GEOMETRICAL AND CFD ANALYSIS OF STIRRER BLADE PROFILE

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ABSTRACT

India has planned to move on green energy to avoid pollution. According to IREDA the amount of the coal used in a year to produce about 260 tonnes which can be supplemented by the bio gas plant, "saving of about Rs. 250 billion, every year. In this project we are intended to make a progress to improve the mixing ratio of the stirrer material which is already in use. The new variant design is used to make the stirrer to improve the mixing ratio. We have chosen twin blade and cross blade design construction done based on hermit curve on CFD software. The final output these blade needs less power and torque.

Key words: *biogas plant, stirrer, stirrer profile, mixing ratio.*

INTRODUCTION

We are taken the stirrer project. The stirrer is device which is used to mix the liquid or solvent. An overhead stirrer is a type of mechanical stirrer, used for stirring solutions in the chemistry lab, though for general purposes, magnetic stirrers are more commonly employed as they're easier to both use and maintain. A many type of magnetic mixer or magnetic stirrer is a laboratory device that use a rotating magnetic field to cause a stir bar immersed in a liquid to spin very fast, thus stirring it. We think that already used stirrer are anchor, paddle, radial propeller, turbine and propeller. Which has less mixing ratio.

So we are decided to change the stirrer design in this project. It is analysis related project. We are decided to increase the mixing ratio and reduce the power need to stirrer

BLADE MODELING (HERMIT SPLINE)

We have created a new design for the stirrer blade based on hermit curve to improve the mixing ratio stirrer blade. Our design based on hermit spline can be classified as two types they are

- Twin blade
- Cross blade

SOFTWARE USED

We have used two software

- CREO parametric
- COMPUTATIONAL FLUID DYNAMICS

PROBLEM IDENTIFICATION

- In biogas plant the stirrer is a component which is used to mix the slurry content the blade design is not efficient enough to stirrer the content well.
- So there is a loss in production of bio gas plant. The amount of the bio gas produced become less.
- The efficiency of the bio gas plant get reduced. in comparison to the amount spend the output produced is less.

OBJECTIVES OF THE PROJECT

- To increase the basic output of mixing ratio by generation of new Hermit Cubic curve blades on the stirrer blade
- To develop a new model of blades by computational and geometrical modelling
- To validate the geometrical profile by computational fluid dynamics
- To optimize the blade design by using Finite element analysis for its structure, and material property.
- The more amount of torque required to digest the slurry content.

METHODOLOGY

- Problem Identification
- Setting Up The Objective For The Project
- Literature Survey
- Mathematical & Geometrical Modelling of Curve For Blade Design
- CFD Analysis For Curve Pattern
- Solid Modelling Of The Blade Using Pro-E
- Structural Analysis Using ANSYS &Validating Model

MODELLING OF HERMITE CUBIC SPLINE CURVE PROFILE USING PRO-E SOFTWARE

Now with respect to the curve pattern generated from the blending function is fed into the PRO-E software were the curve points are plotted and curve is plotted. Now the axis of different points are plotted and spline curve is plotted is shown in Figure 5.1

