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Short Communication

A Qualitative Assessment of a Restored Ball Joint Stud

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Abstract

According to the construction of automotive ball joints, most frequent failures occur in ball joint stud ball surface and socket. In order to assess the quality of restored ball joints, the restoration methods were analyzed. As the socket is made of softer material compared to the stud ball, no cases of damage to the stud ball without damaging the socket have been observed. Restored ball joints were sectioned and analyzed. The damage pertaining to minor damage to the ball and stud, Minor damage to the stud and major damage to the ball and Major damage to the ball and stud have been identified and observed. A 43 % reduction of strength was observed when the stud ball was just polished when it suffered a minor damage. However, a hardness reduction of 66 % was observed in the welded section compared to that of the case hardened section of the parent material.

Introduction

Many automotive components are being rebuilt due to various reasons. One being non availability of spare parts after discontinuing the production and second being economic reasons. Ball joints are one of the components among many, which require frequent replacement. The ball joints are designed to give three degrees of freedom as nodding, rolling and turning. To facilitate these movements, the ball joint is made of a ball, supported in between top and bottom sockets [1, Schmidová, 2021]. Mainly three different methods of ball joint restoration was observed in the industry depending on the severity of the damage and nature of the damage. The main components of a ball joint is shown in Figure 1. The ball joint consists of a Ball Joint Stud which make the rounded part of the joint. This part rotates in a lubricated space supported by ball sockets.

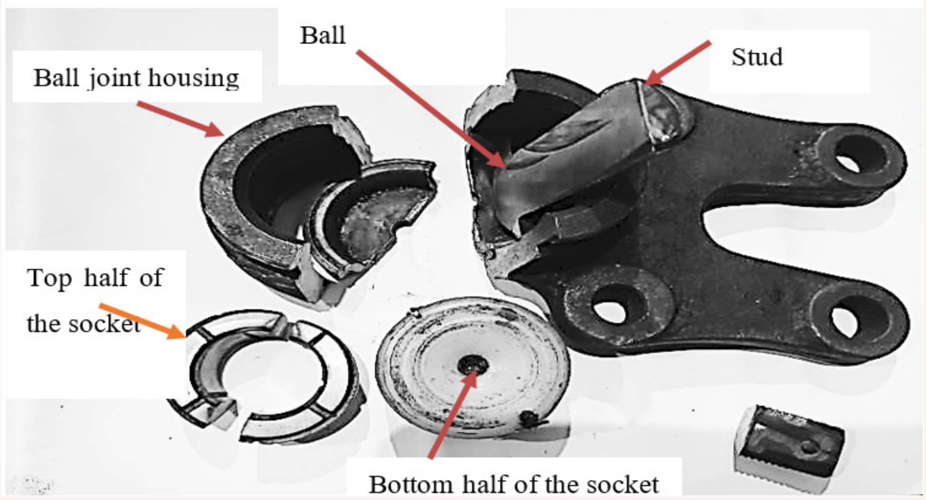

Figure 1: Components of a ball joint.

The stud is expected to bear most of the load transmitting through the suspension system to the vehicle body. When the ball wears out it become nonfunctional and move too much due to the clearance created by the wear. Ball joint socket acts to reduce friction inside the ball joint. It is made of a synthetic material such as be urethane or nylon in most of the cases. All this is housed in the ball joint housing which also connects to one side of the suspension system. Cold-hot forming is used by the mechanical part manufacturing industries for mass production of small or medium sized mechanical parts, [2]. In forging, initial materials which are cut from bars, are formed progressively to final shapes by operations including shearing, upsetting, forward and backward extrusion, piercing, etc. [3].

