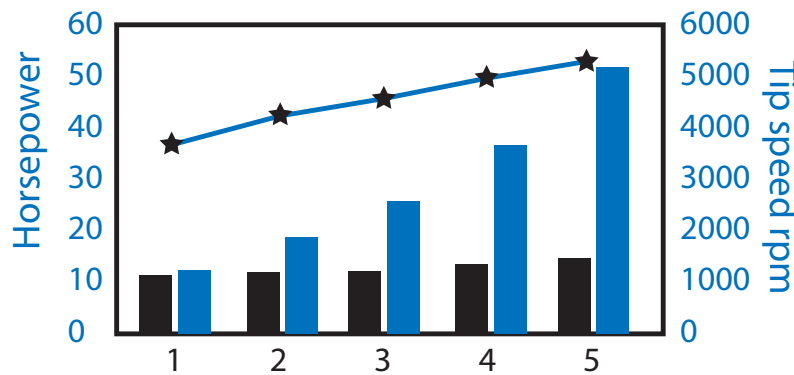
- What type of disperser is it?
- What is the motor plate data? HP____ Amps____
- What shaft rpm are you running? What is the amp reading while running? This information helps determine the HP.
- Is this a variable drive machine, and what is the speed range?
- What is the current impeller type, diameter and condition?
- What is the tank information (diameter, straight side, bottom type, etc.)?
- What is the desired outcome (mix, disperse, etc.)?
- Are there special materials of construction? (i.e. 304 SS, 316 SS, etc.)
- What is the product (viscosity, specific gravity, % solids, etc.)?

Horsepower

The standard rule of thumb for horsepower is 10 HP for every 100 gallons of product. This is a good number to use for materials under 20,000 cps. For more viscous materials, call MorehouseCowles.

Figure 6 is a 25 HP disperser with a properly designed tank for a 12" blade. The shaft speed is 1460 rpm and the product is 10,000 cps, and 1.2 g/cc². The horsepower is affected by the size of the blade as seen in Figure 6. The horsepower requirement goes down as the blade diameter increases to 13 or 14 inches, creating a greater demand than is available. To reduce the rpm would also reduce the fpm below 4,000, resulting in longer dispersion time. Typical fpm is 4,000-6,000. Figure 6 shows that the fpm fluctuates as the diameter of the blade changes.