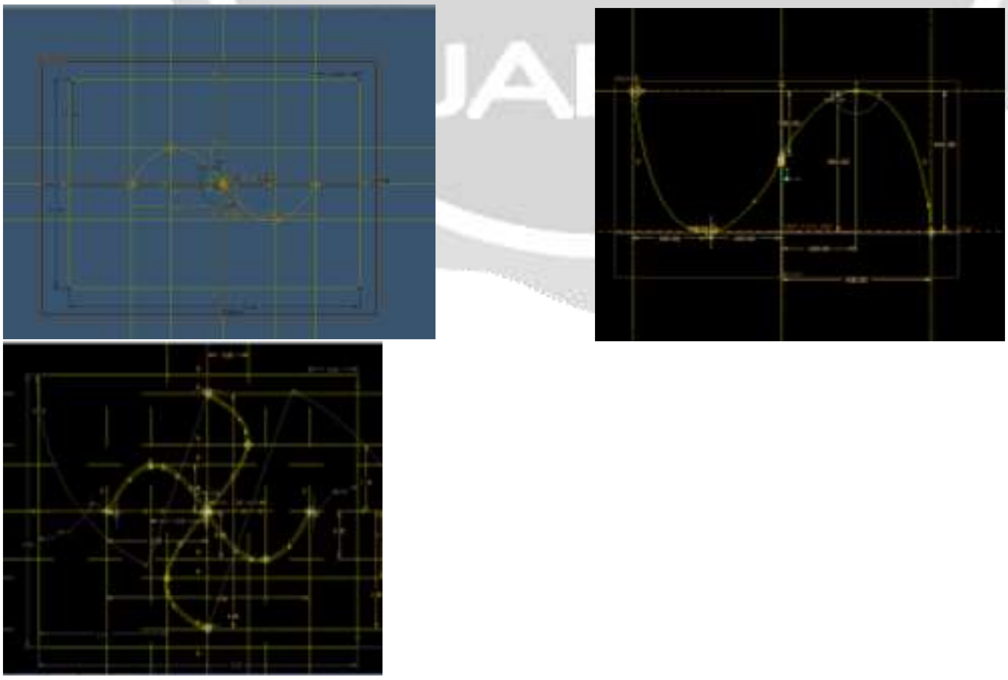
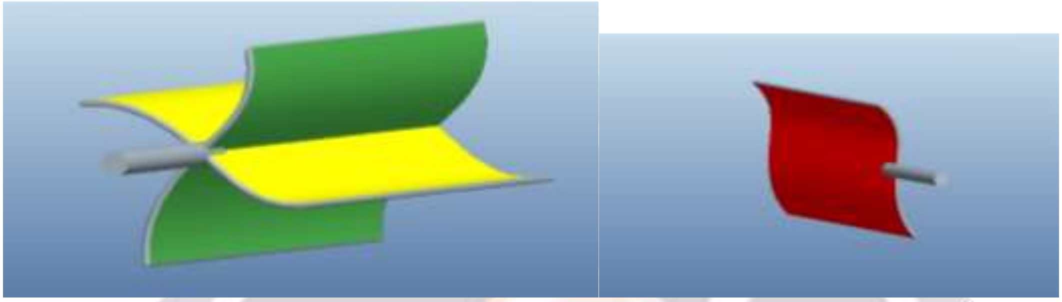
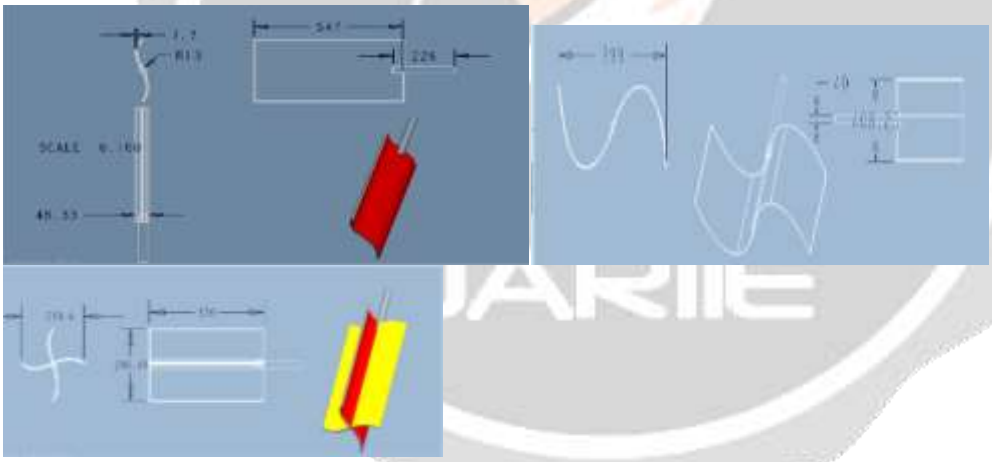


Figure 5.1. The curve pattern generated using the PRO-E software.

A sweep feature is created by taking a sketched profile and sweeping it along a sketched or selected trajectory Figure 4.2 the cross-section of the feature along the entire length of the trajectory is constant. Sketch by reference to the points on the trajectory will updates its shape thru sweep accordingly. This tool is very useful when you are handling some complicated / advanced surface. Now the curve is obtained by sweeping a closed section along an open trajectory, and sweeping an open section along a closed trajectory. Sweeping surfaces is no different than sweeping protrusions, cuts, etc. The biggest difference is that you don’t need to have a closed section. If you have an open trajectory or closed trajectory, you can still have an open profile. The biggest difference is that if the trajectory you are using is the edge of another surface, you may be asked to Join or No Join. If you select No Join, then the new swept surface will be separate from the surface whose edge acted as the trajectory, and a merge operation will still need to be performed to get them to be one large quilt.



