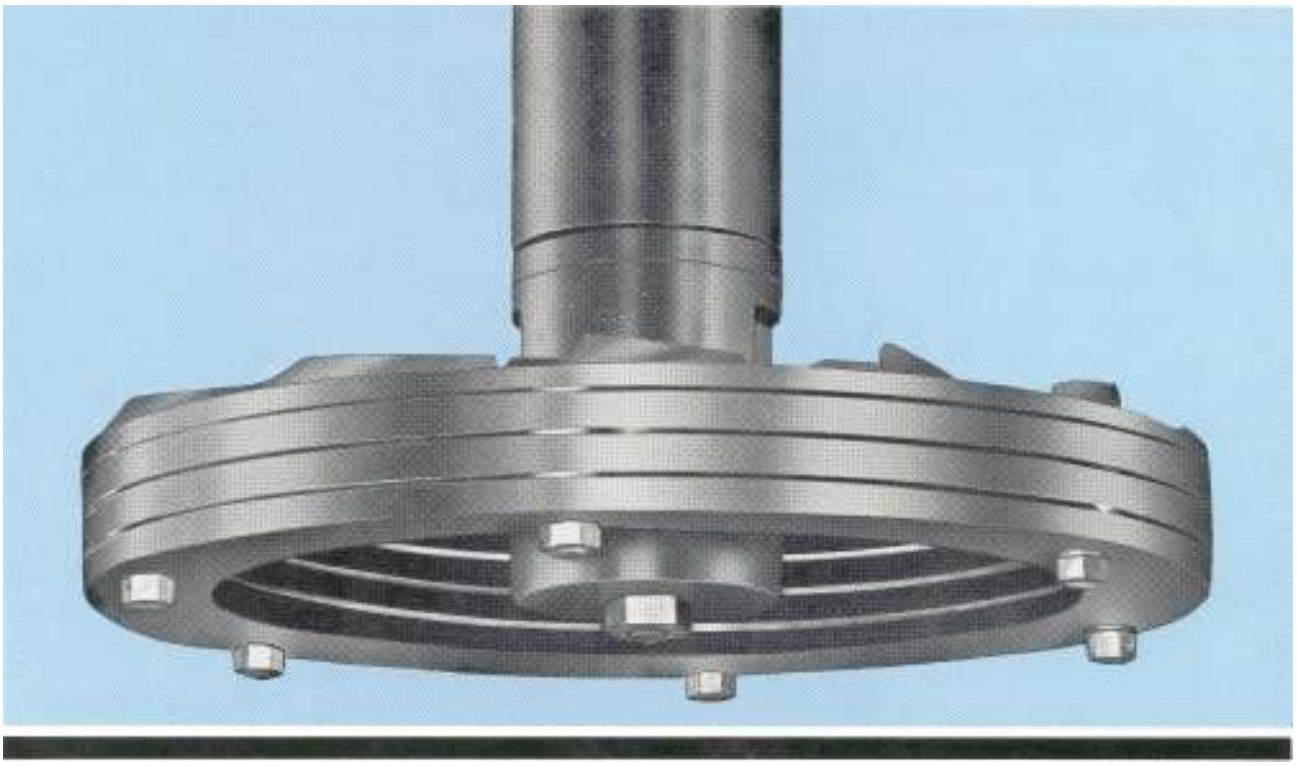
DISPERSE TECH
DISPERSION BLADES

The CONSTANT SHEAR IMPELLER (CSI)

(Patents Pending)



- **Better Dispersion**
- **Faster Dispersion**
- **Less Heat development**
- **Less Power Loss**

The CONSTANT-SHEAR IMPELLER has two unique engineering features -

1 **Separation of functions:** The vanes on top provide impact and turbulence for fast pigment pre-wetting; the profiled rings below generate pure laminar flow for optimum de-agglomeration.

