DESIGN AND ANALYSIS OF ELECTRICALLY POWERED MIXER FOR PHENYL

Sachin N. Waghmare[1], Suraj P. Mail[2], Pranav S. Nalawade[3], Digambar A. Mohite[4], Pranil D. Salunke[5]

[1]Faculty, [2,3,4,5]Students, MechEnggDept, Rajendra Mane College of Engg& Technology, Ambav (Devrukh), Ratnagiri,Maharashtra, (India)

ABSTRACT

Now-a-days cleaning has become most important part in Hospitals, Educational institutions and Industries. And for making these cleaning solution large human efforts has to be made by the worker.This paper describes about the mechanical design and analysis of mixer on the fluid that is to be stirred in the mixing vessel. As we all knew thatmixing is a very important processin any chemical, paints andfood process industry. Toattain the uniform mixing of the solutionwith the desired quality and in order to remove the drudgery of human folk this newly designed mixer is suggested.

The cleaning department requires large amount of cleaning chemical solutions (phenyl) daily. A mixer is a chemical mixing machine which rotatesunidirectional. This mixer is driven by an electrical motor. This type of chemical mixers are used in process industries like paint industries, chemical industry, food processing plants etc. They are mainly employedfor mixing of powders, chemical solutions semisolid fluids etc.

Keywords: -agitator, chemical solution (phenyl), electrical motor, Uni-directional mixer.

I.INTRODUCTION

Mixing is a process where liquids or powders are mixed together in the form of uniform mixture whereasstirring is the process to mix the fluid and powder to dissolve them thoroughly in a given mixture and form a uniform product as output. It is the process which determines uniformity and quality of product. In case of process industries, process of mixing and stirring forms an integral and important part of the total manufacturing process.In either of above cases thorough mixing of material is desirable to give good and quality mixture.Mixing powders of different material in order to form a uniform product as it is quiet easy to mix a powder but when it is desirable to mix powder in a fluid matter specially when the density of powder is high the problem occurs due to heavy weight of particles of powder which has a tendency to settle down.

This mixer is been designedand fabricated for mixing of chemical solution ,which is used to for cleaning purposes in educationalinstitutes, offices, hospitals, large shop floor industriesetc. To keep this working area clean, large amount ofcleaning solutions is required daily for variouscleaning purposes. This solutions are preparedmanually, as a results large amount of human effortsare required, the amount of time required to preparethis solution is also very long duration, and it becomes verydifficult to store the solution, hence to overcome allthis factors this electrically poweredchemical mixer is been designed.By implementation of this mixer in variousapplications the time required to make the solutionwill be reduced and the man power required

will be comparatively less also large amount of solution can be stored which can be further used as per the requirement.

II.LITERATURE REVIEW

Jagdish M. Chahandeet al. (2015)presented the methodology for design and fabrication of Planetary Mixer for Preparing Cake Cream with the related search. The study specifies factors influencing the cake cream making process and recommends a number of design options for planetary mixer. These are based on a systematic study of the cake cream making process and testing of a prototype model of planetary mixer.

Rafiqueet al. (2013) studied for contra–rotating mixing flow within a cylindrical container. The behavior compared against previously simulated numerical results and found with good agreement. Two-dimensional incompressible complex flow of Newtonian fluid is relevant to the food industry. The numerical method adopted is a finite element semi-implicit time-stepping Taylor-Galerkin/pressure-correction multi stepping scheme, posed in a cylindrical coordinate system. The flow replicates the behaviour of actual industrial dough mixing.

B.Kumar and E.Rajasekaran(2014)suggested a new design for the agitators. By careful study of threedifferent models in all aspects one had been taken for the final fabrication. To finalize the best design,simulation which had used to conduct required experiment? Required inputs had been taken fromdifferent literature surveys and the discussion with the experts who were on the field and real time study had been conducted to get the exact requirement of the customer.

