Enhancing The Working Efficiency Ofthe Transmission System Used In Sugarcane Machine

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Abstract- *This project work describes about design and analysis of the transmission system used in sugarcane machine, to improve the performance by reducing the weight and vibration effects. This machine contains rollers, gears, shaft, bearing and belt drive system. Due to unexpected operating condition various faults such as, cross sectional cracks, looseness and misalignment may occur during the operation. The investigation of the stress concentration of the transmission system at varies load conditions are observed with different configurations of the gear system. Here, conventional cast iron gear is replaced to Aluminium silicon carbide gear to reduce the weight and noise. The feasibility of this material is analysed by stress concentration using ANSYS software. From the static analysis the variation of the stress and deformation values of these materials are obtained and better material is recommended for this sugar cane system. To theoretical and ANSYS results are helped to prove the enhancement the effects of the transmission system by reducing the stress concentration.*

Keywords- Alsic gear, cast iron gear, stress and strain analysis, ansys18.0.

I. INTRODUCTION

1.1 SUGAR CANE MACHINE

Fig 1 Sugarcane Machine

Getting a sugarcane juicer machine which is cost-effective, easy to use, low on maintenance & makes you money. When someone is looking for a sugarcane juicer machine, the most important decision is to find a manufacturer who does not only produce the machines but has also spent considerable time to research and practically refine the product. Over the years this is what popular steel industries has exactly done & come up with a sugarcane juice extractor machine which takes into account all the practical needs of anyone planning to install a sugarcane juice machine.

1.2 LIST OF COMPONENTS

COMPONENTS	QUANTITY
HP MOTOR	1
ROLLERS	2
BELT AND PULLEY	1
GEARS	6
SHAFT	4
FRAME	4
ADJUSTING BLOCK	2
SIDE PLATES	4

The above table 1 shows that list of components.

1.2 SPUR GEAR

Spur gears are the widely used power transmitting element between two parallel shafts is shown in figure 1.1. Since the tooth surfaces of the gears are parallel to the axes of the shafts, there is no thrust force generated in the axial direction. Also, because of ease of production, these gears can have degree of precision.

Fig 2 Spur Gear

Spur gears are the simplest type of gear. They consist of a disk with teeth projecting radially. Though the teeth are not straight-sided, the edges of eachtooth are straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts.

II. LITERATURE REVIEW

The review mainly focuses on replacement of cast iron spur gear with the aluminium silicon carbide gear in the application of sugarcane machine.

T. Shoba Rani, et. al. [1] This paper gives information about efficiency, as deflection are less the efficiency of nylon spur gear of more than the cast iron spur gear, results in less noise and long life, the metallic gear results is more deflection compared to nylon and polycarbonate, the cost price and life of nylon is also good. When we replace the metallic spur gear with nylon gear there would be better results we can find in the automobile, robotic and in medical fields where the need of nylon gear is there.

A. Makinde- Ojo,Ayoola Macaj. [2] the improvement of previously constructed sugarcane juice extractor is the main objective of this project work. Comparison of various sugarcane juicers and material change are discussed in this paper.

Mehebub Vohra, et. al. [3] this paper gives information about design-optimization methodology to determine the comparative analysis of spur gear with different material for increase the possibility for application of polymer gears. Research and development on different material spur gear shows that if polymer are design-optimized with sufficient care, it can replace most of metallic gears to take additional benefits like low cost, easy manufacturing, low noises-vibration, low maintenance-lubrication.

J.L. Moya, R. oytisolo, A.E.Hernandez, and J.M. Sierra et al. [4]In this study have performed a theoretical analysis of a procedure to determine the Lewis Factor and also performed the contact analysis of spur gear to fine the stress distribution between gear teeth.

P.B. Pawar. [5] Has developed a metal matrix composite of Aluminium based Silicon Carbide The composition of Silicon Carbide is varied in aluminium and mechanical tests were performed. They proposed to use this material for power transmitting element like gears. Author P.B. Pawar has manufactured the spur gear.

