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DESIGN IMPROVEMENT OF HYDRAULIC JACK FOR REMOVING TUBELESS TYRE OF AN EARTH MOVER

T. Niruban Projoth ,R. Rohith Renish ,
P. Jeyaraman
G. Anandh
Assistant Professor, PG Scholar,
Department of Mechanical Engineering,
VelTech Rangarajan Dr Sagunthala R&D,
Institute of Science and Technology
Chennai 600062, India.
Department of Industrial Engineering,
College of Engineering,
Guindy, Anna University
Chennai 600025, India
niruban@veltech.edu.in,
rohithrenish@veltech.edu.in,
jeyaraman@veltech.edu.in
ganandh89@gmail.com ,

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Abstract

The basic hydraulic jack can be used in the removal of the tubeless tyres is known as Hydraulic Bead Extractor. This type of tubeless tyres can be used in the Field of Machineries like Dumpers, Water sprinklers and Cranes. This

type of hydraulic jack which has the problem of breakage of Wedge at the Edge portion. This kind of Hydraulic Jack is taken for project study with suitable design and modifications are carried out in order to improve the performance of the Hydraulic Jack. The wedge of this jack is designed in such a way that the maximum load is applied at the edge. In this paper we discuss and analyze the problems existing in the jackand an improved design is proposed in order to make the hydraulic jack more efficient than present different types of jacks available in the industries.

***Key Words*:**Earth moving devices; hydraulic jack; knurling; wedge

1 Introduction

Machinery Yard is dealing with maintenance and repair works of cranes, dumpers, water sprinklers, tractors and trailers. This equipment is fitted with various size tyres. The following are fitted with tubeless tyres are cranes, dumpers & water sprinklers. For removal of tyres from the wheel assembly, a hydraulic bead extractor is used as manual removal of tyre from the wheel rim is difficult [1].

Fig .1 HYDRAULIC JACK (Hydraulic Bead Extractor)

The arrangements of the hydraulic jack is shown in fig. which includes hydraulic pump, hydraulic cylinder and wedge arrangement. A set of 4 assemblies are used to remove the tyre from the rim.These tyres does not have property as conventional tyres which are used in tractors, transport vehicles etc. These tyres possess a good rating in ply. The tyre has to be replaced. For replacing the tyre, the wheel has to be removed out from the vehicle. In most of the case, the tyre removal is becoming very difficult with man power. Hence the tyre bead extractor with hydraulic system is being used. The wheel assembly details of a tube less tyre is shown in the Fig 2.

The edge design in the wedge is subjected to high pressure and load to remove the tyre from the wheel rim. Uniform distribution of load is not achieved in the edge design. During high resistance experienced in removal, the edge portion gets broken upthat it can withstand the resistance. The design of the edge needs improvement so that it will not break at high load during removal[2].

Fig 3. Breakage in the edge

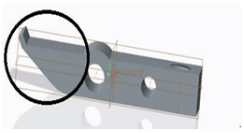


Fig. 4 Modification area

Table 1.fleet strength of tubeless tyres

Tyre specification : 18.00 x 25, 32 PR	
Water sprinklers	6
35 T Dumpers	4
Number of tyres in each machine	6
Total number of tyres handled	60
Tyre specification : 29.5 x 29, 29 PR	
Fleet of C-Cranes	14
Fleet of telescopic cranes	1
Total number of tyres handled	60

The design of the wedge is modified in order to increase the efficiency of the hydraulic bead extractor. The main disorder is found in the design of the wedge and hence the design improvement increases the life span of the product and it makes the jack to increase the gripping capacity.The function of jack is studied and practically handled in order to analyze for understanding the problem.

2 ANALYSIS ON THE PROBLEM

Thereis a defect in the hydraulic jack. Therefore the problem and the solution for the hydraulic jack should be cleared.

Table 2 .Jack description

Capacity of each jack	20 tons
Capacity of 4 jacks	80 tons
Hydraulic Stroke	275 mm

The hydraulic power acting on the wedge is not transmitted uniformly throughout the wedge. Hence the load is concentrated only on the edges of the wedge .Hence the edges tend to break. This makes the outage of bead extractor for frequent use and man power is exploited. The frequent use of the jack reduces the life span of the jack. Hence the design of the wedge is the basic defect in the hydraulic jack [3].