2 **Each unit is custom built** to meet the given job and machine requirements:

A versatile general-purpose model for use in a wide range of mixing and dispersing conditions.
Several special-purpose models:
(a) for use in a specific viscosity range, or
(b) for fast tinting and liquid blending action with minimal air entrapment, or
(c) for pre-mixing only

Description and Guidelines for the use of the constant-shear Impeller

(Patents Pending)



GENERAL

The Constant-Shear Impeller (CSI) was developed by E. L. Midgette, in cooperation with **F.** K. **Daniel, to improve the efficiency of high-speed dispersers. It can be used in place of other impellers on all existing high-speed dispersers.**

The invention is based on the application of the Venturi principle to mixing and dispersing. Centrifugal force pushes the liquid through narrow gaps (.040" - .100") formed by stacked, profiled rings. The resulting flow is purely laminar, hence produces maximum dispersing action, minimum heat, and almost no wear on the rings. The distinguishing performance feature of the CSI is that its power consumption remains nearly constant or even increases (at constant speed) as dispersing progresses, whereas all other impellers pull less power, and thus lose dispersing efficiency with continued operating time and increasing batch temperature.

OPERATION

The optimum operating conditions for the CSI are similar to those of other impellers. The important variables are:

Impeller Size

The approximate relation between CSI diameter and batch dimensions are shown in Table I.

TABLE I

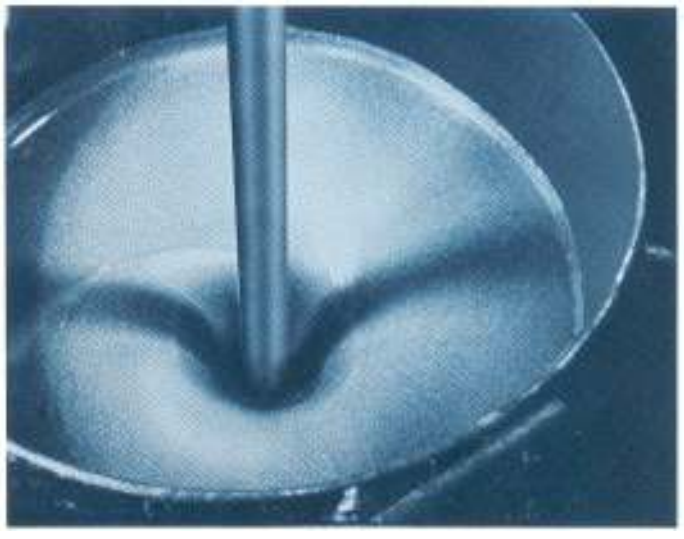
CSI DIAM.	TANK DIAMETER	HEIGHT OF MILL BASE	VOLUME OF MILL BASE (gallons)
3 3/4"	12 1/2" - 14"	9" - 10 ½"	4 ¾ - 7
5 1/2"	19" - 21"	13" - 15 ½"	16 - 23
7 ½"	25" - 28"	18" - 21"	38 - 56
10"	34" - 38"	24" - 28"	95 - 137
12	41" - 46"	29" - 34"	166 - 245
13 1/2	44" - 49"	31" - 36"	204 - 294
17"	58" - 65"	41 - 48"	470 - 690
20 ½	70" - 78"	49" - 58"	815 - 1200

The lower figures in the above columns generally apply to fairly viscous materials, the higher figures to more fluid mill bases. Within these limits, the experienced operator can compensate for differences in mill base rheology by adjusting impeller position and speed until he gets a good flow pattern. The CSI requires a somewhat greater batch height, i.e. it disperses more mill base than other impellers.

Wetting Procedure

Pigment pre-wetting and pigment dispersing require completely different, almost opposite operating procedures. This is true for all impellers, but particularly for the CSI. For fast wetting action, the shaft should be positioned in the center of the tank and the impeller height and speed so adjusted that a deep vortex forms. Excessive speed, causing splashing and high heat development should, however, be avoided. The dry pigment should be charged directly into the vortex as fast as the vortex will take it, that is to say, rapidly at first and then more slowly toward the end. To maintain an effective vortex, the impeller must be raised intermittently and its speed increased as pigmentation becomes higher. Do not choke the impeller by dumping massive amounts of pigment all at once!