III. CALCULATION OF SPUR GEAR DESIGN

Specification of sugarcane machine motor

Power (P) = 1.5kW =1500 W
Speed (N) = 1400 rpm

$$P = (2 \times 3.14 \times N \times T)/60$$

Torque (T) = 10231.3 N/mm^2

TO FIND FORCE

$$T = F \times (d/2)$$
$$F = T / (d/2)$$
$$F = 155.07 \text{ N}$$

Where,

F= Tangential load (N)

Using Lewis equation,
Allowable bending stress = 1.253 N/mm^2
Allowable stress of aluminum silicon carbide = ultimate tensile strength / 3
Maximum allowable stress as per the design of the desired spur gear
= 151 / 3
= 50.33 N/mm^2
= 50.33 N/mm^2> 1.253 N/mm^2

Hence the design is safe.

IV. ANALYSIS PROCEDURE

1. The geometry of the gear to be analysed is imported from solid modeller Pro- Engineer in IGS format this is compatible with the ANSYS.

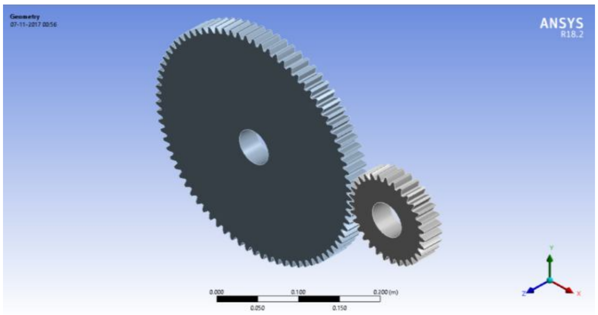

Fig 3 Imported IGS Part

2. The element type and materials properties such as Young's modulus and Poisson's ratio is specified.
3. Meshing the three-dimensional gear model. Figure shows the meshed 3D solid model of gear.
4. The boundary conditions and external loads are applied.
5. The solution is generated based on the previous input parameters.
6. Finally, the solution is viewed in a variety of displays.

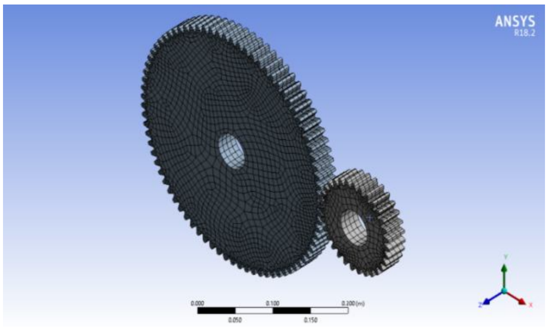

Fig 4 Meshed Spur Gear Model

V. BOUNDARY CONDITIONS

The boundary conditionsacting the role in finite element calculation at this time, we have taken both remote displacement aimed at bearing supports are fixed.

VI. RESULT AND DISCUSSION

6.1 VON MISES STRESS (EQUIVALENT STRESS)

Von-mises stress is widely used inengineers to checked whether their planresolve withstand a given load condition. Von misses stress is considered to be a safe port for design engineers. Consuming this data,asourcecontainerabout the design resolve fail, if the determined value of von- Mises stress induced in the material is more than strength of material. It works well for most cases, especially when the material remains in ductile nature.

The curve plots display the mean of maximum value and the mean of minimum value, which remain produced over the time period. The design is based on this value only. But in the plot the maximum value produced at particular section of time is not considered as a maximum boundary value or design value.

6.1.1 FOR CAST IRON GEAR

The distribution of equivalent stress in gear tooth is shown in fig.