(a) 3D view of blade



(b)Drafting of blade

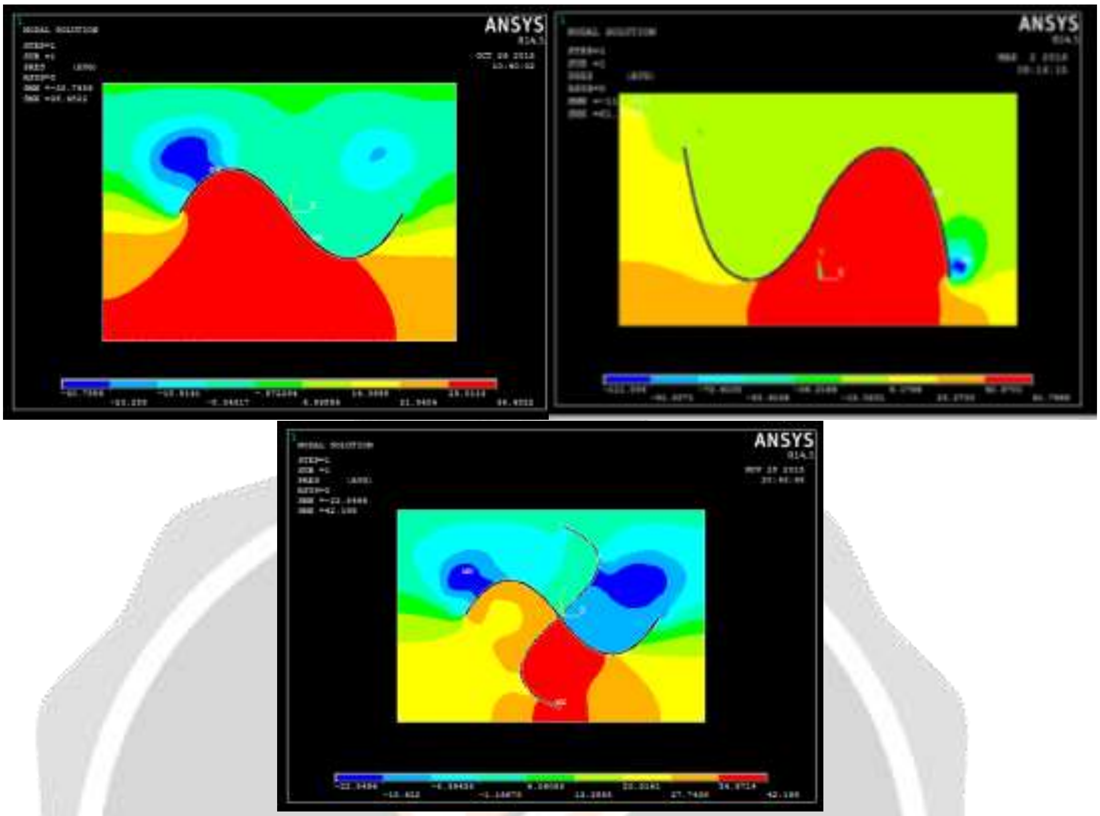
Figure 5.2 The 3D Modelling of the blade profile usnge the Hermite cubic curve by PRO-E software

Now the whole assembly view of the wind turbine for two blade is generated where the system has individual blade profile for each direction of air velocity. This generation for the no of blade we can extend them for up to 4 blades is shown Figure 5.2