A sudden loss of circulation, accompanied by a drop in power consumption indicates clogging of the rings, caused either by careless pigment feeding or too much pigment in the mill base. Higher RPM or slight dilution usually restores the flow in a few minutes, but time is saved, and quality improved, by avoiding clogging in the first place.



Deep Shaft Vortex for Pre-Wetting.

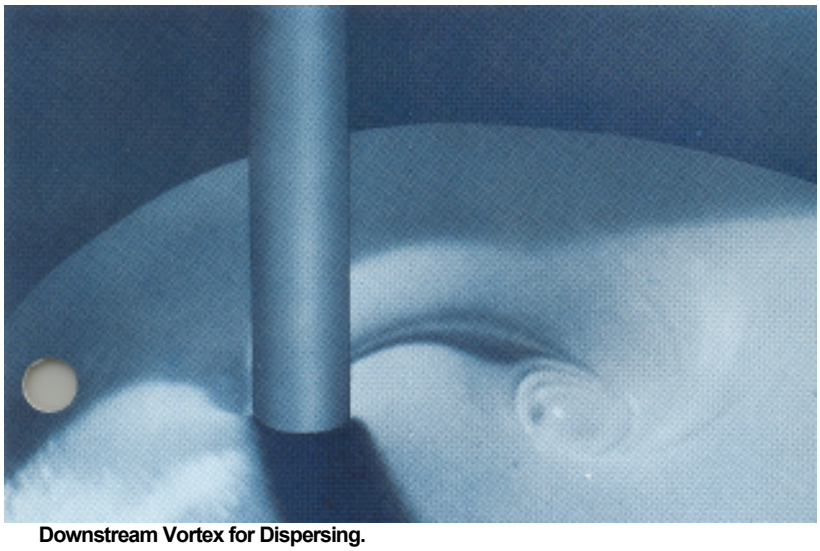
Dispersing Procedure

When pigment loading is completed, i.e.. when no more dry pigment floats on the batch such that the sides of the tank as well as the shaft should be scraped clean and its position changed.

Shaft Position

During the dispersing stage a deep vortex around the shaft is detrimental to good performance. It causes concentric motion of the mill base, resulting in poor power utilization, excessive heat build-up, and air entrapment. This condition is corrected by simply moving the shaft off-center to a position where the deep shaft vortex disappears, yet complete mill base circulation is maintained. Usually, a position halfway between the center and the side of the tank meets this condition, but in no case should the shaft be less than one impeller-diameter away from the side of the tank.

At normal dispersing speeds (4500 - 5500 feet per minute), the off-center position usually causes formation of a vortex or several vortices downstream from the shaft. Sometimes the downstream vortex is stationary, and sometimes it breaks and re-forms rapidly.



Downstream Vortex for Dispersing.



Height of Impeller

Despite the absence of a deep vortex around the shaft, complete circulation of the mill base can be maintained by regulating the speed and/or the height of the impeller in the batch. Normally, the impeller should be located about one impeller-diameter above the bottom, but in oversize batches it may have to go slightly higher. As the batch thins out during dispersion, the circulation increases and may become excessive. In that case the impeller should be lowered and/or the speed should be reduced slightly. However, letting the impeller come too close to the bottom will restrict the flow to the Venturi rings and thereby sacrifice dispersing efficiency.

Speed

The standard CSI, from the 10-inch size up, is designed for optimum performance at between 4500-5000 feet per minute, but the smaller CSI's are set to perform best at lower peripheral speeds. Table II shows the approximate horsepower and RPM range for the different CSI's.

