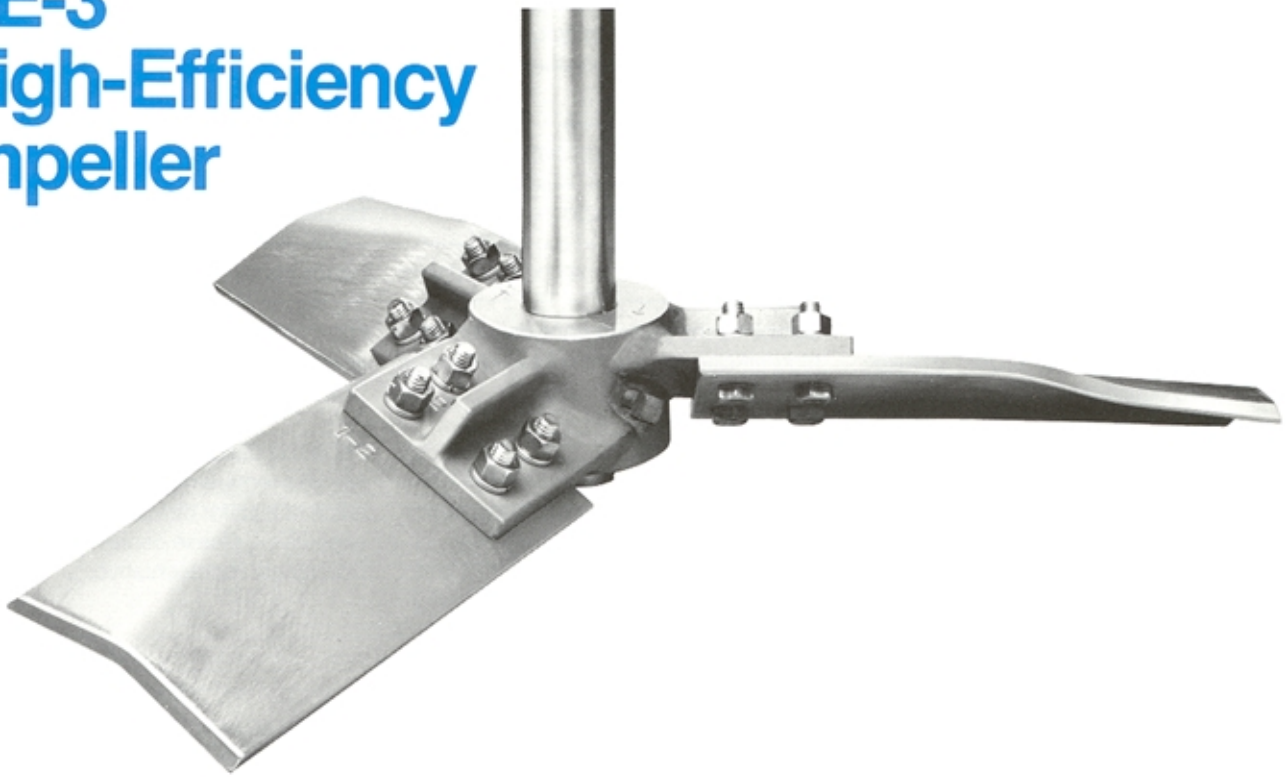
Chemineer

Bulletin 713

HE-3 High-Efficiency Impeller



The Chemineer High-Efficiency (HE-3) Impeller provides all of the benefits of more efficient agitation with very few design limitations. Improved agitation efficiency and greater process flexibility are now available with a practical, fabricated impeller.

What is high-efficiency agitation? In an engineering sense, high-efficiency agitation means that the same process results are achieved with reduced mechanical or energy requirements. On the business side, high-efficiency agitation means reduced capital and operating costs.

The Chemineer High-Efficiency Impeller is a result of extensive testing, and is supported by new technology for proper process application. The HE-3 impeller has three specially designed blades, mounted at a shallow angle, to provide a high degree of axial flow with minimal power requirements. Thus, the HE-3 high-efficiency impeller is able to create more liquid motion with less energy.

Process Performance

Any successful agitator design must provide some required level of process performance. Although process performance has many meanings in the chemical process industries, agitator design has been quantified for most typical applications. The ChemScale® design procedure, developed by Chemineer, is one of the best methods for relating agitation intensity to process performance. The development of a high-efficiency impeller does not change the concept of ChemScale; only the size of agitator required for a given process result changes.

Although bulk fluid velocity, as defined in ChemScale, is a convenient means of characterizing agitation intensity, it is just an indirect measure of process performance. Both the magnitude and the direction of fluid velocities are important in agitation, and must be correctly related to process performance. Thus in addition to basic hydrodynamic measurements, extensive experience and testing with a variety of blending and solids suspension problems are behind each application of an HE-3 impeller.