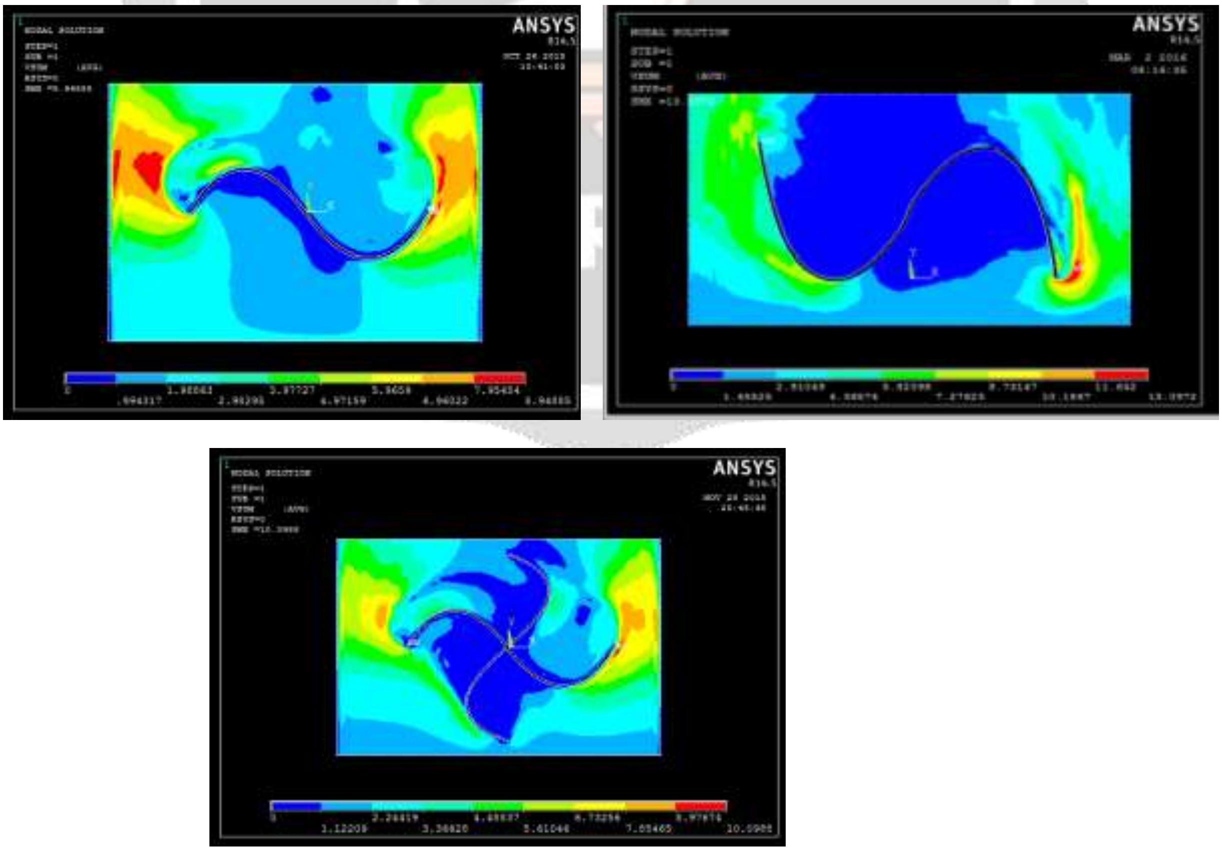
RESULT AND DISCUSSION

Now our profile is been tested for various conditions of inlet velocities and contour plots have been verified is shown in Figure 5from which power calculation is done

Velocity for 2m/s



(a) Pressure contour (Pa)



(b)Velocity contour (m/s)

Table 8.1 Mathematical calculation for the input velocity and the power output for single blade

INPUT VELOCITY (m/s)	MAX PRESSURE OUTPUT (Pa)	MAX VELOCITY OUTPUT (m/s)	SPEED (RPM)	ANGULAR VELOCITY (Rad/s)	POWER (Kw)	TORQUE (NM)
2	36.48	8.94	168	4.47	25	1421.13
4	145.62	17.89	342	8.9	835	23316.52
6	327.56	26.85	513	13.85	6.3E^3	116666.67
8	582.18	35.8	684	17.9	26.7E^3	372924.71
10	909.61	44.75	855	22.38	81.47E^3	909986.55

Now for the various inlet velocity the CFD result is obtained and the maximum velocity of air and pressure is given on the derived equation for the power calculation, then the speed, torque is been calculated and tabulated in the Table 8.1.