H.S.Pordal and C.J.Matice studied inadequate understanding of mixing had resulted in unsatisfactory product quality, increase cost of production and loss of revenue.The use of analysis tool varying rigor to solve mixing problem was described. This solution strategy can be applied to solve mixing problemsrelated to the design of process, Scale-up and scale-down of equipment.

AshishPanchgatte et al (2015) used planetary machine involved a rotating stirrer that revolves about the fixed container axis as well as incorporatedan strainer that changes the flow pattern and also acted as a wiper. Machine has variable mixing speed feature at the same time delivers heavy torque to the stirrer for proper mixing.

TomasJiroutand FrantisekRieger (2011) studied effect of impeller type on off-bottom particle suspension. On the basis of numerous suspension measurements there were proposed correlations for calculation just-suspended impeller speed of eleven impeller types and geometries in the wide range of concentrations and particle diameters. The suspension efficiency of tested impellers was compared by means of the power consumption required for off-bottom suspension of solid particles.

R.K.Thakur et al (2003 described the field of static mixers including recent improvements and applications to industrial processes. The most commonly used static mixers are described and compared.Their respective advantages and limitations are emphasized. Efficienciesof static mixers are compared based both n theory and experimentalresults from the literature.

ChristophErbacher (1999) a device for rapid mixing of two solutions was presented. As the main mechanism for mixing is diffusional mass transport, the flow has to be splitinto several laminar which are narrower than the capillary width.Complete mixing is achieved within a few seconds in a

Flow through device with a channel system that is 600µm wide at its narrowest spot.

DivyaRajavasathavi (2012) used the effect of fluid flow and impeller characteristics on the mixing and hydrodynamic behaviourof a continuous stirred tank reactor (CSTR) was been studied using computational fluid dynamics software, Ansys Fluent 12.0. Various mathematical models like equation of continuity, momentum, volume of fluid method, laminar and the turbulent equations have been used todescribe the flow behavior in the reactor. The hydrodynamic behavior was understood by velocity and pressure profiles and also by the vortices plots.

Raghunath Rajput (2015)presented the properly mixing of the fluid in mixing vessel. In order to have a homogeneous mixing the directions of rotation of stirrer shaft which rotated stirrer blades in opposite directions in one cycle which formed turbulent flow pattern there by leading to creation of irregular flow pattern and resulting into thoroughlymixed paint mixture preparation which created the good quality paint.

Sharma Alok and Genitha Immanuel (2014) presented research was carried out with objective to study the effect of different types of Impellers and Baffles on mixing and examined the correlation between mixing time and mass transfer of Aerobic Stirred Tank Fermenter. An Aerobic Stirred Tank fermenter was assembled with different Impellers and Baffles alternately. The four different Impellers used were Rushton Impeller, Marine Impeller, A320 Impeller and HE3 Impeller while walled and unwalledbaffles were used in combination with these Impellers.

Ronald Weetman and Bernd Gigas(2002)described the mechanical design of mixer with the emphasized on the fluid forces that were imposed on the impeller by the continuum in the mixing vessel. The analysis shown was a result of transient fluid flow asymmetries mixing in the mixing impeller.These loads were dynamics and were transmitted from the impeller blades to the mixer shaft and gear reducer. A general result for a form of fluid force equation was been developed.

V.B. Bhandari& The data book of PSG Institute of technology (2013) has published his latest edition of book “Design of Machine Elements”, it consist of design parameters for design of various mechanical components.

Tanguy et al. (1999) in this paper the mixing hydrodynamics in a double planetary mixer was investigated numerically and experimentally over the course of a cross-linking reaction. Use of various visualization techniques, it was shown that this mixer provided good radial dispersion capabilities but poor axial (top-to-bottom) pumping, irrespective of the viscosity level. Overall, the numerical predictions and the experimental results exhibited good agreement although at 85% conversion, the numerical model was not accurate enough to predict adequately the power consumption due to physical phenomena notconsidered in the computations.

