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Effects of Carburizing on Wear Properties of Steels

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Abstract:- The present investigation is the over view of carburizing process and its effect on wear properties various types alloy steels. Carburising is one of the process of surface hardening and sufficient toughness at the core for increasing hardness over the surface of steel component so that wear resistance at the surface of steel component of steel component can be improve. Aim of carburizing is to increasing carbon content in low carbon steel at the surface.

Keywords:- carburizing, hardening, wear, friction

I. INTRODUCTION

In many industries steel component are manufactured should require good mechanical properties. mechanical proper ties means good hardenability. Carburizing is generally employed in industries because it is the most economical method of case hardening. This method is generally employed for low carbon steel having carbon percentage up to 0.20 or lower than that. This hardness and we resistance and breakage upon impact is useful in parts such as a cam or ring gear that must have a very hard surface to resist wear, along with a tough interior to resist the impact that occurs during operation.

II. CARBURIZATION

Carburizing with certain case depth result in high hardness and increase in mechanical, fatigue and wear strength. In carburizing of steel a low carbon steel placed in an atmosphere that contain sufficient amount of carbon monoxide. In carburization the addition of carbon to the surface of low carbon steel is done at temperature generally between 850-950 degree Celsius. Carburized layer generally being controlled at between 0.8 and 1% **C**. surface carbon is often limited to 0.9% because too high a carbon content can result in retained austenite and brittle martensite.

III. TYPES OF CARBURIZATION

There are following types of carburization processes exist.

A. Solid Carburization

The solid or pack carburization involves heating the steels parts embedded in powdery mixture of 85% coal and 15% $BaCO_3$ at a temperature in range 900-950 degree Celsius. The residual air in the box combines with carbon to produce Co gas. Carbon monoxide gas is unstable at the process temperature and thus decomposes upon contacting the iron surface by reaction.

$2CO = C + CO_2$

The atomic carbon enters the steel through the following reaction.

$Fe+2CO = Fe(C) + CO_2$

The addition of $BaCO_3$ enhances the carburizing effect. $BaCO_3$ decomposes and evolves CO_2 which react with coal to form carbon monoxide.

$C+CO_2 = 2CO$

solid carburization is a time consuming procedure. Typical carburizing time to obtain a case depth of 1-2 mm is around 6-8 hours.

B. Gaseous Carburization

The gaseous carburization is carried out at temperature in range 900-950 degree Celsius. Carbon monoxide and various hydrocarbon are used as a carburizers. They decompose at the process temperature and form atomic carbon. methane, propane, or natural gases are use as carburizer. It is very essential to accurately control the composition and flow rate of carburizing gas. Gas carburization is the main process in mass production. In gaseous carburization process diffusion of carbon can be accurately done by using diffusion period.

A quick hardening is obtain in gaseous carburizing by direct quenching in oil. this type of carburizing process is cleaner and closer quality control can be achieved.

C. Liquid Carburization

This is the method of case hardening steel by placing it in a bath of molten metal cyanide so that carbon will diffused from the bath into the metal and produce a case comparable to one resulting from pack or gas carburizing. liquid carburizing is differ from cyaniding by composition of case produce i.e. in cyaniding case is higher in nitrogen than carbon which is reverse in liquid carburisation.

IV. LITRETURE REVIEW

B. Selc¸uk, R. Ipek, M.B. Karamıs [1]. The friction and wear characteristics of AISI 1020 and 5115 steel surfaces improved by various thermo chemical heat treatments such as carburizing, carbonitriding and boronizing were determined. Samples prepared from the test materials were treated at liquid and gases carburizing, gases carbonitriding and solid boronizing mediums. The hardness distributions, microstructures and X-ray diffraction studies were performed. The wear tests were carried out with pin-on-disc sample configurations and weight losses were determined as a function of sliding distance and applied load. The friction behaviors of tested samples were also examined. it is conclude that the heat treating capacity of a simple steel such as AISI 1020 was determined and compared with other treated steel samples. it is also found that Boronized low carbon steels can be used instead of carburized or carbonitrided low alloyed steels to be worked under light friction load.