Figure 6

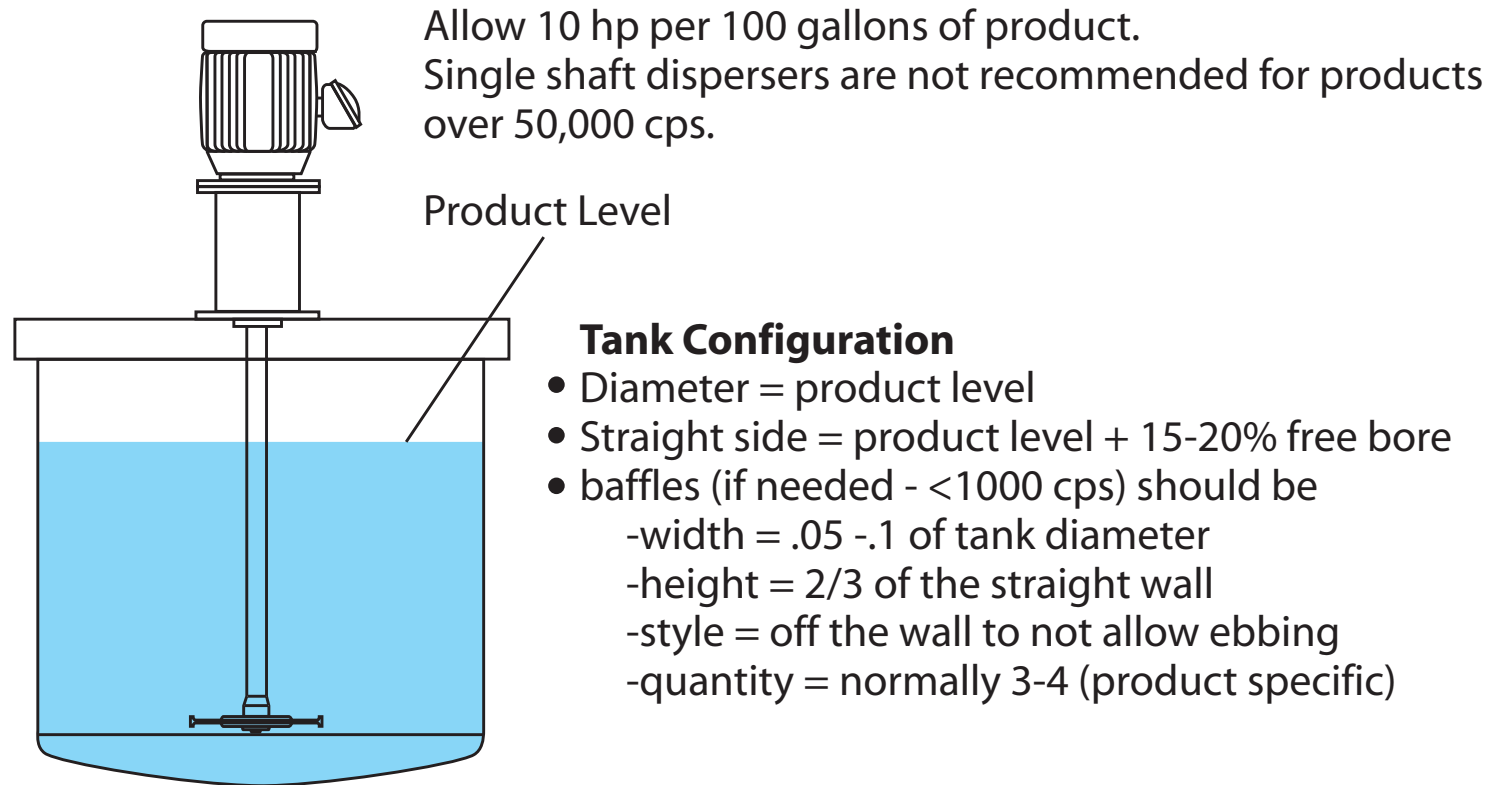


	1	2	3	4	5
■ Blade Diameter	10	11	12	13	14
■ Horsepower	12	19	25	36	52
★ Tip Speed "fpm"	3796	4176	4555	4935	5315

Tank Configuration

The product level should be equivalent to the tank diameter. The side of the tank is equal to the product level, plus 20% added for free-bore.

Figure 7: Tank Configuration



Typical blade tip speed: shaft rpm x .262 x blade diameter = fpm

Blade diameter = 1/3 tank diameter

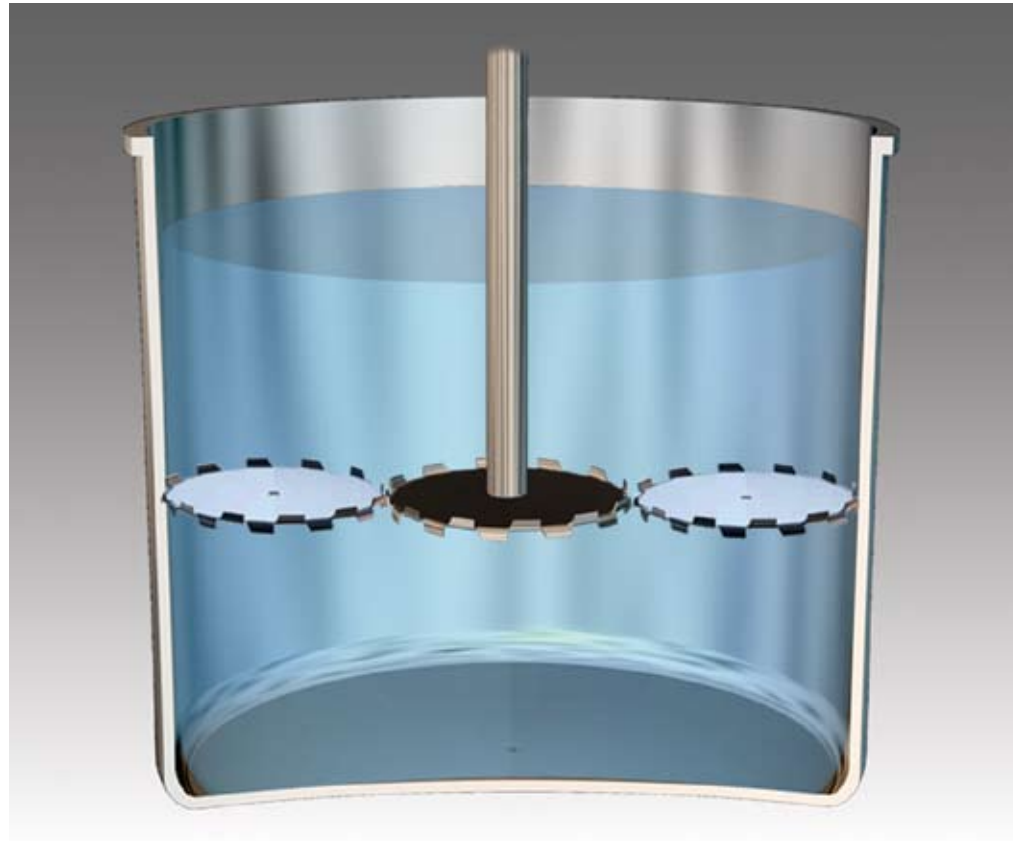
Blade position = 1 to 1 1/2 blade diameter from the bottom of the tank.