M. V Joshi & V. V. Mahajani(1996) has published his 3rd edition of book “Process Equipment Design”, it consist of design parameters for design of various mechanical components like Agitators, Coupling, Pressure Vessel.

III.PROPOSED METHODOLOGY

A chemical mixer is being designed which consist of a container impeller blades, electrical motor, pair of pulleys, pedestal bearings and drive shafts. We are using the container made up ofPVC; it is placed at about 6inches from ground, so that it is easy to pour the material for the workers preparing the chemical solution(Phenyl). The motor is placed vertically in order to mount the pulley and belt assembly on the motor

shaft. This machine is designed to mix the cleaning solution used for cleaning the floors. In electrically powered system an electrical motor is used to run the motor shaft. As the motor shaft rotates, the pulley mounted on motor shaft also rotates. The power transmission will be takes place from motor to impeller shaft. As the impeller shaft rotates the impeller blades also rotate along the direction. And hence the mixing of chemical ingredients is obtained. The speed of the electrical motor is controlled using speed regulator. The 3d model of chemical mixer is as shown in fig 1.

Fig1.Praposed Model of Mixer

IV. DESIGN CALCULATIONS

The following table gives the details of components used in fabrication of mixer.

Table No.1 list of components

Part name	Material/ Specification	Dimensions
Electrical motor	0.5hp,0.37kW,1440rpm	-width 100mm Length 250 mm
Pedestal bearing	Cast iron and stainless steel	ID=25mm
Flange coupling	EN8	ID1=25mm ID2=19mm
Shaft	EN8	D1=25mm, D2=19mm D3=16mm
Pulley 2"	Cast Iron	D=50.8mm
Pulley 8"	Cast Iron	D=203.2mm
V belt	Polyester, rubber and cord	A section 41inch length
Agitator	EN8	L=165*4*25
Tank	PVC plastic	Capacity=75lit

V.RESULTS

We carried the study from the data used for solving the problem in order to proceed for finding out the dimensions of the agitator which will provides us minimum hydrostatic pressure acting on the agitator blade. We assume certain dimensions of acceleration in (m/s^2) and speed in (rpm) through a basic knowledge of ANSYS SOFTWARE and then analyzed the same in flow simulation for boundary conditions as shown in the fig 2.

Boundary Condition 1

Magnitude: - Acceleration = 0.024 m/s^2

Boundary Condition 2

Speed = 350rpm.

Boundary Condition 3

Density of Phenyl = 0.909 gm/cm^3

Following is the images which show other operational parameters for final design of agitators:-