The effects of flow patterns are also important in determining impeller efficiency. The HE-3 impeller creates axial flow with less radial and rotational flow than a standard pitched-blade (P-4) turbine. The discharge from the high-efficiency impeller spreads less rapidly, thus allowing the impeller to be successfully placed farther from the bottom of the tank. Consequently, tank geometry is less of a factor in designs using an HE-3 impeller because the strong axial flow will control a wider range of liquid levels.

Different agitator horsepower and speed combinations are capable of providing similar process performance with any one type of impeller in most applications. When different types of impellers are considered, even more equipment combinations will produce similar results.

The agitator selections for two different process situations are shown in the tables. Four different agitators, capable of similar process performance using standard P-4 turbines, are compared with four agitators using HE-3 high-efficiency impellers for each situation. A smaller Chemineer HT Agitator Drive size is required for the same process results. Similar or lower horsepower motors can be used with the larger-diameter HE-3 impellers.

The benefits of a more efficient impeller delivering equivalent process performance are available for both new and existing applications. Many agitators can be updated by replacing standard P-4 turbines with HE-3 impellers to improve blending, heat transfer, or solids suspension.

Impeller Technology

In some ways the axial flow produced by an agitator impeller is related to the thrust created by a marine or aircraft propeller. To create either axial flow or thrust, an impeller must impart momentum to the fluid. The energy which is not transferred to the fluid as momentum is dissipated as turbulence. In agitator applications where fluid motion is a principle design consideration, as in many blending and solids suspension problems, the efficient conversion of energy to fluid momentum is important.

Impeller design for improved axial flow requires an understanding of the lift and drag characteristics of different blade shapes. The length, width, and thickness of the blades of our high-efficiency impeller are optimized for performance, as well as strength and weight. Careful evaluation of the different impeller design variables in actual agitation situations resulted in an efficient and practical design for the HE-3 impeller.

A special blade contour provides many of the improved performance characteristics of the HE-3 impeller. Reduced drag at the leading edges of the blades efficiently converts mechanical energy to fluid motion. All of these performance benefits are achieved with practical fabrication techniques for economical application of high-efficiency agitation to many different process situations.

HE-3 Impeller Features

For many years high-efficiency impeller designs required either heavy castings or complicated fabrications. These options severely limited the application of such impellers to small or very special agitation equipment. The HE-3 impeller combines the performance benefits of high-efficiency designs with the practical features of fabricated turbine construction.

Standard impeller sizes from 22 to 120 inches in diameter are readily available from Chemineer. Designs requiring smaller or larger impellers (over 18 feet in diameter) have been built for specific applications.

The standard materials of construction are carbon steel and 304 or 316 stainless steel. High alloys and L-grade stainless are available when required for severe environments. Optional rubber covering offers resistance to both corrosion and erosion.

Blades bolted to standard hubs simplify installation. Smooth and steady impeller performance eliminates the need for stabilizer fins, even with long shafts. HE-3 impellers are available for all sizes and types of Chemineer HT Agitator Drives.

For a complete review of your specific process requirements and the most efficient agitator design for your application, please contact your local Chemineer representative.

Agitator Performance Comparison

Standard Turbine P-4				High-Efficiency Impeller HE-3			
Case Size	Motor Power	Agitator Speed	P-4 Dia.	Case Size	Motor Power	Agitator Speed	HE-3 Dia.
Process Situation A							
3HT	3 hp @	30 rpm	64 in.	2HT	3 hp @	56 rpm	57 in.
3HT	7.5 hp @	68 rpm	44 in.	2HT	2 hp @	37 rpm	68 in.
3HT	10 hp @	84 rpm	40 in.	2HT	5 hp @	84 rpm	50 in.
3HT	15 hp @	125 rpm	36 in.	2HT	7.5 hp @	125 rpm	43 in.
Process Situation B							
5HT	15 hp @	45 rpm	66 in.	4HT	5 hp @	30 rpm	92 in.
5HT	20 hp @	56 rpm	64 in.	4HT	10 hp @	56 rpm	71 in.
6HT	30 hp @	68 rpm	62 in.	4HT	7.5 hp @	37 rpm	88 in.
6HT	40 hp @	84 rpm	56 in.	4HT	15 hp @	68 rpm	71 in.

For each of two different process situations, eight equivalent ChemScale selections are shown. Each situation shows that several alternative horsepower and speed combinations are capable of similar results, but the efficient performance of the HE-3 impeller consistently reduces the drive size.

Operating Locations in:

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