Flat bottom tanks are appropriate for 500 gallons or less.

Dish bottom tanks are best choice for larger tanks.

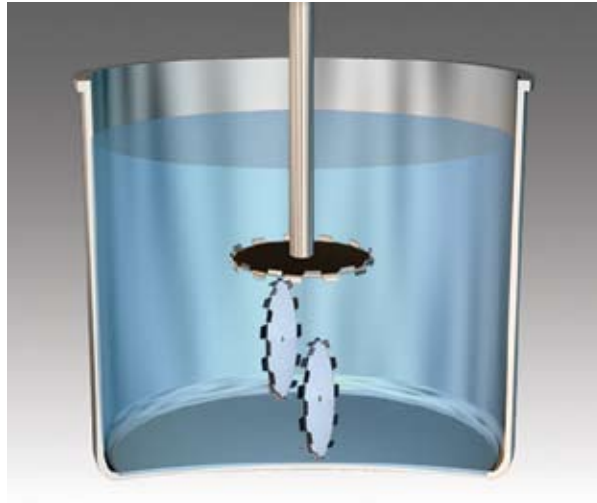
Blade Sizing

The blade diameter should equal $\frac{1}{3}$ the tank diameter to ensure good laminar flow, and to get the most efficient dispersion from the equipment.

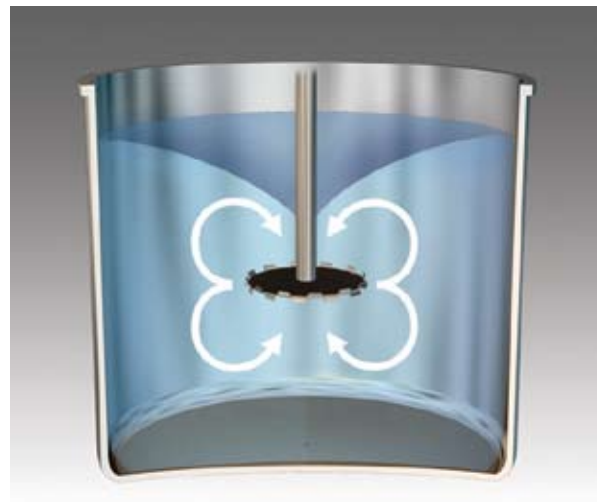


Blade Positioning

The blade should be 1 to 1.5 diameters off the bottom of the tank.



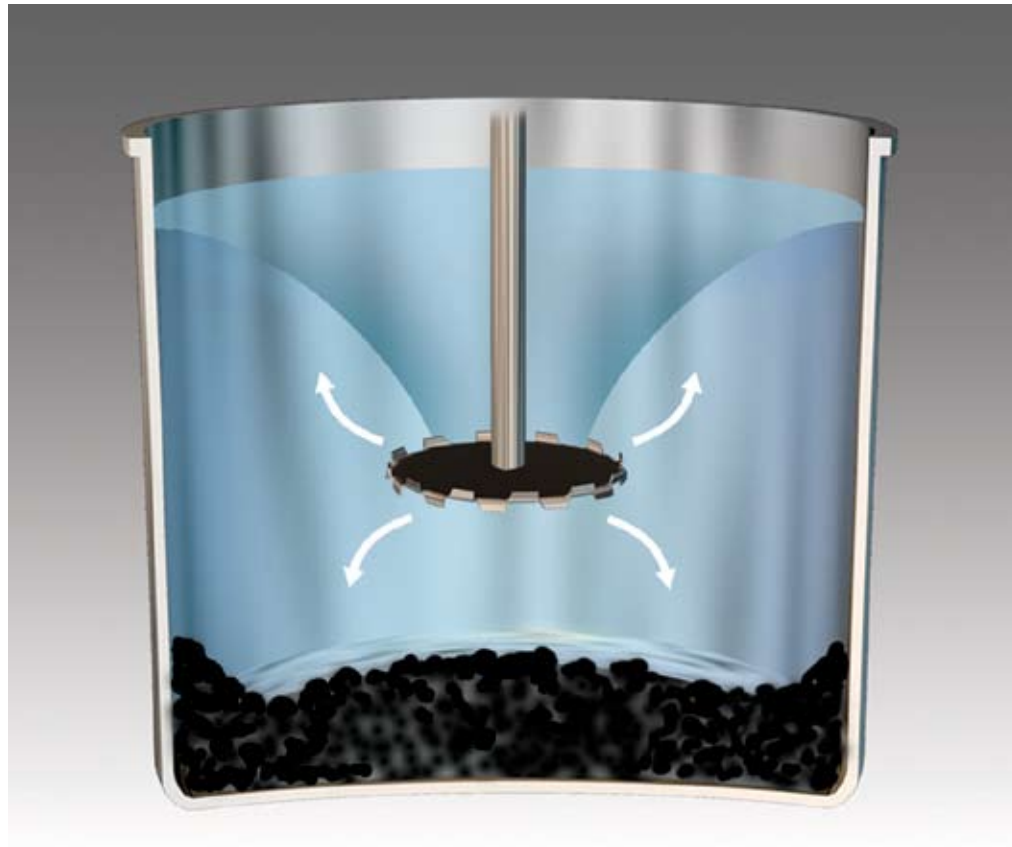
Good laminar flow will result in a good vortex.