TABLE II

DIAM.	HORSEPOWER	RANGE	SPEED
3 ¾″	1 -2	2200- 3000	2150- 2950
5 ½"	7 ½ - 10	2000- 2500	2900- 3600
7 ½″	10 - 15	2000- 2500	3900- 4900
10"	20 - 30	1900- 2200	5000- 5750
12"	20 - 40	1600- 1900	5000- 6000
13 ½″	25 - 40	1400- 1700	5000- 6000
17"	40 - 75	1100- 1330	5000- 6000
20 ½″	75 -100	930- 1100	5000- 6000

Upon request, the CSI's can be set to perform well at other RPM and horsepower ranges.

Circulation

Excessive as well as insufficient circulation must be avoided. Too much circulation causes splashing, undesirable heat development, wastes power, and may throw mill base out of the tank. Too little circulation causes specky grinds and slow dispersion. Faulty circulation below the surface can be detected easily by probing with the hand (or thermometer) for temperature differences along the wall and bottom of the tank. Stagnant layers or pockets thus found can be eliminated by shifting the position of the CSI, by increasing the RPM, or by using the next larger CSI.

Duration of Dispersing

If proper circulation is maintained, maximum dispersion should be reached in ten to twenty minutes after completion of the pigment wetting step.

Higher speeds or longer operation will seldom improve the grind or the color development, but reformulation of the mill base may do so. Neither reformulation nor prolonged processing will be effective where the poor grind is caused by foreign substances or by hard aggregates. Pigments should be pre-tested in the laboratory for dispersability. If the expected grind reading can be reached in ten minutes in the Osterizer or Waring blender, equal results can be expected in the CSI also.

Mill Base Composition

The mill base composition has a considerable effect on the dispersing efficiency of the CSI, as on all other impellers. Too high viscosity (above approximately 150 KU) will choke the flow through the rings; too low viscosity will cause excessive circulation. For formulating guidance, see the article entitled "Determination of Mill Base Composition for High Speed Dispersion" by F. K. Daniel, Journal of Paint Technology, Volume 38, page 534, September, 1966. Reprints are available on request.

Cleaning and Maintenance

The CSI is normally cleaned by spinning it briefly in a wash solvent shortly after removal from the batch. Foreign materials or large pigment aggregates lodged between the rings must be removed by pushing a spatula through the ring segments, inwardly. This should be done routinely after completion of each batch. It only takes a minute or so to do, but assures continued top performance of the impeller. The presence of much dry pigment between the rings indicates faulty loading which should be corrected. If dry paint is allowed to accumulate between the rings, which cannot be removed by the spatula or by strong solvents, soaking in caustic overnight is recommended. Disassembling the CSI is advisable only as a last resort.

NOTE: Blockage of part of the ring openings by paper or other obstructions may cause vibration of the shaft. If the vibration is strong, remove the obstruction before completing the batch.

Field of Application

The CSI is superior to other impellers in several respects:

1. It produces finer dispersions over a wider range of mill base formulations. Its superiority is most striking with poorly wetting vehicles.
2. It develops less heat for any given fineness of grind than other impellers. For example, a100 gallon batch of $Ti0_2$ in short oil alkyd may be dispersed to a $7^3/_4$ NS grind in ten minutes, going from 80°F (after completion of the wetting step) to 110°F. Thus heat reactive pigments or paint additives which cannot be safely used at higher temperatures can now be processed in High Speed Dispersers.
3. In tinting operations the CSI develops full color in a shorter time; more importantly, however, it sometimes eliminates after-development of color or flooding or floating troubles. Furthermore, the CSI model "M" (without the wetting vanes and with narrow ring spacings) minimizes air entrapment.

Summing up, the CSI greatly enhances the capabilities of High Speed Dispersers, sometimes to the point of making subsequent milling unnecessary. Yet, the CSI has limitations too: It cannot handle very viscous, fibrous, or granular materials, and it requires somewhat greater attention to sound operating procedures than the sawtooth impeller. In brief, the CSI is a worthwhile new tool, but not a panacea.