|| Volume 2 || Issue 3 || OCTOBER 2017 || ISSN (Online) 2456-0774 ||
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

Conical Curved Agitator

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Abstract – In this era, mixing is one of the most fundamental operations in industries like paper, food, cosmetic, chemical, biochemical and pharmaceutical applications. Agitator is one of the important parts in the mixing process. Proper and uniform mixing gives improved quality of the product. In this paper, we have mainly focused on different types of agitator used in industries to increase the mixing performance in industry. Also includes the different parameters used for design of agitator. The design of agitator effects on the mixing process as proper design can increase the mixing and uniform distributions of all additives, chemicals, raw material present in pulp. The review drives us to design an error prone model for agitator which will increase the mixing percentage, ultimately increase the gain of industry to get place into market with price for produce- This work gives approach for performing stress analysis of an agitator of a large mixing vessel used in pulping process plant. The agitator is subjected to vibration due to multi-axial forces resulting from bending and tensional loading imposed by the mixing operation. The work also discusses an alternative approach for estimating stress amplitude variation through dynamic stress analysis. Research work gives solution for developing the agitator with curved conical shaped Wildman which is made by using welding techniques standard material plates, Agitator looks conical shaped from side view and circular hub is designed to hold the structure of agitator. Project gives result and validation on the basis of software tool as well as mathematical tool. This proves the strength in designed agitator. Along with agitation process of pulping stirrer is also considered which is mounted on top of the agitator hub.

I INTRODUCTION

The conical curve agitator mixer is the newest generation of agitators. The conical curve agitator has advantages of good mixing performance, easy to discharged etc. Spray device, heating devices, lifting devices and drying devices are for the option. If this mixer is equipped with heating devices then it will becomes an ideal drying machine. Since the dawn of brick houses and homemade bread, people have become increasingly familiar with solid-liquid mixing. Solid-liquid mixing is virtually involved in most fundamental technologies such as those utilized by ceramics, plastics, and food industries in our modern world. As a result, mixing tanks are of interest of many industries due to the simplicity of the application. Mixing in agitated tanks which is widely being used in chemical, petrochemical and biochemical industries has been a favourite discussion topic for many researchers since 1950's.

II PRINCIPLE OF AGITATORS

The agitation is achieved by movement of the heterogeneous mass (liquid-solid phase), to the impeller. This is due to mechanical agitators, to the rotation of an impeller. The bulk can be composed of different substances and the aim of the operation is to blend it or to improve the efficiency of a reaction by already blended and the aim of agitation is to increase a heat transfer or to maintain particles in suspension to avoid any deposit.

III WHAT IS CONICAL CURVED AGITATOR?

It refers to the induced motion of a "homogenous" material in a specified way. It is the random distribution, into and through one another, of two or more initially separate phases.

Agitation plays an essential role in the success of many chemical processes, and there is a wide range of commercially available impellers that can provide the optimum degree of agitation for any process. The problem arises in selecting the best impeller for the required process. Equipment manufacturers often provide expert guidance, but it is beneficial for designers and engineers to acquire fundamental knowledge of various types of impellers. These objectives, summarized in physical properties such as viscosity play an important role in the selection of impellers in laminar, transitional, and turbulent operations.

Figure 1 Conical Agitator

IV DEFINITION OF PERFECT MIXING

Perfect mixing is defined, ideally, as a level of equilibrium at which all elements are distributed homogeneously with regards to concentration gradient throughout the media. Mixing is no longer believed to be a unit operation. In other words, mixing has become such an integral function of chemical plant processes in which a vast area of all forms of Newtonian and non-Newtonian liquids may be combined. Mixing consumes a considerable amount of time in the processes of a plant and there is no justification for losing profit because of over-mixing, time-wasting, under-mixing, or low quality mixing. In the present marketplace, processing material has become so important that there is always a compromise between the plant capacity and the product quality in which mixing is a vital criterion.

V GEOMETRY CONSIDERATION IN MIXING

The impact of the tank geometry is critical in the rate of mixing and power consumption. In fact, without proper tank geometry adequate mixing is not achievable in the prescribed amount of time. Optimal mixing requires the utilization of the variables listed below.

