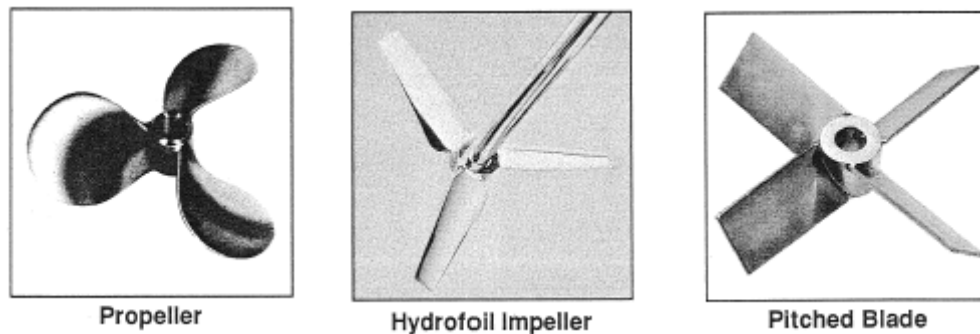


MIXER IMPELLERS

A mixer is any mixing element, which is driven by auxiliary equipment, such as shaft, speed reducer, and electric motor to provide mixing action.

Mixers are generally categorized by the flow pattern they produce relative to the shaft centerline or the impeller axis in a fully baffled tank. Further, breakdown is based on relative shear produced. The resulting divisions are: axial flow, radial flow, hi-shear, low-shear or high flow and specialized impellers (those which are normally used in unbaffled tanks).



The primary types of axial flow impellers (see Fig. 1) are the propeller, the pitched blade Turbine, and the hydrofoil designs. The propeller is restricted to small mixers because of its weight. The pitched blade is used when a balance of flow and shear is required. The hydrofoil offers the best high flow design. Both are built with cast hubs and bolted blades in larger sizes.

The flow pattern produced by a typical axial flow impeller is shown in Fig. 2. When the vessel is fully baffled and the agitator is center mounted, excellent top to bottom motion is produced resulting in good mixing (see Fig. 2b). If the baffles are removed (Fig. 2a), swirling and vortexing result, mixing becoming very poor and the hydraulic forces on the impeller increase dramatically. The flow pattern can be improved by moving the agitator off center (Fig. 2c). This will restore most of the top to bottom motion; however, the hydraulic side forces remain high and if the impeller passes very close to the wall, the force may become cyclic.

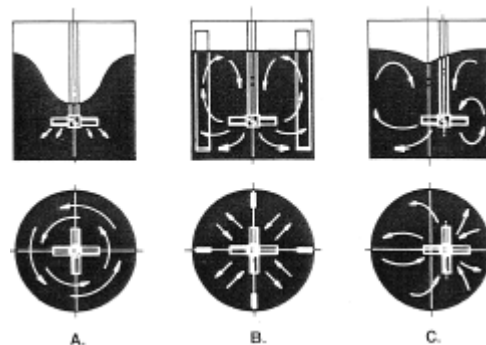


Fig. 2
Axial turbine flow patterns

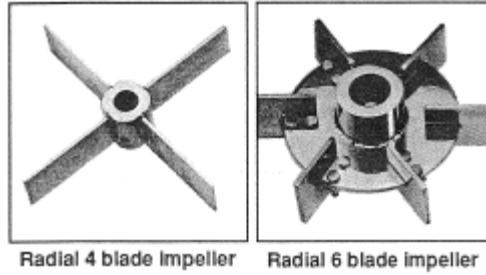


Fig. 3
Radial Flow Impellers

Typical flow impellers are shown in Fig.3. Both provide more shear and less flow per unit of applied horsepower than the axial flow designs. They are commonly used on dispersion applications involving pigments and/ or fillers. The 6 blade design is known as the Rushton turbine, and is often used on gas dispersions. The center disc prevents channeling of the gas up the shaft.

Fig.4 shows typical flow patterns produced by radial flow impellers. Fig.4b shows the flow pattern in a fully baffled tank-Note the tendency to form two agitation zones, each of which has good top to bottom mixing but reduced interaction between zones. Again, removing the baffles (Fig.4a) results in a simple swirling motion, producing little agitation, poor

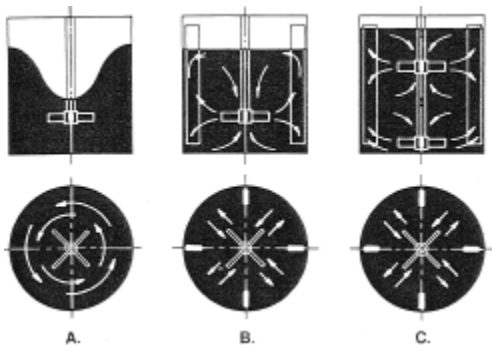


Fig. 4
Radial turbine flow patterns

mixing, a vortex and much higher than normal hydraulic forces. Although not shown, off-center mounting will provide somewhat better mixing with high hydraulic forces.

Fig. 4c shows two radial impellers in a fully baffled tank. This situation can be used to provide a degree of staging. If some degree of control from inlet to outlet is required, this configuration can be used along with proper location of the inlet and outlet to provide some control of residence time and reduce short-circuiting.

A COMMENT ON TANK BAFFLES:

Historically, four baffles, spaced 90 degrees apart, have been considered "standard" with baffle width decreasing as viscosity increased.

The lack of a radial flow component in the discharge from hydrofoil impellers results in (a) less swirling and (b) lower hydraulic side force.

As a result, hydrofoil designs are operated very successfully with three baffles, spaced 120 degrees apart.

EMI Cleveland Mixer will be happy to supply specific baffle design recommendations for any mixing application.

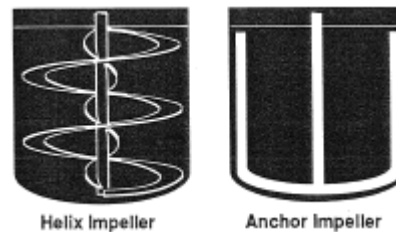


Fig. 5
Specialized Impellers

Two of the most common specialized impellers are shown in Fig.5. Both are primarily used in high viscosity liquids and produce flow by displacement with very little shear. These specialized impellers produce bulk mixing.

The specific type of impeller to be used is a direct function of the material characteristics and process requirements, with a final judgment between types, which will work based on economics.