Blade Speed

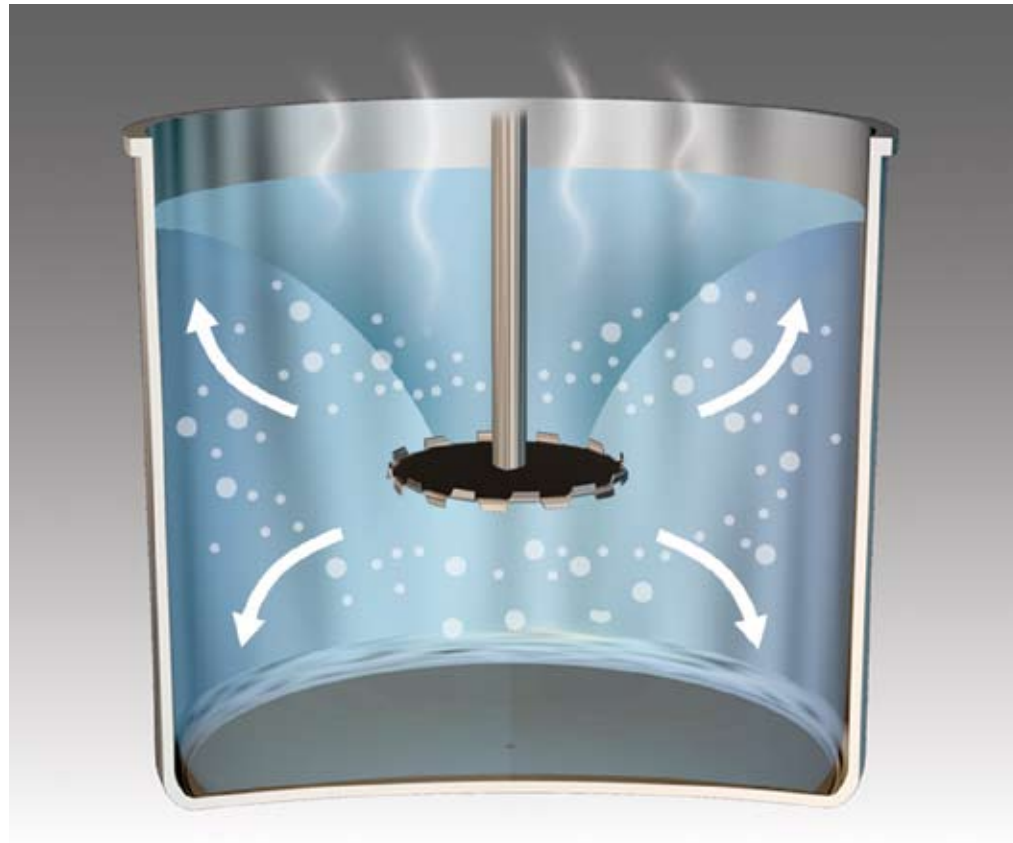
Too Slow

A blade that spins too slowly will result in long dispersion times and possibly material settling. Good dispersion speed is between 4,000 - 6,000 fpm.
Shaft rpm x .262 x blade diameter (in inches).



