International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 05 | May -2019 ISSN: 2395-0126

Review Study of Bearing Cup Failure due to different Heat Treatment process

Prof. Dhiraj V .Gundare ,Jagadale Maheshwari D[1], Sakhare Pallavi R [2], Sonawane Rahul B[3]

Automobile Engineering Department, Dr .D Y Patil soet lohegaon pune

Savitribai Phule Pune University

dvgundre@gmail.com

jagdalemaheshwari73@gmail.com

pallavisakhare358@gmail.com

rahul.3256.rs@gmail.com

➢ **Abstract-**

In automobile industry power transmission system are used according to different features of vehicle driving type. There are many types of layout used in automobile vehicle .its include engine, clutch ,transmission unit, propeller shaft , universal joint,differential ,axle and wheels.at time of vehicle assembly different types of load (fatigue load),acting on transmission system this load is effect on universal joint assembly.due to the failure of universal joint that's way customer faced many difficulties hence we decide eliminate the bearing cup failure with cost effective solution .in study analysis decide to conduct surface heat treatment process in include carburising ,nitriding, carbonitriding compere the with each other process after conducting wear test.

Keywords— propeller shaft , universal joint ,carburising, nitriding, carbonitriding.

1.INTRODUCTION

The automobile is a typical industrial product that involves a variety of material and technologies. The present societal needs that metallic materials are ideally suited for applications in heavy stressed components that require high durability.The heavy load applied on bearing cup materialwhen the vehicle in running condition due to fatigue failure in bearing cup material get fail, this failure reduced with the help of increasing the strength of bearing material by using various heat treatment process.

2 .Literature review

Bayrakceken et.al. [2006] did failure analysis of an automobile differential pinion shaft which reveals that the fracture has taken place at a region having a high stress concentration by a fatigue procedure under a combined bending, torsion and axial stresses having highly reversible nature. The crack of the fracture is initiated probably at a material defect region at the critical location. Makevet et.al.[2006] in their paper present a case study in failure analysis of a final drive transmission in an off-road vehicle. The failure involved a satellite gear mounting shaft that departed from the differential assembly as a result of fracturing of a retaining pin.

Asi [2006] studied the failure analysis of a rear axle shaft used in an automobile which had been involved in an accident. The axle shaft was found to break into two pieces. The investigation was carried out in order to establish whether the failure was the cause or a consequence of the accident. An evaluation of the failed axle shaft was undertaken to assess its integrity that included a visual examination, photo documentation, chemical analysis, microhardness measurement, tensile testing, and metallographic examination. The failure zones were examined with the help of a scanning electron microscope equipped with EDX facility. Results indicate that the axle shaft fractured in reversed bending fatigue as a result of improper welding. Substituting composite structures for conventional metallic structures has many advantages because of higher specific stiffness and higher specific strength of composite materials. In their work Lee et al.[2004] one-piece automotive hybrid aluminium/ composite drive shaft was developed with a new Manufacturing method, in which a carbon fibre epoxy composite layer was co-cured on the inner surface of an aluminium tube rather than wrapping on the outer surface to prevent the composite layer from being damaged by external impact and absorption of moisture. The optimal stacking sequence of the composite layer was determined considering the thermal residual stresses of interface between the aluminium tube and the composite layer calculated by finite element analysis.

➢ METHODOLOGY FOR ANALYSIS :-

1.Hardening – To improve the hardness ofbearing cup, resulting increase life of bearing cup and make it tough we use hardening process.The material is heated above its critical transformation temperature and then it is cooled quickly by using quenching process. Hardening is remove the internal stress present in material

2.Annealing – During annealing, metals are heated to a specified temperature and held there for a prolonged period of time. They then undergo cooling, which can be fast or slow, depending on the type of material and desired characteristics. This process refines the grain structure of the material, making it easier to work with. With metals that cannot undergo heat treatment, annealing helps to reduce the hardness caused by cold working.