R. Ipek, B. Selcuk [2] The variation of the wear mechanism and the worn surface profile of the cam shaft were investigated under the dry wear conditions. The samples which were made of AISI 1040 were hardened by induction. The counter body material was AISI 1020 borided steel. The wear was determined as weight losses of the samples as a function of wear test duration and loads. The variation of camshaft profile was captured by a level sensor during the wear. The profile variation was continuously monitored on the computer screen throughout the tests. It was found that the wear mechanisms of the cam surface change along the contact surface. The maximum wear value was obtained just to cam tip.

M. Preciado, P.M. Bravo, J.M. Alegre [3]. The effect of deep cryogenic treatment on the hardness and wear resistance of carburized steels used in gears was studied. The performance of the deep cryogenic treatment on quenched and tempered (first stage of tempering) steels, increased the wear resistance but the hardness was only increased in steels tempered at 200 ◦C. To avoid the influence of the retained austenite, and considering this presence beneficial for its application on gears, it was stabilized prior to performing the cryogenic treatment. It is suggested the possibility of creation of nuclei sites during the 200 ◦C tempering, where new segregations of carbon and alloying elements could cluster during the cryogenic treatment producing an increase in the hardness.

B. Selc,uk, R. Ipek, M.B. Karamis,, V. Kuzucu [4]. In this study, the wear behavior of the borided and carburized AISI 1020 and 5115 steels are investigated. Some of the samples prepared from test materials are carburized and some borided. The microstructure, worn surface and hardness distribution of the samples are examined. After and before wear testing, the surface phases of the treated samples are determined by X-ray diffraction method. Fe2B phase is obtained on the borided surface. The wear tests are conducted with plate-on-disc sample con®guration under dry sliding conditions. The wear behavior and friction characteristics of the samples are determined as a function of sliding distance and the load. The results are compared with each other. It is observed that the weight loss of the borided AISI 1020 steel is lower than that of carburized AISI 5115 steels.

Boyel, D.O. Northwood, R.bowers, X. Sun, P.bauerle [5]. Another study complements work on the effect of initial microstructure and heat treatment on the residual stresses, retained austenite, and distortion of the same carburized automotive steel. the feasibility of using either a new steel or heat treatment process cycle require acceptable properties in both the case and the core; both directly affect part quality and performance. It is noted that the PS-18 steel was noted to have higher ultimate tensile strength and lower chary impact toughness than the SAE 8620 steel.

Sandor, L. T.; Politori, I.; Gonçalves, C.S.; Uehara, A.Y.; Leal, C.V.; Sato, M [6]. For the simulation of carburized layer, samples made of SAE 43XX were employed, varying the content of carbon from 0.20 to 1.00 %. Specimens were copper layer electroplated, and then, they were heat treated in a cycle of carburizing, quenching, and tempering in five different temperatures to expose them to the thermal effects without diffusion of carbon. The results of the micro hardness for the steels and for the analyzed conditions are presented. The curve of micro hardness has the same profile of a carburized layer for the SAE 4320 heat treated in the same conditions. The crack growth rates as a function of delta K for three tempering temperatures are plotted. It is show that when the hardness is high at 200 ºC tempering temperature, there is a scattering of the curves and for the case of lower hardness at 600 ºC tempering temperature, the curves are closer. With increasing of tempering temperature there is a decreasing of the hardness and a significant effect of the metallurgical condition of the resistance of fatigue crack growth. Further, with decreasing of the carbon content there is a very significant increase on the resistance of the fatigue crack growth. As a result of that, in the case of a carburized layer there is a raise of the fatigue crack growth resistance when the crack grows into the steel, from the surface to the core.

S.Ilaiyaveial, A. Venkatesan [7]. The wear performance of manganese phosphate coating on AISI D2 steel were subjected to various heat treatment. the surface of manganese phosphate coating was studied by scanning electron microscope and X-ray spectscopy. the wear test were preformed in pin on disc apparatus. the result of the wear test shows that annealing after manganese phosphate coating gives lowest coefficient of friction and lowest rise in temperature at higher load.

V. CONCLUSION

The process of carburisation were discussed due to requirement in automotive industries on large scale. This process is extensively used in industries to improve wear resistance and mechanical properties such as hardness, toughness, and friction wear. This process is employed for steel component having low carbon percentage. Various types of low carbon steel alloy were carburized in different heat condition and wear and mechanical properties were studied in many experiment.

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