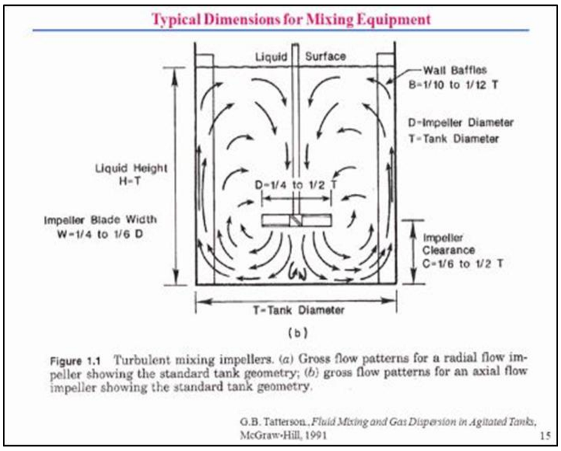

Figure 2 Geometry of mixing

1) Vessel: The shape of the vessel such as conical curve type ,and the bottom contour of the tank such as flat, dished or conical affect the hydrodynamics of the flow drastically and, as a consequence, the mixing yield. Generally, dish bottomed cylindrical vessels are preferred. A flat bottom, for instance, requires 10 to 20%more power than a dished bottom to achieve perfect mixing. Tanks with a ratio of liquid height to tank diameter equal to one (ZIT = 1) are ideal for top entry with a single impeller. If the liquid height to tank diameter is more than one (ZIT > 1) the number of impellers must be greater than one to achieve perfect mixing. Nonstandard vessels with varying levels of liquid heights and different numbers of impellers can be used with buoyant solids to optimize mixing.

2) Shaft: The shaft may be installed depending upon the process used from the top, side or the bottom of the tank. Entries from the top do not require sealing to prevent leakage, while entries from the side may avoid vortices and do not require baffles. Side entries perform well for solids with low settling velocities (Tatter son, 1994).

3) Impeller: There are a variety of impellers in industry and it is difficult to find an impeller which meets all the requirements of a process. Impellers are typically classified according to their mixing regime; laminar or turbulent. To generate laminar flow for poor momentum transport liquids impeller diameters must approach tank diameter. Helical ribbons, screws, and anchor impellers are examples of creeping flow producers. Baffles in laminar flow are not necessary since the flow is too slow to generate a vortex. Despite the previously mentioned impellers, turbulent regime flow makers are one-fourth to on half of the tank diameter. They are either classified as axial flow makers or radial flow makers. Impeller geometry is an indication of the type of impeller required, although the impeller diameter ratio to the tank diameter has a significant effect on mixing parameters. For instance, some propellers draw less power than other impellers with the same diameter or the clearance of the impeller has drastic effect on the flow and usually suggested to be T/4 to T/3 from the bottom of the tank for axial impellers.

VI METHODOLOGY

The conical curve agitator is an electro- mechanic set consists of two shafts. The first shaft is the bearing axis while the second shaft is the axis of the quartet upper bearing impellers group and the triple lower group which are called as agitating group. The agitating group is located inside a conical shape container equipped especially to contain square directors for the liquid entrance and square directors called fixing group for the liquid exit.

1) Suction
2) Discharge
3) Quartet upper impeller
4) Triple lower impeller
5) Shaft
6) Internal container

Figure 3 Conical curve agitators (Internal container)

The fixing group is installed containing the agitating group inside any tank whether from upper or lower position. The agitating process occurs through the agitating group bearing causing a lower pressure over the upper group leading to withdrawing the liquid from the square directors of the liquid entering and consequently the liquid moves to the denser place under the quartet upper group. Then, the liquid moves to the so high pressure area under the agitating group causing the liquid exit from the square directors in the bottom of the container as shown in Figure. This agitator is distinguished with the following advantages:

1) It does not cause vortex in the centre of the liquid so that there is no need to put baffles inside the agitating tanks.
2) It does not lead to bubbles inside the gas causing dribble so it is considered suitable for liquids of low flash points.
3) It does not cause bubbles or cavitations which leads to increasing the agitating efficiency.
4) To design the conical agitator, there is no need to calculate the electric power of the motor according to the tank size and liquid type.
5) It is universal and suitable for all liquids and all liquids and tanks.