Too Fast

Faster is not always better regarding blade speed. Going too fast will result in air in the product, excess heat build-up and low quality dispersion.



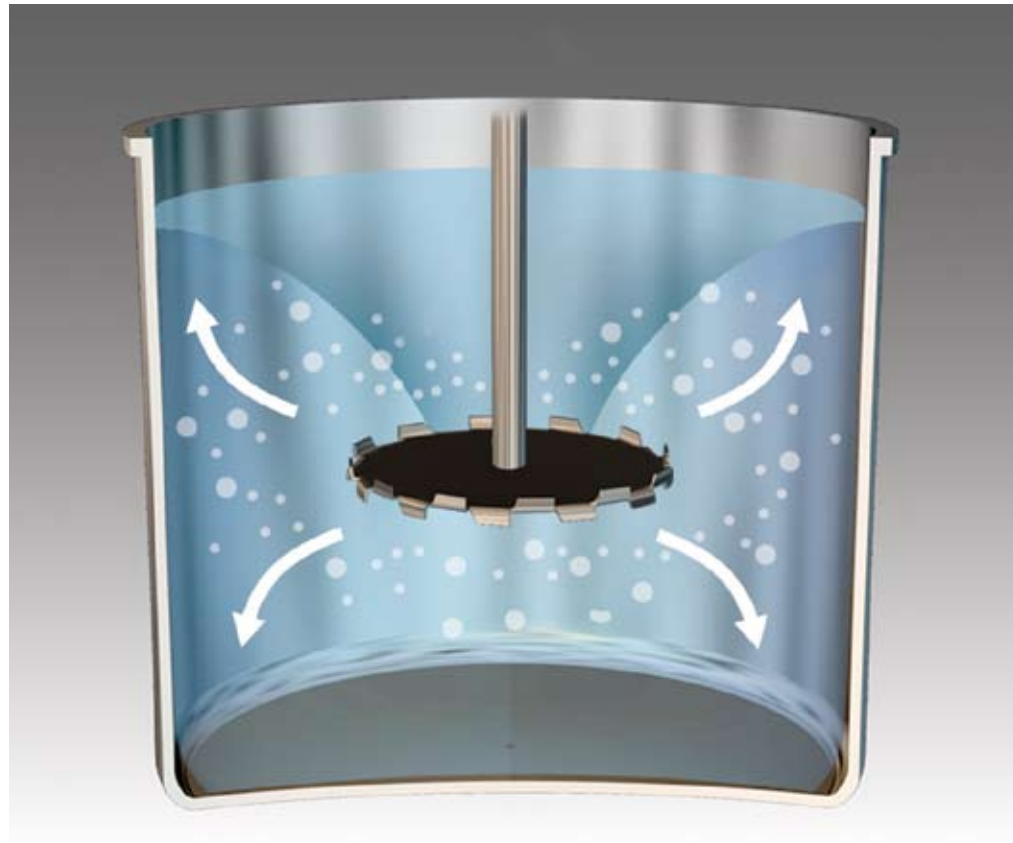
Too Small

A blade that is too small for the tank will not get good product movement and some settling of solids will occur in addition to longer dispersion times.



Too Big

A blade that is too big for the tank will not get good product movement and will put air into the product.



