AN EXPERIMENTAL STUDY-REPAIR AND MAINTENANCE WELDING OF BILLET SHEAR BLADES

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SYNOPSIS

In olden days the concept of repairing and reclaiming the engineering components was a sensitive issue whereas in the present days due to the development of welding technology and its consumables calls for adaption of maintenance welding wherever possible. With this view in mind, the used and damaged cold billet shear blades of Seamless Steel Tube Plant (SSTP) was reconditioned by maintenance welding or hard facing. This paper deals with the selection of welding process, consumables, preparation of specimens for conducting various experiments for its mechanical properties, test results, maintenance welding and usage of shear blades, etc.

INTRODUCTION

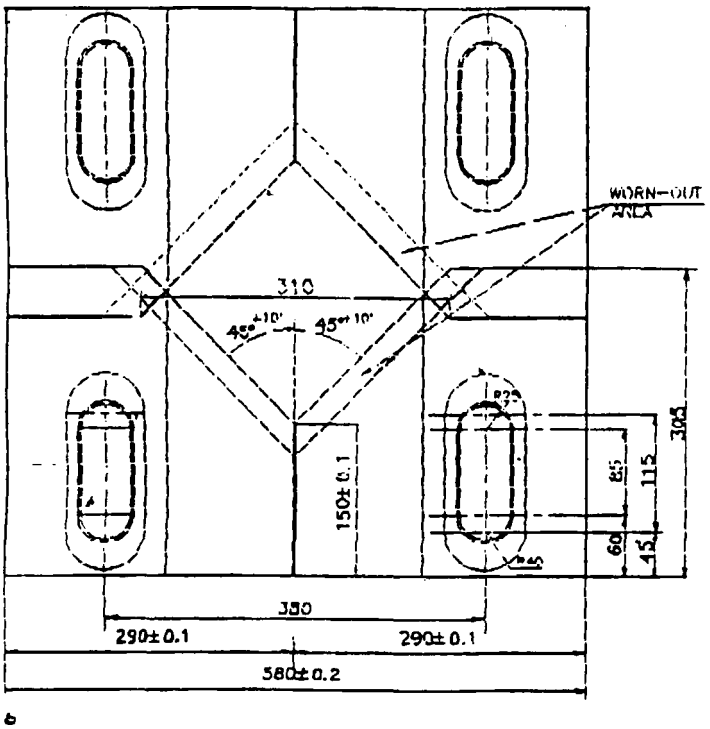
As a part of repair or reclamation activities in Seamless Steel Tube Plant of BHEL, Trichy, the tubes making tooling components are being reconditioned by metallising, hard chrome plating, hard facing by welding, maching etc., By this approach, the high cost imported and intricate shape used tools are being reconditioned by removing the damaged portion and then matching the profile with template, conversation of used and small worn out radius profile to the next higher radius profile. Salvaging and recycling of drive shafts and bevel gear housing by metalising and hard chrome plating, recondition of the worn out push bench stand housing by hard facing and machining, reconditioning of the worn out portion of shear blades by machining etc., are being done. In order to further improve the shear blade life and to implement hard facing methodology as a trial measure, the manual arc electrodes are welded over the test coupons and studied for its mechanical properties and then the worn out shear blades also hard faced and test results are reported in this paper.

ROLE OR FUNCTION OF COLD BILLET SHEAR BLADES

For cutting the tube making raw material 180x180 mm square blooms into cut billets of various lengths, the shear blade segments are mounted, two at the top and at the bottom with diagonal shape blade mounting, view of which is shown in **Fig.1.** The shear blades were made up of the cold working tool steel viz. X45 Ni Cr Mo4 (DIN 1.2767) and SR4 (ASP) with hardness 50 ± 1 HRC. While shearing, the bottom blades are kept stationary and top blades are moving downwards. The billets shearing equipment is operated with 1600T shearing force. During cutting, the blades are subjected to high impact force and severe abrasive wear. Due to this, the cutting edges are blunt or damaged after 20,000 to 25,000 cuts and the damaged area is shown in Fig.1. In the present reconditioning methodology, the damaged portion of the blade is machined, (1) which is resulting and shorter life, in order to prolong the working height for a longer period and to achieve the higher performance or extended life of blades, the hard facing approach is thought of.

SELECTION OF HARD FACING PROCESS AND MATERIAL

When special surface properties are required, the metal added differ from the base metal and the process is commonly called hardfacing (2). The hardfacing property and quality requirements, physical characteristics, of the workpieces, metallurgical properties of the base metal and composition of hard facing alloy, welders' skill etc. are the important factors of hardfacing. Ultimately, economic consideration predominates and cost is the determining factor in the final process selection. While adopting hardfacing technique, for reconditioning, the aim must be that the components has to work like a new part and cost should not exceed 40%. (3) Accordingly, manual metal arc welding process, which is available at SSTP, which does not call for any special skill, is selected. For hardfacing material, discussions were held with electrode suppliers. Accordingly, four brands of electrodes were selected for this experimental study. These are identified as BRAND 1, BRAND 2, BRAND 3 and BRAND 4 in the studies



MATERIAL : X45 Ni Cr Mo4 (DIN 1. 2767) OR SR4 (ASP)
NOTE :
HARDENED & DEMAGNETIZED STRENGTH = 135-145 Kp/mm²
HARDENESS 50 ± 1RC

Fig .1 : Billet shear blade mounting view

EXPERIMENTAL RESULTS AND DISCUSSION

The test coupons, 100x100x6 mm plates were prepared for conducting abrasive wear tests and dia 6mm x 30mm and dia 8mm x 30mm pins were prepared for friction wear test. After preheating to 200° deg C, The electrodes were welded in different layers by setting the welding parameters which are given below. After finish machining, the specimens are subject to various experimental studies.