3.Quenching – Quenching involves cooling a metal at a rapid rate. Its impact on metal properties varies from alloy to alloy. Ferrous alloys, for instance, will harden when quenched, whereas non-ferrous alloys will tend to become softer. Cooling can be conducted using a gas such as air or nitrogen. Most often, however, liquids like water or oil are used. Due to the rapid rate of cooling, quenching builds up stresses in the material which must be relieved by tempering.

4.Tempering – As mentioned previously, tempering is a procedure that alleviates the stresses built up in the material during other heat treatment processes. Metals are reheated at a low temperature to attain a desired combination of strength, hardness and durability. Tempering time and temperature are controlled to produce the desired material properties. Steels are always tempered after quenching in order to relieve stresses and reduce the brittleness from hardening.

➢ HEAT TREATMENTS

Selection of steel types and grades and appropriate heat treatment methods are very important to produce components of reliable quality. The control of a given alloy‘s chemical composition and the inclusion content of steel have an impact upon and can create variance in an alloy‘s properties. Other contributing factors impacting the quality and reliability of final components include refining, casting, rolling and cooling methods. Further strength, toughness, fatigue strength and wear properties result largely from the microstructure and hardness results created by heat treatment condition and methods applied.

1.Carburizing

Carburizing is a case-hardening process in which carbon is dissolved in the surface layers of a low-carbon steel part at a temperature sufficient to render the steel austenitic structure, followed by quenching and tempering to form a martensitic microstructure. The resulting gradient in carbon content below the surface of the part causes a gradient in hardness, producing a strong wear-resistant surface layer on a material, usually low-carbon steel, which is readily fabricated into parts.

In gas carburizing commercially the most important variant of carburizing the source of carbon isa carbon-rich furnace atmosphere produced either from gaseous hydrocarbons, for example, methane (CH_4), propane(C_3H_3), and butane (C_4H_{10}), or from vaporized hydro-carbon liquids. Carburizing is a remarkable method of enhancing the surface properties of shafts, gears, bearings, and other highly stressed machine parts.

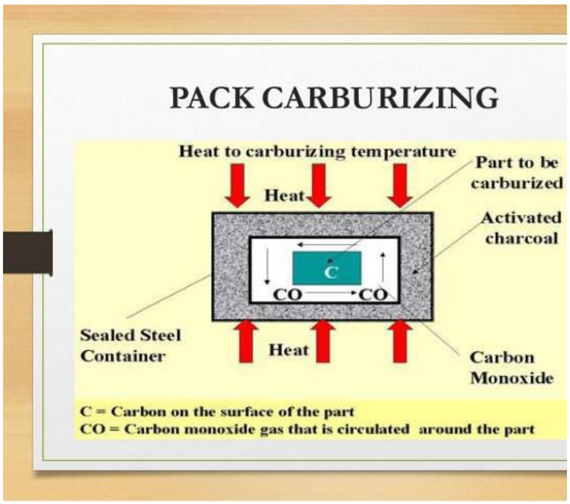


Fig:- carburizing

2. Carbonitriding

Carbonitriding is a modified form of gas carburizing, rather than a form of nitriding. The modification consists of introducing ammonia into the gas carburizing atmosphere to add nitrogen to the carburized case as it is being produced. Nascent nitrogen forms at the work surface by the dissociation of ammonia in the furnace atmosphere; the nitrogendiffuses into the steel simultaneously with carbon. Typically, carbonitriding is carried out at a lower temperature and for a shorter time than is gas carburizing, producing a shallower case than is usual in production carburizing. In itseffects on steel, carbonitriding is similar to liquid cyaniding.