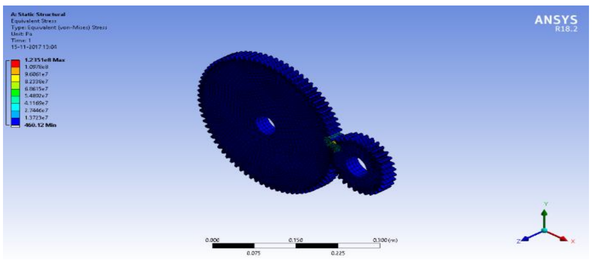

Fig 5 Equivalent Stress for Cast Iron Gear.

6.1.2 FOR ALUMINIUM SILICON CARBIDE COMPOSITE GEAR

The distribution of equivalent stress in composite gear is shown in fig.

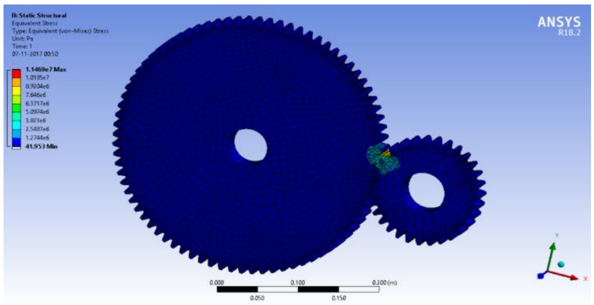

Fig 6 Equivalent Stress forAL Sic

6.2 EQUIVALENT STRAIN

6.2.1 FOR CAST IRON GEAR

The distribution of equivalent strain in cast iron gear tooth surface is shown in fig.

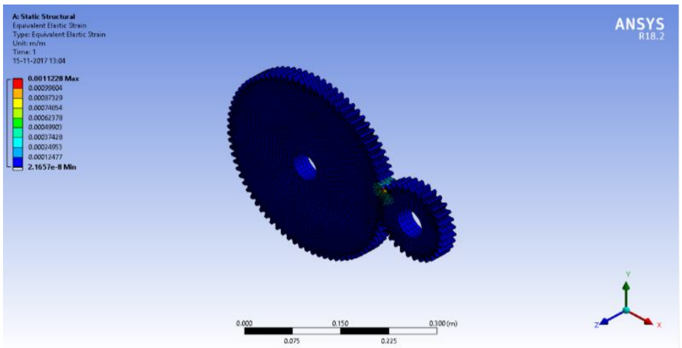

Fig 7 Equivalent Strain for Cast Iron Gear

6.2.2 FOR ALUMINIUM SILICON CARBIDE

The distribution of equivalent strain in composite gear tooth is shown in the fig.

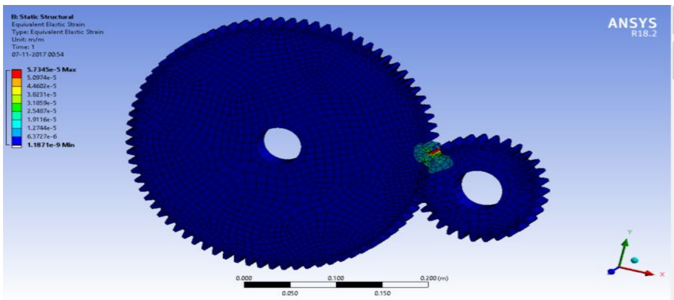

Fig 8 Equivalent Strain for Aluminium Silicon Carbide Gea

6.3 DEFLECTION

6.3.1 FOR CAST IRON GEAR

The distribution of deflection on cast iron gear tooth surface is shown in fig.

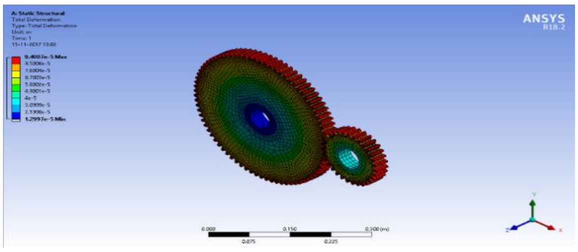

Fig 9 Deflection for Cast Iron Gear

6.3.2 FOR ALUMINIUM SILICON CARBIDE GEAR

The distribution of deflection on composite gear tooth surface is shown in fig.