VII CHARACTERIZATION OF MIXING QUALITY

Agitation and mixing may be performed with several objectives:

1) Blending of miscible liquids.
2) Dispersion of immiscible liquids.
3) Dispersion of gases in liquids.
4) Suspension of solid particles in slurry.
5) Enhancement of heat exchange between the fluid and the boundary of a container.
6) Enhancement of mass transfer between dispersed phases.

When the ultimate objective of these operations is the carrying out of a chemical reaction, the achieved specific rate is a suitable measure of the quality of the mixing. Similarly the achieved heat transfer or mass transfer coefficients are measures of their respective operations. These aspects of the subject are covered in other appropriate sections of this hook. Here other criteria will be considered. The uniformity of a multiphase mixture can be measured by sampling of several regions in the agitated mixture. The time to bring composition or some property within a specified range (say within 95 or 99% of uniformity) or spread in values-which is the blend time, may be taken as a measure of mixing performance. Various kinds of tracer techniques may be employed, for example:

A dye is introduced and the time for attainment of uniform color is noted. A concentrated salt solution is added as tracer and the measured electrical conductivity tells when the composition is uniform. The color change of an indicator when neutralization is complete when injection of an acid or base tracer is employed. The residence time distribution is measured by monitoring the outlet concentration of an inert tracer that can be analyzed for accuracy. The shape of Response curve is compared with that of a thoroughly (ideally) mixed tank.

The last of these methods has been applied particularly to chemical reaction vessels. It is covered in detail in. In most cases, however, the RTDs have not been correlated with impeller characteristics or other mixing parameters. Largely this also is true of most mixing investigations, but is an uncommon example of correlation of blend time in terms of Reynolds number for the popular pitched blade turbine impeller. As expected, the blend time levels off beyond a certain mixing intensity, in this case beyond Reynolds numbers of 30,000 or so. The acid-base indicator technique was used.

Requirements of Mixing:

1) Minimum power requirement.
2) Efficient mixing in optimum time.
3) Best possible economy.
4) Minimum maintenance, durable and trouble free operation.
5) Compactness.

Causing the Mechanical Problems with Agitators:

Mechanical problems with agitators are rarely as simple as steady bearings or larger shafts. Either approach may solve the problem or make it worse; you have identified a couple of advantages and problems for each option, but others are possible. From the information you have provided, I can only guess at possible solutions However, from your description, the problem may be in the rigidity of the mounting. If both agitators are having similar problems, it is likely that the support structure is at least contributing to the problems. To make any recommendation for or against the options you mentioned would require a much more thorough analysis than a simple description of the agitator's. Detailed dimensions and drawings would be needed to completely evaluate the strength of the agitator impellers and shafts.

The drives and supports are potential sources of problems. Even your process conditions need to be examined to establish the loads on the agitators. Other mechanical problems such as natural frequencies for both the agitators and the supports can cause motion problems. For an independent start, an article entitled, "Consider Mechanical Design of Agitators".

VIII DESIGN CONSIDRATION FOR AGITATORS

The degree of mixing is highly dependent upon the design parameters of both the vessel and the stirrers as well as the particle characteristics such as size distribution, density and the shape and liquid properties such as density, viscosity, surface tension and those which affect the rheological behaviour, if applicable. One of the most popular methods of mixing is engaging a vessel with an agitator. It is essential to characterize parameters affecting the batch mixing vessel, in which mixing is usually conducted, as well as being an ideal reference for continuous processes.

1) Determination of amount of energy required or power required for satisfactory performance of mixing operation.

2) Process has to be well defined e.g. a mixing system is to be designed to make up and hold in uniform suspension 15% slurry.

3) Description of the components to be mixed. Their properties at initial stage, final stage, overall specific gravity, initial and final viscosity, concentration etc.

4) Details of the tank geometry.

5) Outline of the mixing cycle: It depends upon the nature of the operation. Decide whether the process is a batch, semi-continuous or continuous etc.

Factors affecting for designing of the Agitator:

1) Circulation pattern.
2) Diameter and width of the agitator.
3) Location of the agitator.
4) Method of baffling.
5) Power required.
6) Shaft overhang.
7) Shape and size of the vessel.
8) Type of stuffing box or seal, bearing, drive system.
9) Type of vessel.