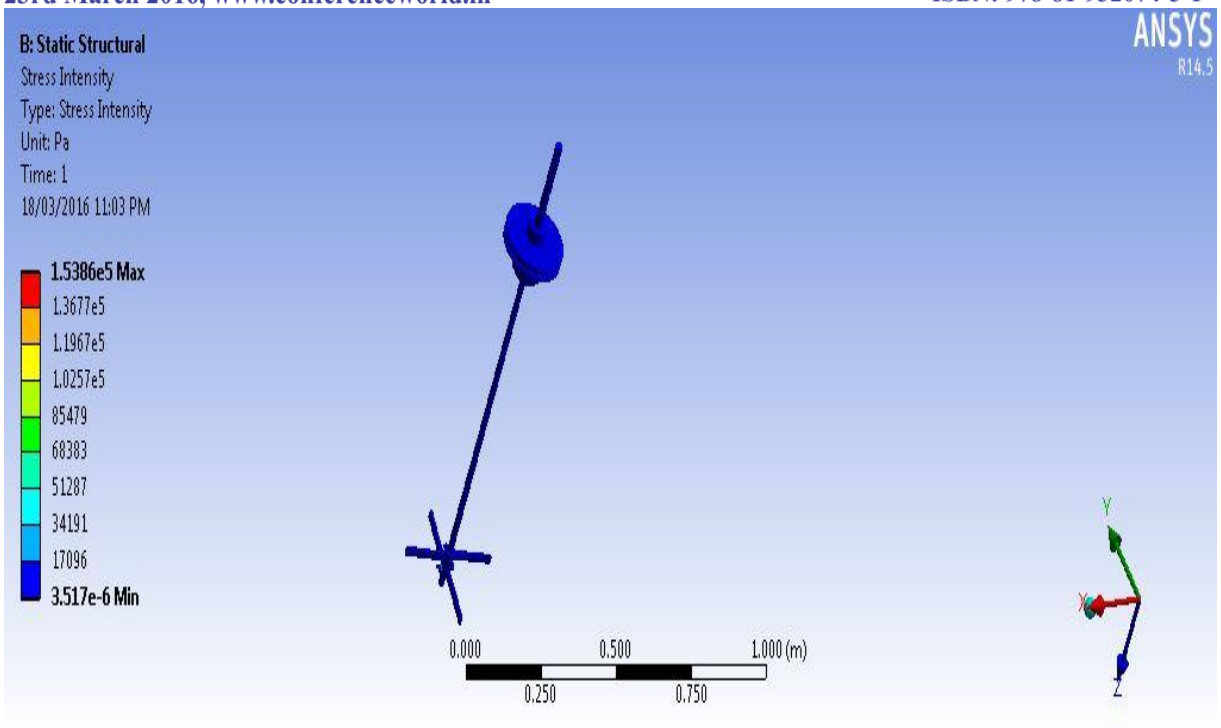

Fig. 2

VI.CONCLUSION

At 300 rpm, mixture is taking 600 seconds for uniformly preparing phenyl of 50 liters capacity.The capacity and the time taken can be varied by changing mixer speed with the help of rheostat. The optimum solution is to achieve the maximum cleaning solution for the purpose of cleaning.

This mixer is been designed and fabricated for mixing of chemical solution ,which is used to for cleaning purposes in educational institutes, offices, hospitals, large shop floor industries etc.

By implementation of this mixer in various applications the time required to make the solution will be reduced and the man power required will be comparatively less also large amount of solution can be stored which can be further used as per the requirement.

VII. AKNOWLEDGEMENT

We would like to express our sincere thanks to Konark Engineering at Ratnagiriwho helped us out in fabrication ofElectrically Powered Mixer for Phenyl, after a lot of practice and hours put into it. Our sincerethanks toProf. S. N. Waghmare of Mechanical Department for giving us the opportunity to take up this paper, for his guidance and supervision in all respects of this paper.

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Sachin N. Waghmare is working as Assistant Professor in Mechanical Engineering Department at Rajendra Mane College of Engg& Technology for last 11 years. He received his MTech in Mechanical Engineering at VeermataJijabai Technological Institute (VJTI),from Mumbai University. His research interest is in the field of reliability, quality, manufacturing and industrial engineering

	SurajPradeep Mail has completed his Diploma in Automobile Engineering at Rajendra Mane Polytechnic, Ambav,Ratnagiri. Presently he is pursuing B.E. in Mechanical Engineering at Rajendra Mane College of Engineering and Technology, Ambav, Ratnagiri. His research interests include Design, Production and Energy
	PranavShantaramNalawade is pursuing his B.E. in Mechanical Engineering at Rajendra Mane College of Engineering and Technology, Ambav, Ratnagiri.His research interests include Design, Production& further studies in Mechanical Engineering.
	DigambarAnantMohite is pursuing his B.E. in Mechanical Engineering at Rajendra Mane College of Engineering and Technology, Ambav, Ratnagiri. His research interests include Design& further studies in Mechanical Engineering.
	PranilDashrathSalunke has completed his Diploma in Mechanical Engineering at RajaramShinde institute of Engineering and Technology, Pedhambe, Chiplun. Presently he is pursuing B.E. in Mechanical Engineering at Rajendra Mane College of Engineering and Technology, Ambav, Ratnagiri. His research interests include Design and Production