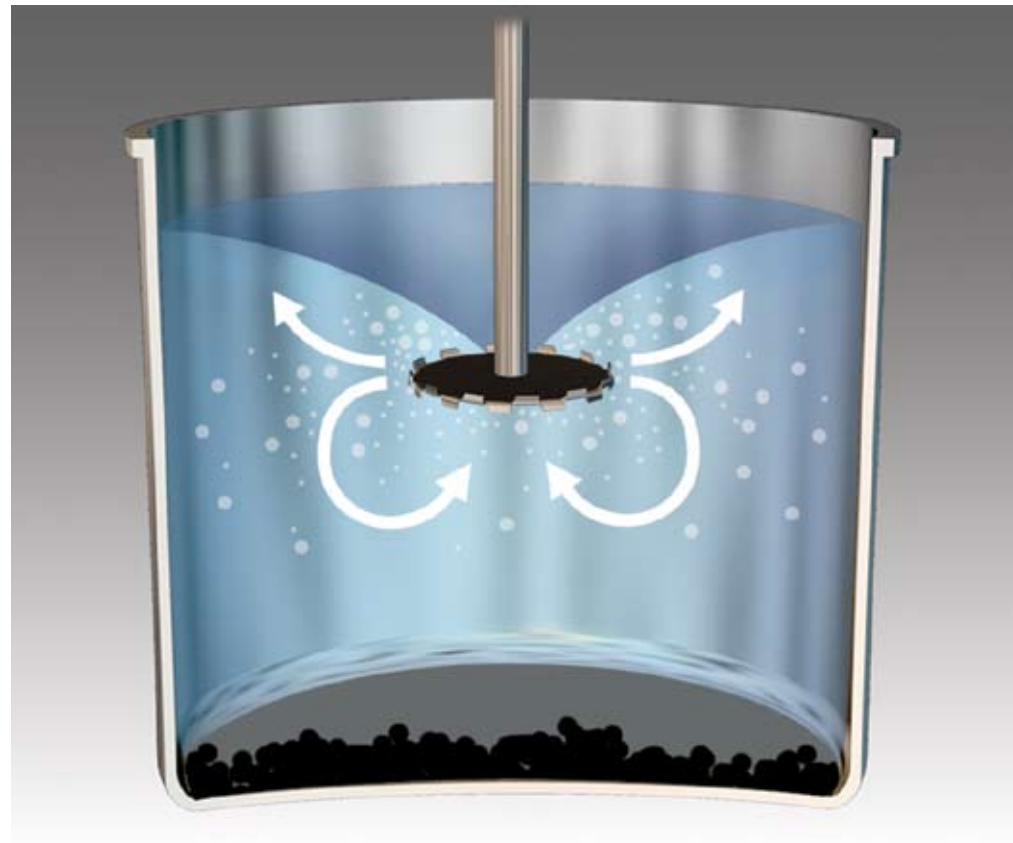
Too Low

A blade that is too low in the tank will decrease product flow and create dead spots that will not be dispersed.



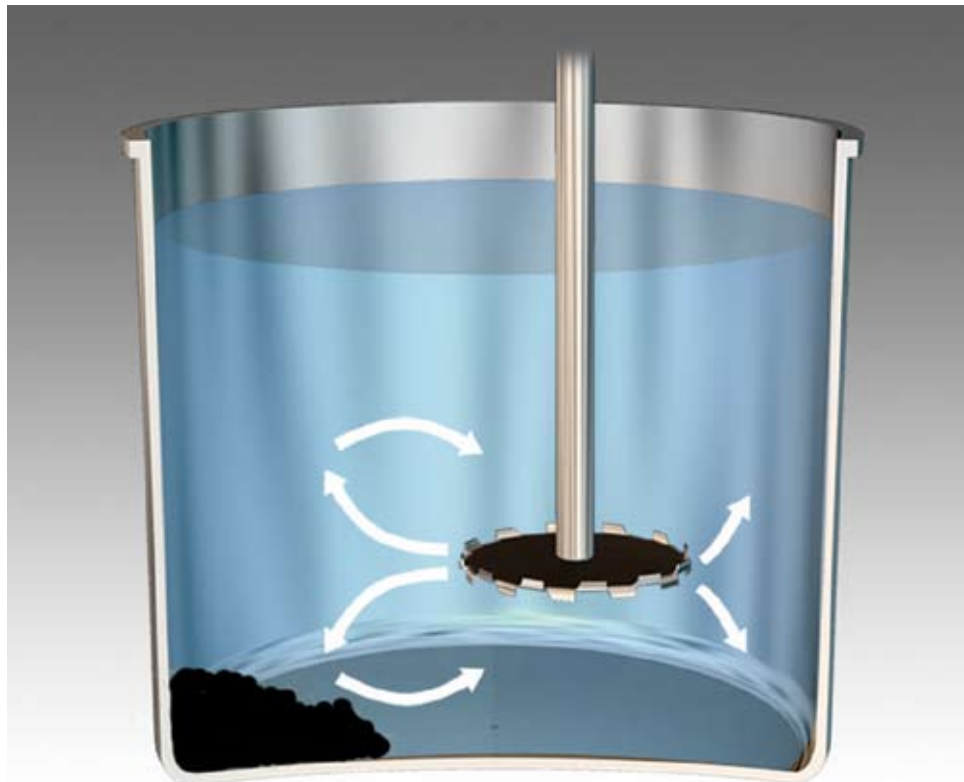
Too High

A blade that is too high in the tank will cause flow to the bottom of the tank to be decreased, and will allow some solids to settle and not get dispersed. This also introduces air into the mix.



Off Center

If the tank is too big for the disperser and the blade is off center, it is difficult to get a good dispersion, although there are times when it is advantageous to have the blade slightly off center. To minimize the vortex in the tank with a lift mounted disperser, move the blade 1/2 to 1 blade diameter off center (with the machine off).