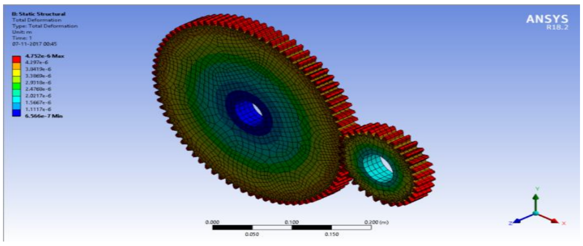

Fig 10 Deflection for Aluminium Silicon Carbide Gear.

6.4 ANALYSIS TESTING RESULTS

6.4.1 ANALYTICAL RESULTS FOR CAST IRON GEAR

Table 2Analytical Results for Cast Iron Gear

s.no	Load(N)	Von mises stress (N/mm^2)	Deformation (m)	Equivalent strain (m/m)
1	155.07	8.147	6.201×10^{-6}	7.407
2	180.85	9.501	7.232×10^{-6}	8.632
3	217.13	11.41	8.687×10^{-6}	10.37
4	271.42	14.28	10.876×10^{-6}	12.99

The above table 2 shows that Analytical Results for Cast Iron Gear.

6.4.2 ANALYTICAL RESULTS FOR ALUMINIUM SILICON CARBIDE GEAR

Table 3Analytical Results for Aluminium Silicon Carbide Gear

s.no	Load(N)	Von mises stress (N/mm^2)	Deformation (m)	Equivalent strain (m/m)
1	155.07	8.231	3.392×10^{-6}	1.160
2	180.85	9.607	3.956×10^{-6}	1.353
3	217.13	11.54	4.751×10^{-6}	1.625
4	271.42	14.47	5.949×10^{-6}	2.034

The above table 3 shows that Analytical Results for Aluminium Silicon Carbide Gear.

6.4.2 THEORETICAL RESULTS FOR CAST IRON GEAR

table 4 Theoretical Results for Cast Iron Gear

s.no	Load(N)	Von mises stress (N/mm^2)	Deformation (m)	Equivalent strain (m/m)
1	155.07	9.33	6.53×10^{-7}	0.101×10^{-3}
2	180.85	8.64	5.19×10^{-7}	0.093×10^{-3}
3	217.13	10.91	5.46×10^{-7}	0.118×10^{-3}
4	271.42	12.92	5.17×10^{-7}	0.140×10^{-3}

The above table 4 shows that Theoretical Results for Cast Iron Gear.

6.4.3 THEORETICAL RESULTS FOR ALUMINIUM SILICON CARBIDE

Table 5 Theoretical Results for Aluminium Silicon Carbide

s.no	Load(N)	Von mises stress (N/mm^2)	Deformation (m)	Equivalent strain (m/m)
1	155.07	9.20	3.95×10^{-7}	0.061×10^{-3}
2	180.85	8.26	3.04×10^{-7}	0.055×10^{-3}
3	217.13	9.91	3.03×10^{-7}	0.066×10^{-3}
4	271.42	12.39	3.04×10^{-7}	0.082×10^{-3}

The above table 5 shows that Theoretical Results for Aluminium Silicon Carbide.

VII. CONCLUSION

The analysis results of von-mises stress, Deformation and strain energy induced in Aluminium silicon carbide gear is within the allowable limit. Hence Aluminium silicon carbide gear has the capacity to replace the cast iron gears in sugarcane machine. The weight and noise can be reduced by using aluminium silicon carbide composite material instead of cast iron as gear material. Also the mechanical properties such as hardness, toughness, corrosion resistance are higher than that of cast iron. It is concluded that the aluminium silicon is suggested for gear material with improved performance by reducing the weight and vibration effects and increase the efficiency of the sugar cane machine.

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