

Preventing beater arm failure in cotton ginning machine towards enhanced productivity and energy conservation

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Abstract

The beater arm is exposed to a high oscillating torque of 1000 rpm through the main rotating shaft. The beater shaft is attached through gear mechanism to a 1440 RPM motor and due to Gears, 1000 RPM is transmitted to beater arm. During its working it was observed that the left arm of beater arm breaks at a particular location frequently. Its working was observed on various geographical locations and sites but the same problem continued to occur. The Maximum breakage cases were at the left arm itself.

To study the breakage statistics, complaints from various customers were studied. The number of samples are collected from various sites and every sample and tested. Still the problem existed from various locations.



REJECTION PERCENTAGE OF BROKEN BEATER ARM

A Monthly record was maintained to find out how many pieces of beater arm are manufactured in that month and out of which how many are rejected. Also the reasons for rejection were listed and also the no. of

parts rejected due to that reason was mentioned. This data helped in finding out the Parts per million Quantities and also the rejection percentage.

Parts per Million Formula:

$$\text{PPM} = \frac{\text{Rejected Quantity} \times 10 \text{ lac}}{\text{Manufactured Quantity}} \times 100$$

CHEMICAL COMPOSITION OF BEATER ARM

Beater arm is made up using Spheroidal Graphite Iron (SG iron) of Grade 500/7. Chemical composition is an very important Factor in any type of Failure or Breakage. It is observed that in any analysis of breakages or failure the first analysis test conducted is of Chemical composition. Every small element in the composition contribute to Various Factors of that Product such as strength ,Hardness, ductility etc.

The SG iron of grade 500/7 provides a typical Tensile strength of 500N/ mm². Also it provides a elongation of 7%.S G Iron/Ductile iron is not a single material but is part of a group of materials which can be produced to have a wide range of properties through control of the microstructure. The common defining characteristic of this group of materials is the shape of the graphite. In ductile irons, the graphite is in the form of nodules rather than flakes as it is in grey iron. The following Table gives the Chemical Composition of Beater Arm.

OBSERVATIONS OR POSSIBLE REASONS OF FAILURE

[1] Occurrence of Blow Holes:

Blow holes were observed in the inner side when the broken profile of Beater arm was observed visually. Basically, blowhole is a kind of cavities defect, which is also divided into pinhole and subsurface blowhole. Gases entrapped by solidifying metal on the surface of the casting, which results in a rounded or oval blowhole as a cavity. The occurrence of blow holes state that there is a fault in chemical composition or molding process, so blow hole may be the most probable reason of failure.

[2] Internal Cracks

The second possible reason observed was cracks developed at the arm joint. The possible conclusion may be the voids or the chemical composition of the material is not able to sustain the high oscillating load at 1000 Rpm. Undetected cracks in the product can bring about potential safety hazards when the product is put in use. Factors such as localized tensile stress and stress concentration result in crack initiation and propagation. On the other hand, conditions such as high temperature, compressive stress and diffusion are conducive to crack healing. The factors that affect crack propagation may result in micro cracks extending to macro cracks. On the contrary, macro cracks probably close gradually, and may heal completely under the right conditions

[3] Improper Clamping or Lifting Method

The 3rd Possible reason may be the Clamping Method. The C hooks used in lifting the machine is directly attached on the main rotating shaft passing through the beater arm. This indirectly exerts a huge amount of pressure on Beater arm causing Cracks and developing internal stresses in the beater arm. It is said that the main functioning part of machine should never be stressed before operation. But here it is not followed.

Possible implications and preventive measures taken

1. The supplier of Material was immediately changed because maximum observations intended towards fault in material. The test reports after change of supplier are yet to come.
2. The amount of material at the joint of the both arms of the Beater arm was increased for providing greater strength at the joints. The material was uniformly increased as a slope from bottom to top of the Joint.
3. Also arc size at the joint was increased. Increasing the arc size provides a greater amount of area to sustain heavy cycles of load exerted on the beater arm.

Keywords: Internal stresses, clamping method, heavy cycles of load exerted, solidifying metal.