Welding Data

Parameters	Brand 1	Brand 2+3	Brand 2+4
Dia of electrode	4mm	3.2mm	3.2mm
Current Range	115 Amps	80 Amps	80 Amps

Taber Abrasion Wear Test

The test coupons made out of X45NICrMo4, SR4 (ASP material) and the hard faced specimens are subjected to abrasion wear test in Taber abraser and (4) by using the test results a graph is drawn, which is shown in **Fig.2**. The graph indicates that the SR4 material and Brand 2+4 electrode combination are having better wear resistant property than the other materials.

Friction Wear Test (5)

By using pin on disc unit, the friction wear test was conducted by using 6mm and 8mm dia specimens. As a Sample, dia 8mm X 30mm specimen with surface finish of 0.8 Micron, applied load 10 Kg, Speed 300 RPM and with lubrication SAE40, the test result obtained was related in as a graph which is shown in **Fig.3.** Similar to Taber abrasion wear test, this test graph also reveals that the Brand 4 materials had improved wear resistant property than the other one.

Hardness Evaluation

The hardness survey was conducted on the blade materials and hardfaced layer. The details are given below.

Material	Hardness (HRC)	Average (HRC)
X45Ni Cr Mo4	45,48,46,45,44	46
SR4	49,50,52,52,49	50
Brand 1	19,20,22,18,18	20
Brand 2+3	60,62,61,60,60	60
Brand 2+4	50,50,51,50,50	50

Micro Structure Study

The specimen was mounted, polished and then viewed under microscope with 200x magnification. In all the hard faced layer, homogenous and very fine carbide layers were observed which had produced a hard

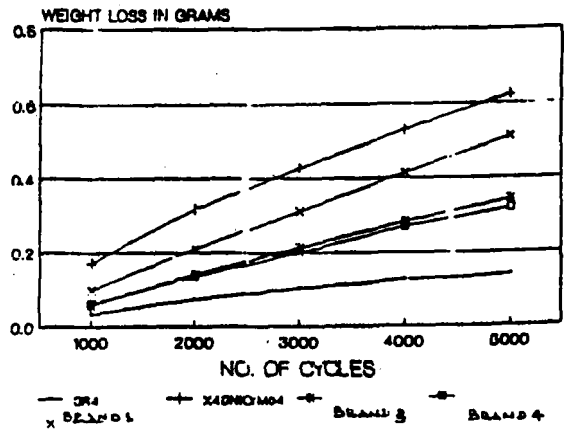


Fig. 2 : Number of Cycle Vs Weight loss(gms)

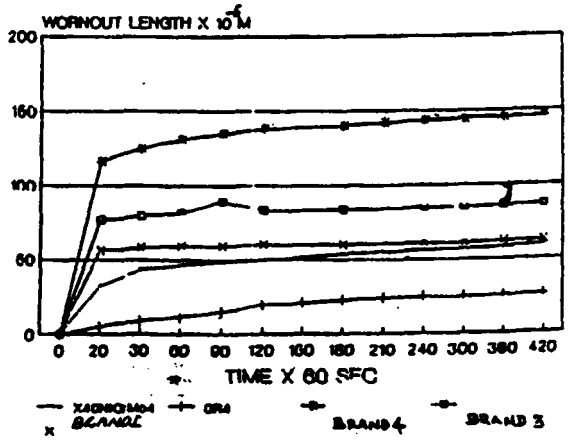


Fig. 3 : Time Vs Worn-out length $X10^{-6}$ m

and tough surface. In Brand 1 welded layer, delta ferrite in an austenitic matrix was observed. In the case of Brand 3 and Brand 4, where Brand 2 was used as buffer, carbide rich, very fine micro structure was observed. The successive layers of electrode deposits are well bonded to each other. Also the micro structure had revealed that the bonding of electrode deposit over the base metal is satisfactory.

CONCLUSION

By adapting hardfacing technique in billet shear blades, the following advantages were achieved.

1. An in-house economic reconditioning procedure was established.
2. Lead to reduction in inventory carrying cost by incurring less reclamation cost.
3. Timely spare availability is ensured.
4. The life cycle time of shear blade is extended with improved performance and thus reduced the equipment down time.

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REFERENCES

1. SSTP Hot mill documentation
2. S. K. Supali Hard facing technics low heat input welding.
3. H.P. Gard Industrial Maintenance, S. Chand & Co Ltd., Ram Nagar, New Delhi 110 055, 1986 Chapter 19, Pager 232.
4. Bharat Bushan and D.K. Gupta and Book of Tribology, MCGRAW HILL Inc. New Delhi, 1961, PP 15.64
5. Instruction manual for wear and friction monitor, TR 20.