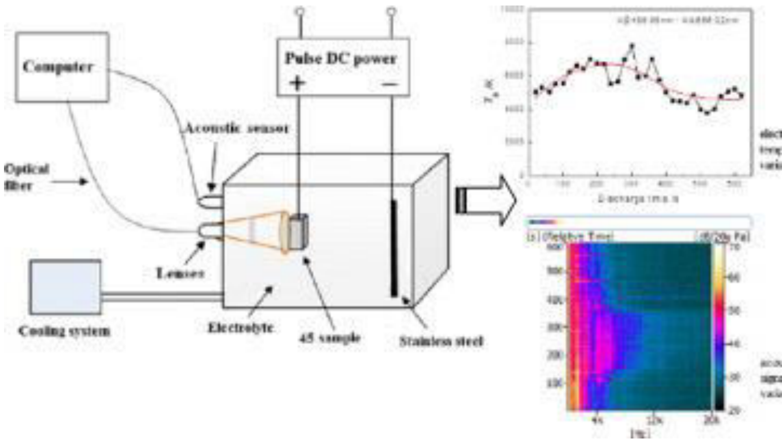
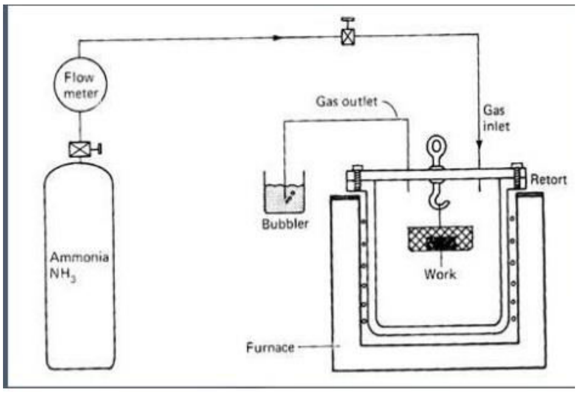


Fig :- carbonitriding

3) Nitriding:-

Gas nitriding is a case-hardening process whereby nitrogen is introduced into the surface of a solid ferrous alloy by holding the metal at a suitable temperature (below Ac1, for ferritic steels) in contact with a nitrogenous gas, usual ammonia. Quenching is not required for the production of a hard case. The nitriding temperature for all steels is between 495 and 565 °C (925 and 1050 °F).The term liquid nitriding has become a generic term for a number of different fused-salt processes, all of which are performed at subcritical temperature. Operating at these temperatures, the treatments are based on chemical diffusion and influencemetallurgical structures primarily through absorption and reaction of nitrogen rather than through the minor amount of carbon that is assimilated. A typical commercial bath for liquid nitriding is composed of a mixture of sodium and potassium salts.



➢ **Conclusion:-**

As this problem is chronic concerns and high severity concern, systematic concern resolution process is adopted to analysethe problem and find out cost effective solution.

The overall conclusion is, the above heat treatment process can help to improve the material strength, hardness, life of materials. By using various heat treat method it prove that every method is work as per material application. The every heat treatment process using as per their application, while the carburising heat treatment process can use full to improve the hardness of material ,toughness and durability , increase its overall strength due present of carbon percentage increase in material. Similarly nitriding process is a case-hardening process and carbonitriding is carried out at a lower temperature and for a shorter time than is gas carburizing, producing a shallower case than is usual in production carburizing. In its effects on steel, carbonitriding is similar to liquid cyaniding.

REFERENCES

[1] M. Godec, DJ. Mandrino, M. jenko ―Investigation of fracture of car‘s drive shaft Institute of Metals and TecnologyLjubljana , Slovenia, Elsevier- Engineering failure analysis, pp 1252-1261,2009.

[2] H. Bayrakceken,,Failure analysis of automobile differential pinion shaft|| Elsevier -Engineering failure analysis, pp 1422-1428,2006 [3] E. Makevet, I Roman, Failure analysis of final drive transmission in off-road vehicle|| Elsevier -Engineering failure analysis , pp 579-592,2002

[4]Osman ASI,Fatigue failure of rear axle shaft of an automobile|| Elsevier-Engineering failure analysis, pp 1293-1302,2006.

[5] Dai Gil Lee, Hack sung Kim, Jong woon Kim, Jin kook kimDesign and manufacture of an automotive hybrid aluminum/composite drive shaft|| Elsevier-Composite structures pp 87-99,2004.

[6] S.A. Mutasher, Prediction of torsional strength of the hybrid aluminum/composite drives shaft|| Elsevier- Materials and Design 2009 pp 215-220.