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RESIDUAL STRESSES AND ITS TRIBOLOGICAL AFFECTS

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Abstract: The study has been made on behavior of mild steel under the effect of residual stresses. To perform the experiment a HSS blunt tool has been used on shaper. The experiment has been performed on specimens under different contacting force. Specimens have been deformed plastically differently at different position. Behavior of mild steel has been determined by measuring the hardness on different plastically deformed lines.

I. INTRODUCTION

Failure in static loading form only a small proportion of the total numbers of failures of machine parts. The predominent numbers of failures are due, not to static failures, but to excessive deflection, fatigue fractures, corrosion and wear. And in all of these types of failures, the residual stresses play an important role.

Residual stresses are the stresses that remain in the body in the absence of any external load. These stresses are the consequences of the history of plastic deformation, which may be due to mechanical working, thermal expansion or volume changes at micro level transformation. Residual stress may be desirable or undesirable. Most mechanical processing operations such as machining, casting, rolling, welding and shot peening involve non uniform plastic deformation; this induces residual stresses in the work piece. The magnitude and sign of the residual stresses induced in the material by a given process depends upon the processing parameters and the properties of the material.

II. TOOL SETUP

In this work a different tool post in shaper has been used for measurement of ploughing wear. For this Instead of a cutting tool, a blunt HSS tool has been used. In this tool -post, combination of 3 springs have been used which are useful for measuring the force applied by tool on work piece.

Figure 1- tool setup

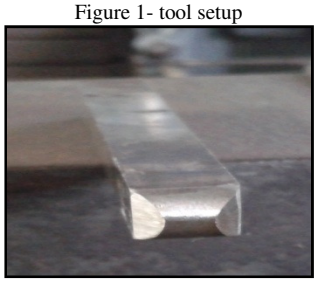

Figure2- HSS Blunt Tool

III. SPECIMENS PREPARATION

To prepare specimens two different type of mild steel raw material have been taken.

1. First specimen has been prepared by grinding operation.
2. Second specimen has been prepared by turnig, grinding, buffing, etching etc. these successive processes is done for removal of residual stresses produced by each machining operation.

Etching: mixture of 98% ethyl alcohol & 2% HNO_3 are applied on entire surface of work piece for 2 minute and then washed by distil water. Then after work piece is rubbed on filter paper to remove the top layers affected by residual stresses.

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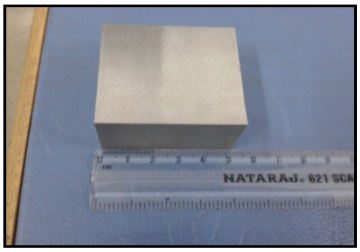

Figure3- Mild Steel Specimen of quadrilateral shape

III. Experiment

1. Preparation of specimens.
2. Specimens have been put on shaper with corrected tool holder.
3. HSS blunt tool has been contacted with specimen first with 0.2 mm depth. Then it has been moved only once over the specimen by scratching it. Because of using blunt tool, chips have not formed and material is plastically deformed.
4. The same procedure is used with different contact depth 0.4, 0.6, 0.8, 1.0 mm.
5. Hardness on scratched and non scratched portion has been measured by using Brinell hardness tester.

