

# Failure Analysis of Beater Shaft of Double Roller Ginning Machine using FEM

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**Abstract**— Ginning is the process of separation of cotton fibers from its seed. In the cotton ginning machine there is a fixed knife and moving knife. This moving knife is called as beater and it oscillates about its central longitudinal axis of the beater shaft. The fixed knife is in contact with the roller made of leather linings. The distance between the roller and the fixed knife is adjusted according to the quality of the raw cotton. Using this fixed knife and rollers cotton fibers are captured and the beater beats the held cotton to remove seed from it. During the operation the shaft fails at particular point due to wet cotton and after some duration (fatigue failure). In order to remove these failures two approaches will be used i.e. changing the dimensions of the shaft or changing the material of the shaft which will remove the failure at greater extent. So first we will design and analysis the beater shaft using Pro E and ANSYS 12.0 software respectively and finding the failure at particular point and also redesign the shaft and analysis of the same.

**Key words:** Ginning machine, beater shaft, beater shaft design, and failure analysis

## I. INTRODUCTION

Textiles constitute an important component of India's economy. Ginning is the first and most important mechanical process by which seed cotton is separated into lint (fiber) and seed and machine used for this separation is called as gin. This process is repeated for number of times and due to push-pull-hit action the fibers are separated from the seed, carried forward on the roller and dropped out of machine. The ginned seeds drop down through the grid which is oscillating along with beater. This paper reviews the existing literature and research work related to ginning machine, design and analysis of shaft and many more. The study is done for providing best solution on the failure of beater shaft of DR ginning machine.

### A. Review Of Ginning Machine:

P.G.Patil (Central Institute for Research on Cotton Technology (ICAR), Nagpur) and P.M. Padole (Dept. of Mech. Engg., Visvesvaraya National Institute of Technology, Nagpur) in his paper titled DOUBLE ROLLER COTTON GINNING MACHINE: ITS DRAWBACKS AND POSSIBLE MODIFICATIONS explained the Detail design study revealed that present Double Roller (DR) Gin carries several drawbacks. In order to remove these drawbacks two conceptual modified models of DR gin were designed using Pro/ENGINEER software. Best design of modified DR gin found to be simple in operation, energy efficient, requires minimum operational cost, and consumes less spares. Saving in space requirement of the machine is observed to be 54 %. This modified design minimized lubricating points and application of grease. This design facilitates precise control over roller pressure. Machine

manufacturing is very easy. This machine is very sturdy and operator friendly.

Prashantkumar Gulabrao Patil, Vaishali Patil in his paper titled 'Development of Prototype Double Roller Gin with Improved Power Transmission and its Performance Evaluation' explained the new power transmission system of double roller gin. Double roller gins are commonly used in India for ginning seed cotton. International Textile Manufacturers Federation's survey 2005 reported that degree of grease and oil contamination in cotton lint is serious in India. Study revealed that the source of this contamination is the gearbox (power transmission system) of double roller gin as it is filled with grease/oil measuring about 20 kg. Prototype double roller gin has been designed and developed with new power transmission system which minimizes the use of oil and grease to a great extent. High Volume Instrument's results on fiber parameters indicated that quality of lint is at par with existing double roller gin with no prospect of oil and grease contamination. Developed machine is useful for cotton breeders, ginners, farmers to ascertain the ginning percentage and purity of seeds could be maintained. This prototype double roller gin could be the basis for design of modified double roller gin of a commercial size.

P. G. Patil (Corresponding Author) Central Institute for Research on Cotton Technology, Nagpur, P. M. Padole Visvesvaraya National Institute of Technology, Nagpur, India, A. B. Dahake Central Institute for Research on Cotton Technology, Nagpur, K. M. Paralikar, Central Institute for Research on Cotton Technology, Mumbai, J. F. Agrawal Yeshwantrao Chavan College of Engineering, Nagpur in his paper titled Improving Lint Quality using Modified Double Roller Gins in India explained the present research design and develop a modified double roller gin. Test data was generated through experiments conducted on a specially designed experimental set up employed on an existing commercial DR gin. Those data were then used to design and develop a modified DR gin. The ginning performance of the modified DR gin was then evaluated.

Mr. M. K. Sharma – President, Bajaj Steel Industries Ltd., Nagpur India in his paper titled 'Cotton Ginning Technologies - Selection Criteria for Optimum Results' explained the ginning technology which is most suitable for the type of cotton available for ginning should be selected i.e. for the black seed long and extra long staple cotton if it is clean McCarthy Single Roller or double Roller should be selected but if it is machine picked / having higher trash then roto bar should be used. For fuzzy seed cotton up to medium staple cotton if it is having higher trash Saw Gin set up should be used however if it is hand picked / clean Double Roller should be used to obtain best fiber parameters.