Methodology

First, the restoration methods applicable to ball joints was investigated in the industry. Mainly three different methods based on the severity and the damaged location could be observed as follows:

i. Minor damage to the ball and stud
ii. Minor damage to the stud and major damage to the ball
iii. Major damage to the ball and stud

According to the construction of ball joints, most frequent failures occur in stud ball surface and the socket. As the socket is made of softer material compared to the stud ball, no cases of damage to the stud ball without damaging the socket have been observed. In order to examine the quality of restoration of such ball joints, restored ball joint was dismantled, and physical examinations were carried out. The stud of each analyzed ball joint was sectioned and the hardness was measured at locations shown in Figure 2.

Figure 2: Hardness measuring points on the stud ball.

Results and Discussion

Hardness is a mechanical property that can be used to quantify the resistance of a material to withstand mechanical forces such as indentation, abrasion, cutting or scratching [4]. The results of hardness measurement on a new ball stud, polished stud ball at 1 mm depth and a restored ball stud with arc welding after severe wearing off is given in Figure 3. Ball joints with severe damage to the stud ball and minor damage were sectioned and compared with that of a new. When compared with the new one, the polished stud ball had a reduction of hardness throughout the profile. The maximum reduction in the hardness was 43 %. On the severely damaged profile, due to the damage to the ball, the surface of the ball has been filled with welding and was machined subsequently to get the original shape. The maximum reduction of hardness was 66 %. However, the points J and K which refers to the core of the structure did not have a significant change in hardness in all three cases analyzed.

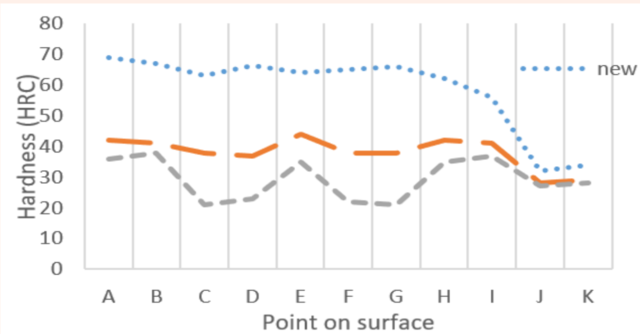

Figure 3: Hardness profiles.

The welded section was observed under the microscope. The structure of the interface between the parent material and fusion zone of the weld is shown in Figure 4. The initial investigation of the section revealed three distinct regions, core in the middle and the case on the surface. In addition to the core and the case, there was another section which at a glance looked aien. This section can easily be identified as the restored section by local welding and subsequent machining. An image of the fusion zone obtained under the microscope is given in Figure 4.

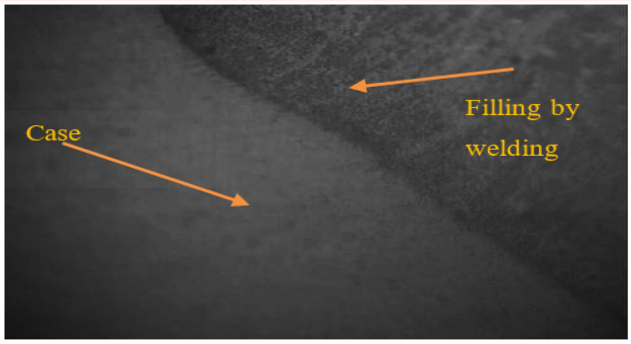

Figure 4: Fusion zone of case and welded filling.

Conclusions/Recommendations

The analyses reveal that restored studs had a lower hardness value compared to the original surface. However, the stud with minor damage which could be restored to use by polishing the surface had a reasonable surface hardness compared to that of the severely worn out one with welded filling. The maximum reduction in the hardness for the 1mm polished surface was 43 %. On the severely damaged profile, due to the damage to the ball, the surface of the ball has been filled with welding and was machined subsequently to get the original shape. The maximum reduction of hardness was 66 %. If the ball is severely damaged, it can be recommended to carry out a suitable heat treatment procedure before welding to the parent material to accommodate better fusion and carryout a surface hardening for the restored ball and stud in order to accommodate a homogenous micro structure with high surface hardness.

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