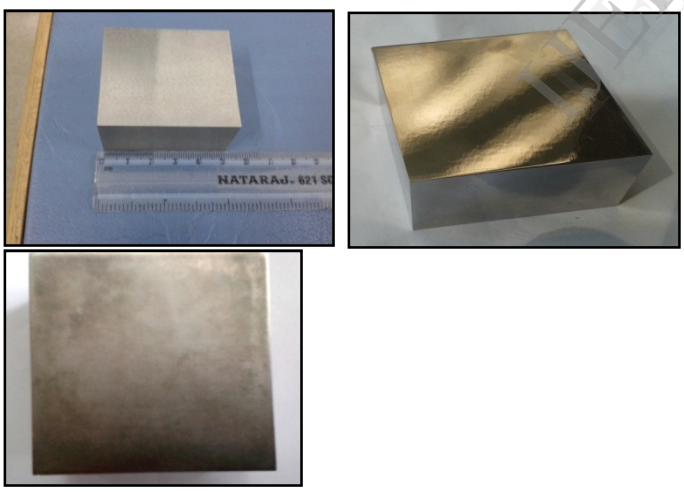

Figure4-prepared specimen

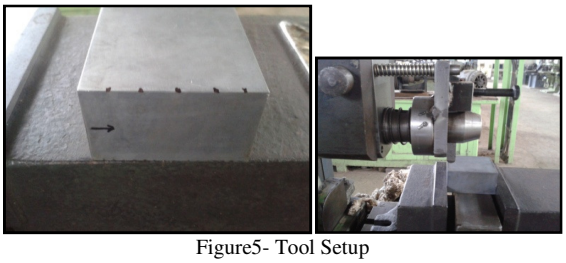

Figure5- Tool Setup

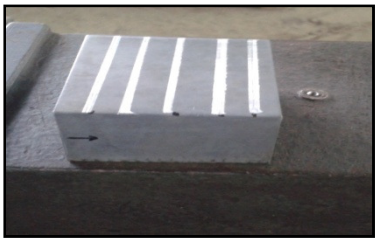

Figure6- Specimen after Scratching Operation

Figure7- Hardness Testing of Specimen

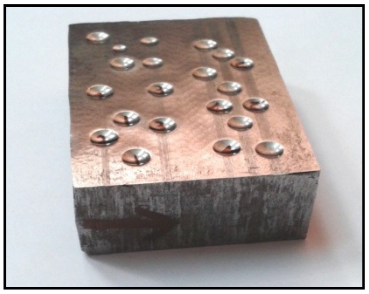

Figure8- Specimen 1

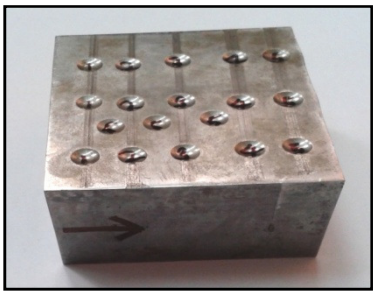

Figure9- Specimen 2

IV. OBSERVATION

Specimen 1st-

Contacting Depth (mm)	***BHN***
0	143
0.2	137
0.4	142.5
0.8	148
1.0	150

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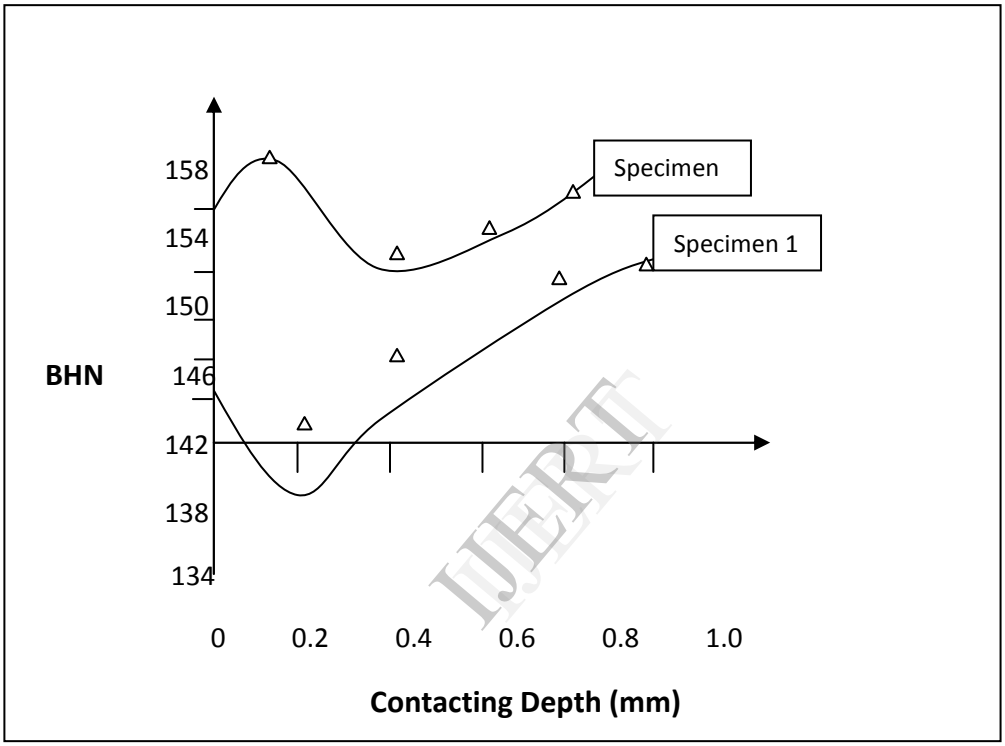
Specimen 2nd

Contacting depth (mm)	***BHN***
0	155
0.2	156.33
0.4	150.66
0.6	152.66
0.8	155.66

Behavior Graph of Mild stee:



Specimen 1

1. At 0.2 depth contact there was drop in hardness of material. The reason was that some amount of residual stresses (produced by grinding) were present at surface layers which were released first and effect of contact force was not more.
2. There after the value of hardness increased significantly due to sufficient plastic deformation.

Specimen 2

The behavior of graph shows that at the surface the earlier residual stresses were negligible and there was increase in hardness even at low contact force. But some amount of residual stresses was present beneath the surface layers which were released first and then again there was increase in hardness due to more contact forces.

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