Gurumurthy Vijayan Iyer , Nikos E. Mastorakis WSEAS in his paper titled Environmental Effects of Chrome Composite Leather-Clad Rollers Commonly Used by Cotton Roller Ginning Industries and Design and Development of Chromeless Rubberized Cotton Fabric Roller for Cotton Double Roller Ginning Machines explained the hazards of chromium contamination and pollution caused by the use of Chrome Composite Leather-Clad (CCLC) rollers commonly used in cotton roller ginning industries and attempts to eliminate the chromium contamination and pollution during the cotton ginning process. The cotton ginning process is the first phase of mechanical operation in cotton textile production. Cotton grown in the plant, commercially known as seed-cotton (or kapas), consists of 24 to 40 seeds per boll.

Mr. M.K. Sharma, President, – Bajaj Steel Industries Limited, Nagpur in his paper titled NEW DEVELOPMENTS IN COTTON GINNING explained the Double Roller Ginning Technology has become most advantageous particularly in context of Africa and Asia and in the future may be used by many other countries in the other part of the world, which is evident from the fact that most recently some ginning factories in the PERU & EGYPT have started using Double Roller Ginning Technology based ginning factories. Due to wide spread acceptance of this technology after various developments as indicated above, the production of Double Roller Gins has increased from around 3000 prior to 10 years back to now about 12000 Double Roller Gins per annum in year 2008, thus this technology is the fastest developing ginning technology in the present times.

Mr. M. K. Sharma – President, Bajaj Steel Industries Ltd., Nagpur in his paper titled 'Advances in Cotton Ginning Technology in India 2010-2013' explained the various operations in a ginning & pressing factory is being continued to further improve the quality and cost efficiency as well as ease of operations for ginning & pressing factories and many advances have taken place in the past few years to improve the processing of this unique crop, each component of which is having multiple uses similar to items like coconut where each component adds to value. Continued journey of advances is day by day improving the areas remaining to be addressed for the cotton processing sector in most beneficial manner.

#### B. Review of Design and Analysis:

Prof. P. S. Nerkar<sup>1</sup>, Dr. J. F. Agrawal, Mr. P.D. Deshpande in his paper titled Analysis of Power Transmission System for Ginning Machine with Feeding Mechanism using FEA explained their commendations and suggestions to improve quality of cotton fiber, suggestions for ginning factories are highlighted. In India, it was found that ginning factories do not operate efficiently with regard to the labour force employed and the amount of capital invested. In order to make a more concrete evaluation of the cotton ginning sector, it is necessary to determine the structural characteristics of the factories, costs and profitability, the level of technical efficiency, and the most important, potential for improvement in the industry. Irregular feeding of Seed Cotton to ginning machine decreases the production rate of seed and fiber. It also affects the quality of the fiber and seed. To overcome these difficulties feeding mechanism

is developed. The primary function of feeding mechanism is to feed seed cotton uniformly to the ginning machine at controllable rates. Feed rollers, located at the bottom of the feeder, directly under the hopper, control the feed rate of seed cotton to the ginning machine. Stress analysis carried out by using FEA software and the results are compared with the calculated values. This paper illustrates how the chain drives are very important to carry forwards the power. Shrikant V. Peshatwar and Laukik P. Raut in his paper titled Computer Aided Fixture Design for Machining of Key-ways on Eccentric Shaft explained the Fixtures reduce operation time and increases productivity and high quality of operation is possible. Eccentric shaft play an important role in application of ginning machine. Machining of keyways on eccentric shaft is an important task. Machining on simple shaft is easy as compare to eccentric shaft by conventional process. Machining of keyways on eccentric shaft is a time consuming process, so reducing this time is a main aim. The job having a cylindrical shape and number of keyways are required on it at a different position. This is a challenging task for design engineer and hence Computer Aided Fixture Design (CAFD) is incorporated in manufacturing industry. It deals with the integration of CAD and CNC programming in CAM systems using software's for fixture design. Except V block, no other option is available to hold cylindrical object and hence special type of fixture is designed for this case, which can be used for machining of keyway on eccentric shaft.

Gurumurthy Vijayan Iyer , Nikos E. Mastorakis WSEA in his paper titled 'Environmental Effects of Chrome Composite Leather-Clad Rollers Commonly Used by Cotton Roller Ginning Industries and Design and Development of Chrome less Rubberized Cotton Fabric Roller for Cotton Double Roller Ginning Machines' explained the hazards of chromium contamination and pollution caused by the use of Chrome Composite Leather-Clad (CCLC) rollers commonly used in cotton roller ginning industries and attempts to eliminate the chromium contamination and pollution during the cotton ginning process. The cotton ginning process is the first phase of mechanical operation in cotton textile production. Cotton grown in the plant, commercially known as seed-cotton, consists of 24 to 40 seeds per boll. This approach towards design and analysis of beater shaft have not done before and there are very less literature available on this topic only related references are taken for guidance.

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