Vortex

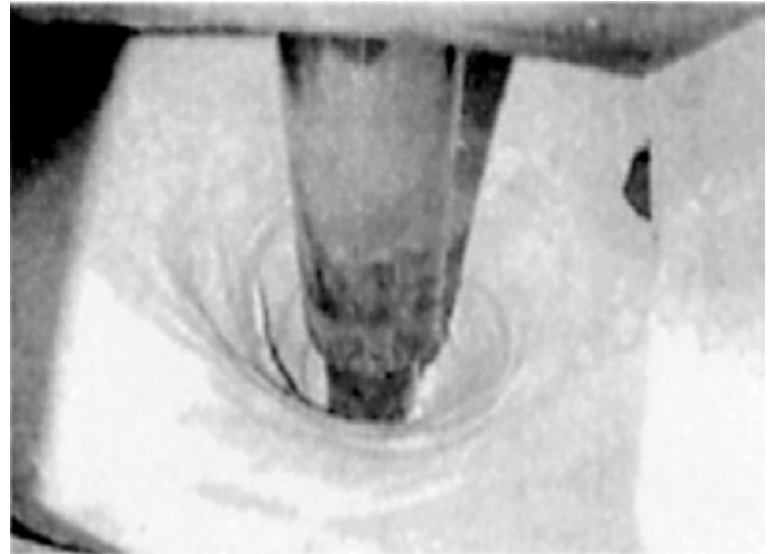
Choked Vortex

A choked vortex can be caused by poor blade position, slow speed or adding dry materials too quickly.



Good Vortex

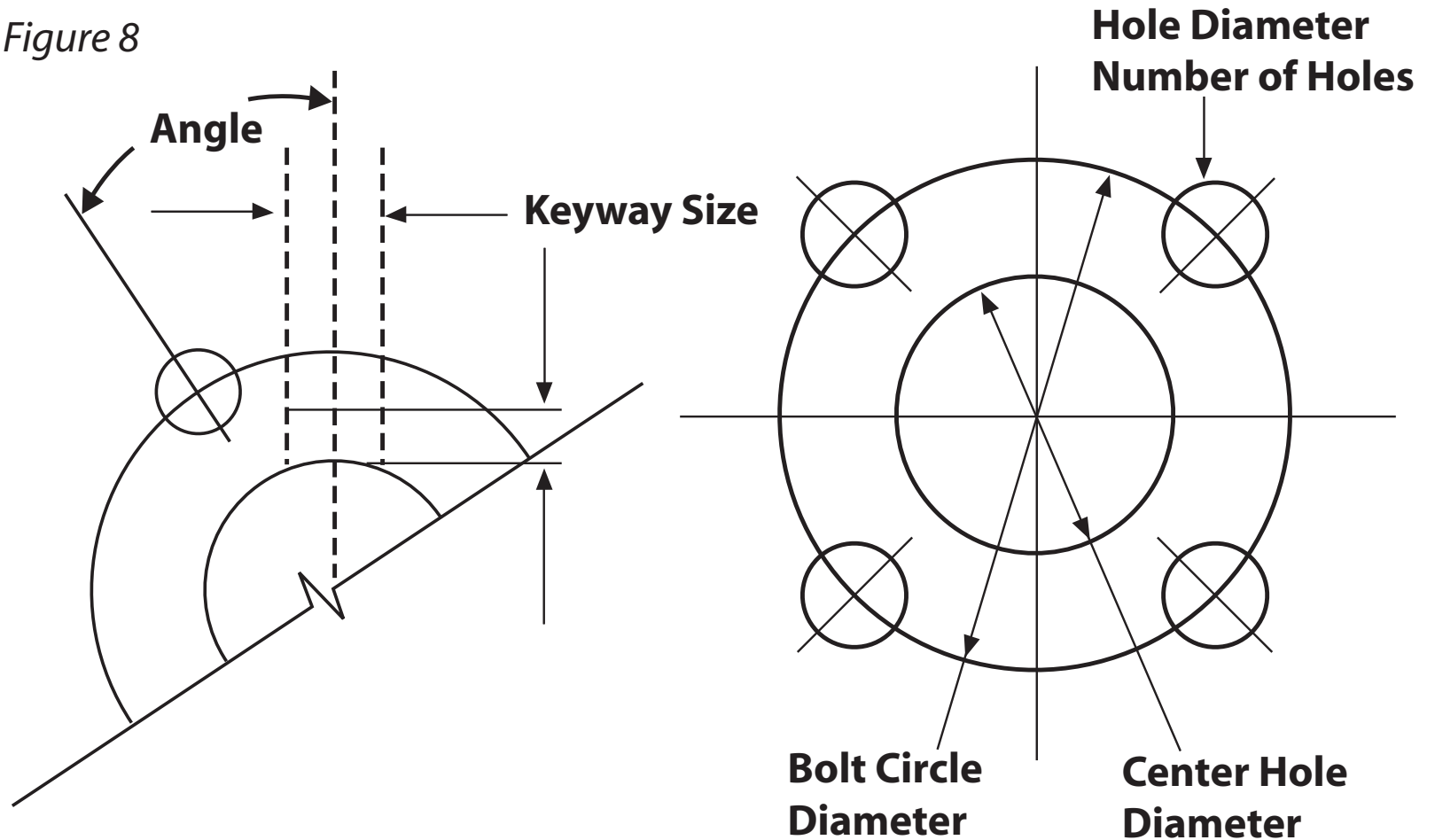
A good vortex allows observation of the shaft almost to the blade.