Fig.5 Breakage part in the wedge

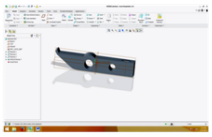


Fig. 6 Design of existing wedge

Hence by increasing the area, it sustains uniform distribution of load and it also increases the gripping capacity of the wedge. This intend increases the efficiency of the jack. The design planning was done and the design was done with Creo 2.0 Software (3 D software).The design of the wedge is not engineered to spread the load uniformly throughout the wedge. This tends to arise the following problem such as breakage in the wedges, gripping capacity is low and the efficiency also reduces.

The analysing process was done with ANSYS software. The analysing was done in order to check the improved design productivity. The analyzing process was done with proper guide, for getting accurate results.The fig.7 shows the analysis of the existing wedge design of the jack. It clearly notifies the breakage in the edges. The red part shows the breakage in the jack. Initially the breakage occurs in the edges and then to the middle part[4]. If

the jack tends for more usages there is a risk of breakage in the wedge middle part. Hence this may cause minor accidents to the workers and damage to the environment they work, because mostly unskilled labours are employed.

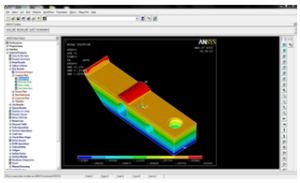


Fig. 7 Stress analysis of the existing jack

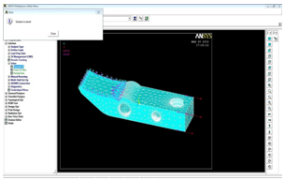


Fig. 8 Meshing of shells

The Analysis is done with following steps: selection of the type of the material analysis (structural), real constraints, material, meshing, load, solution, result and output.Fig.8 shows the meshing of shells and load is applied to it. After all the solution is compiled by the software, it evaluates the nodal solution and thus the results are obtained. The Fig 10 shows the result of the analysis in a single chart, it cannot be observed for a better result[5]. There are many plots for defining the analysis output. But most of the analysis process goes through the animated analysis process. This shows clearly about the analysis process.

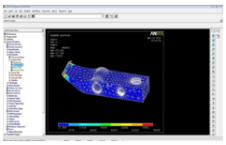


Fig. 9 Plot result of analysis

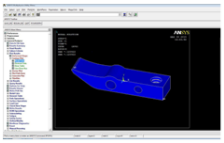


Fig. 10 Plain design before analysis

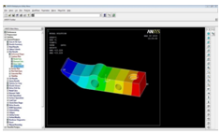


Fig. 11 Design 1 analysis

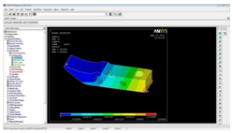


Fig. 12 Design 2 analysis

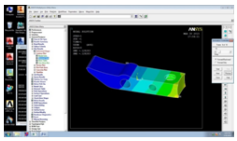
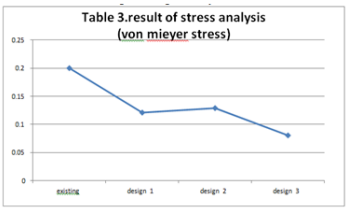


Fig. 13 Design 3 analysis



The above line graph shows that design 3 is the more efficient of spreading the load uniformly. The stress analysis proves the design 3 is better than other designs. Hence the design 3 is validated as better for the wedge improved design.

3 IMPROVED DESIGN

The beak portion of the wedge is modified and analyzed. The below design is the final result of analysis. It bears more stress uniformly while others are not negligible. Knurling is been done to the design to avoid deformation.

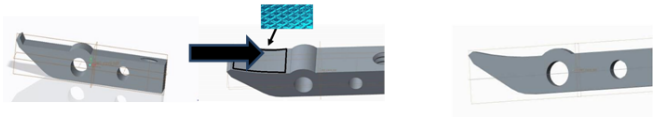


Fig. 14 Comparison of Existing design and Improved design

The improvement in the design improves the life of the product. The gripping has been increased with this type of design and the time of the removal of the tyre has been decreased. More number of tyres can be removed in short span time.Time reduction during removal of tubeless tyres with new designed wedge is achieved. Frequent breakage of the wedge and reconditioning works totally avoided is considered to be the tangible benefit.

4 CONCLUSION

Thus the problem was analyzed and the improvement on the wedge of jack is done based on certain analysis. Based on certain studies and suggestions by experts, knurling was also done in the design such as to improve the grip of the jack when holding the rim. Thus the improvement in the design improves the life of the product.

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