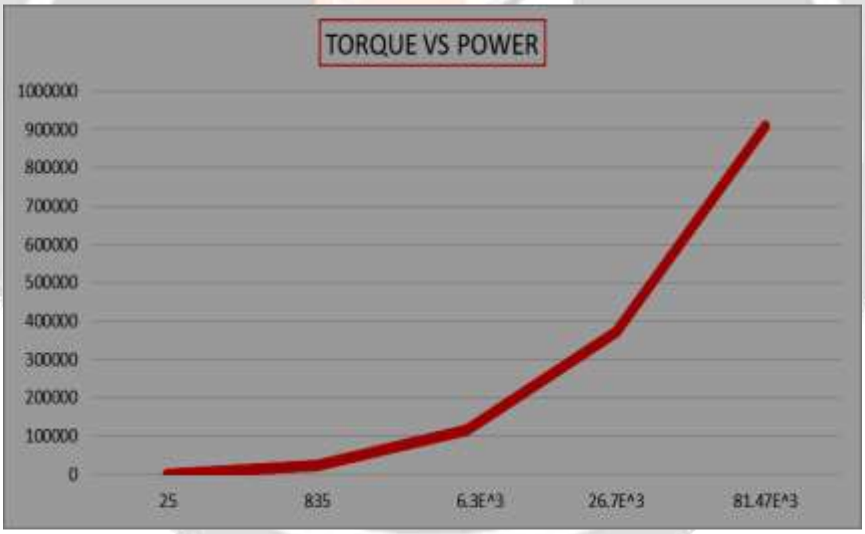


Figure 8.1 Torque vs. Power for single blade

Inference

From the CFD analysis and mathematical derivation for various outputs have been inferred here we have observed that our new model of blade profile provides a better output for mixing ratio is shown in Figure 8.1

Table 8.2 Mathematical calculation for the input velocity and the power output for multi blade

INPUT VELOCITY (m/s)	MAX PRESSURE OUTPUT (Pa)	MAX VELOCITY OUTPUT (m/s)	SPEED (RPM)	ANGULAR VELOCITY (Rad/s)	POWER (Kw)	TORQUE (NM)
2	42.19	10.09	193	5.045	43.34	2144.5
4	165.794	20.2	386	10.1	1366.54	33809.47
6	371.787	30.3008	579	15.15	10.34E^3	170587.08
8	660.17	40.4	772	20.2	43.53E^3	538500.25

Now for the various inlet velocity the CFD result is obtained and the maximum velocity of air and pressure is given on the derived equation for the power calculation, then the speed, torque is been calculated and tabulated in the Table 8.2.

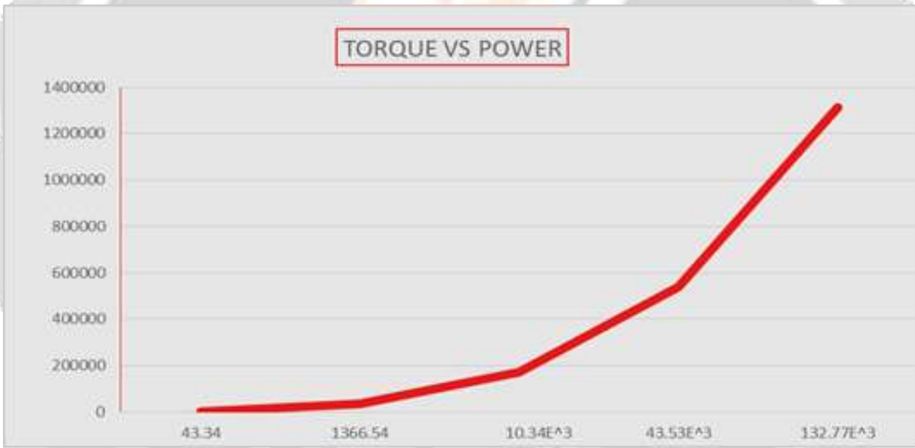


Figure 8.2 Torque vs. Power graph for multi blade

CONCLUSION

As we conclude that the design of stirrer blade with high yield of mixing ratio is been designed. The analysis output of this design model is analyzed in CFD software. This result of the design are added in the above report for verification. From that we conclude that the multi blade profile is more efficient than other blade profile and blade need less power than other blade. The FRP used to make the blade design for more corrosion resistant and give longer life than steel

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