Drill Pattern

Be Sure the drill pattern is submitted with the purchase order. Nothing is worse than shutting down a piece of equipment, cleaning it up, taking off the old blade, then discovering the new blade does not fit.

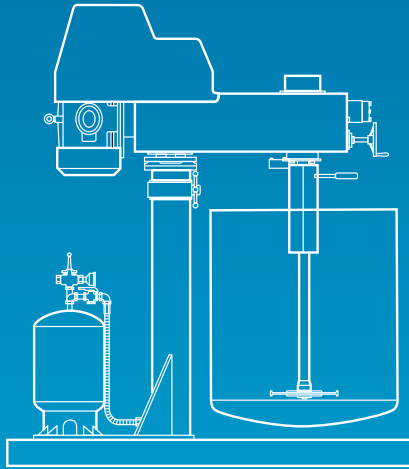
Figure 8



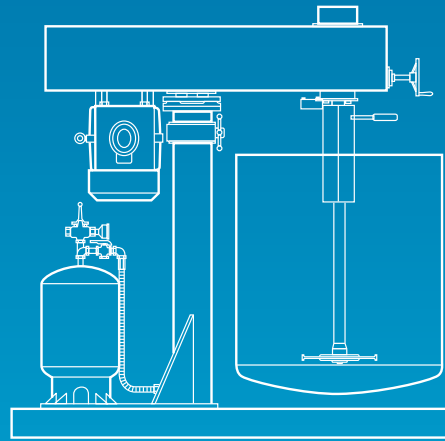
Configurations

Dispersers for every application:

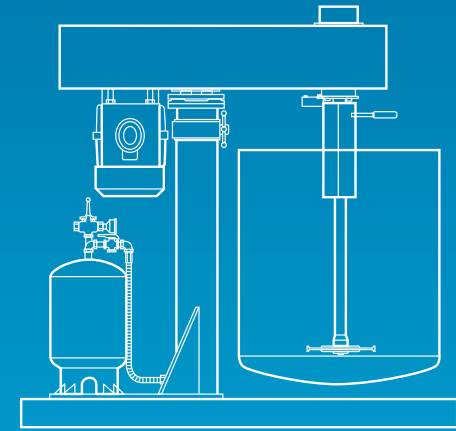
1-300 hp, lift mounts, tank mounts, variable speed, fixed speed or 2 speed, 0-50,000 cps.



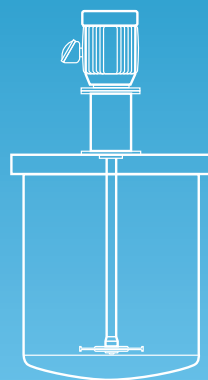
J-Series



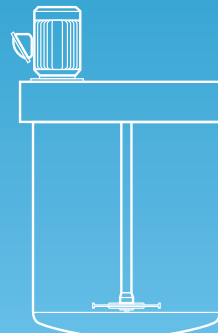
W-Series



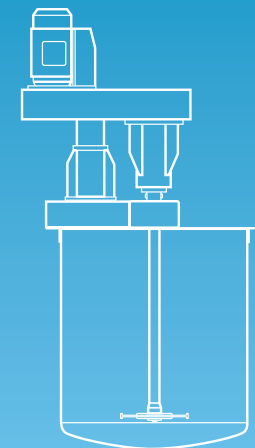
V-Series



D-Series



TV-Series



TVH-Series