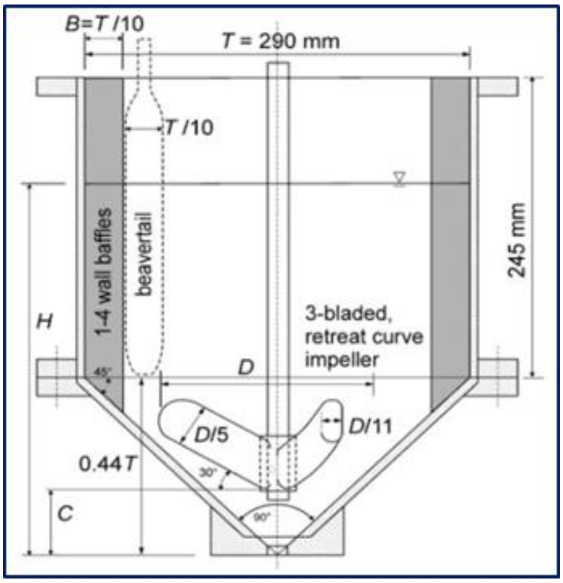

Figure 4 Design of agitator

IX WORKING PRINCIPLE OF CONICAL AGITATOR

The vertical conical agitator consist of driving part, conical cylinder, outer ribbon, inner ribbon screw agitator and discharged valve. The outer ribbon drive the materials rotate and lift them from bottom to top, while the inner ribbon drives the materials to the bottom, thus complete the mixing.

The mixing process can be optimized by controlling the mixing energy, which can be achieved by adjusting the rotational speed. The conical paddle mixer has a typical rotor speed of between 1 and 10 m/s.

Figure 5 Working principle of conical agitator

Advantages

1) Flexibility of batch size.
2) Homogenous mixing.
3) Complete discharge.
4) Easy cleaning.
5) Proper mixing is done.
6) 100% discharged is done.

X APPLICATION OF CONICAL AGITATORS

1) Fine chemicals, agrichemicals.
2) Petrochemicals.
3) Polymer processing.
4) Paints and automotive finishes.
5) Cosmetics products.
6) Food.
7) Drinking water and waste water treatment..
8) Mineral Processing.

XI CONCLUSION

The review finds that, there are different types of agitator are available. In the different industry mixing process of pulp is not uniform and proper. Different stresses are produced in the agitator like bending stress, deformation stress. The parametric study can give the new design that is conical agitator which can increase the mixing percentage. Also weight of agitator is high due to different joining methods present to join arms and hub together. We can reduce the weight of conical agitator so power consumption of agitator can decrease and efficiency and mixing percentage increases with reducing of its weights.

REFERENCES

[1] 'John Frank Pietranski' P. E., Ph.D. "Mechanical Agitator Power Requirements for Liquid Batches" vol.3, 2012.

[2] 'Saeed Asiri' (2012) "Design and Implementation of Differential Agitators to Maximize Agitating Performance" in International Journal of Mechanics and Applications 2012.

[3] ‘D. S. Dickey’ and ‘J. B. Fasano’ “Mechanical Design of Mixing equipment”, (2004).

[4] ‘Ibrahim S.’ and ‘A.W. Nienow’ “Power Curves and Flow Patterns for a Range of Impellers in Newtonian Fluids: 40<Re<5x105”, Trans IChemE, Part A, [73], July 1995.

[5] ‘Armenante’, P. M. and ‘E. U. Nagamine’ (1998) “Effect of low off-bottom impeller clearance on the minimum agitation speed for complete suspension of solids in stirred tanks”. Chemical Engineering Science 53[9], 1757–1775.

[6] ‘Ayranci’ I. and ‘S. M. Kresta’ (2011) “Design rules for suspending concentrated mixtures of solids in stirred tanks”. Chemical Engineering Research and Design 89[10], 1961-1971.

[7] ‘Setyawan’ ‘H. Margono’ & ‘Winardi S.’ (2001) Effect of particle size.

[8] ‘Prof. A. A. Hiwrale’ “Design and analysis on conical curved agitator” IRJET Volume 03 Issue: [12].

[9] ‘Mr. A. P. Shastri, Prof. N. B. Borkar’ “International Journal of Research in Advent Technology “(E-ISSN: 2321-9637) Special Issue 1st International Conference on Advent Trends in Engineering, Science and Technology “ICATEST 2015”, 08 March 2015.