



Research Paper

## DILUTION OF CHROMIUM CARBIDE HARDFACED LAYER MADE BY PASTE TECHNIQUE USING E-7014 SMAW ELECTRODE

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In the present work a detailed study was done to study the effect of different compositions of chromium powder on mild steel, deposited by paste coating process. On coating weld metal AWS E7014 SMAW electrode was deposited with SMAW Process. Dilution of various nine samples has been checked .It was found that dilution mainly depend upon heat input and chemical composition of base metal and electrode material. It was further observed that sample have higher Cr content possess fine grain.

**Keywords:** Welding, Hardfacing, SMAW, Dilution test

### INTRODUCTION

Hardfacing is a process of depositing the filler metal on to a compatible surface for the enhancement of wear properties. Hardfacing is one of the most useful and economical way to improve the wear performance of a component. Shielded metal arc welding is most commonly used process for hardfacing due to its easy availability and versatility of operation. Low carbon steel (Mild Steel) is selected for the present work as substrate material due to its low cost, easy availability and variety of applications. Parts of agriculture and earth moving equipment like support roll of tractor, dipper teeth, Plough shares,

Knives and cutter like feed chopper, grader blades, are recognized as severe problems, resulting in failure by wear (Stringer J, 1998; Kumar S *et al.*, 1999). As the resistant elements (Cr) increases, carbide formation gets increased, which results in enhanced wear resistance. One possible way to solve these problems applying a hardfaced layer (Pandey S and Kumar M, 2010; Rathod D *et al.*, 2012). This process is one of the most popular and has been widely adopted in many industries due to its flexibility, cost effectiveness and superior quality of the wear resistance and hardness is obtained (Parmar R S, 2008). High heat input resulted larger carbide precipitation, lowers the hardness,

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low heat input resulted higher hardness (Gualco A et al., 2010).

In this presented study, the Shielded Metal Arc Welding (SMAW) method of making surface modification to improve the wear properties of mild steel materials has been used. Wear resistance is less for mild steel for oblique impact (Crespo A C and Scotti A, 2008). Higher mass losses were measured in mild steel versus carbides (Selvi S et al., 2008). The mild steel is hardfaced with different compositions of chromium. The mild steel is frequently used material due to its low cost, which at same time soft material with poor wear properties.

To reduce this wear problem, the hard-facing was done by welding coating (welding of Cr and sodium silicate) using SMAW on the mild steel plate and were investigated with regard to their wear and micro hardness characteristics. Hardfacing leads to hard surfaces , higher hardness gives the high wear resistance (Gulenc B and Kahraman N, 2003).

It has been reported that the quality of deposits in submerged arc welding (SAW) surfacing of low alloy steel with super-ferritic filler material. They found that microstructure of 3rd layer have super ferritic phase but that of 1st and 2nd shows the influence of base metal. Hardness is maximum at 3rd layer (360 HV1) whereas 1st and 2nd layers show lower hardness due to higher dilution (Klimpel A et al., 2009).

## MATERIALS AND METHODS

The material used in the current investigation is mild steel with hardfaced layer made by paste technique USING E-7014 SMAW

ELECTRODE. Three levels had been chosen for current, chromium percentage and coded as upper level (H), medium level (I), lower level (L). The decided values of process parameters with their notations and units are given in the table.

**Table 1: Process Parameters**

S.No.	PARA METRES	UNITS	H	I	L
1.	Cr %	-	90	80	70
2.	Current	ampere	150	130	110

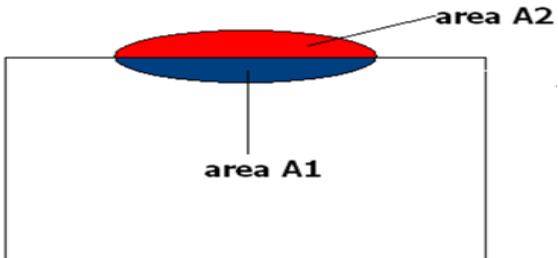
A three level factorial design of ( $3^2=9$ ) nine trials has been selected for determining the effect of two independent parameters. The selection of three level factorial design helps in reducing experimental runs to the minimum possible.

The rectangular mild steel specimens having dimensions 100mm × 30mm × 10mm were prepared.

Dilution is an important factor in hard-facing, Proper amount of dilution is very necessary, if dilution is less that means filler metal has not penetrated inside the base & it will be lacking in bond strength. On the other hand, if dilution is higher than more metal of electrode will penetrate which will result in wastage of material. Dilution basically depends upon the heat input and chemical composition of electrode and base metal. Dilution was measured by profile projector machine. The results of dilution are discussed in next chapter.

Method to calculate dilution as:

$$\text{Dilution} = \{A1/(A1+A2)\} * 100$$

**Figure 1: Dilution**

Where A1 = Area weldment penetration

A2 = Area of weld bead on top surface as shown in Figure 1.

## RESULTS AND DISCUSSION

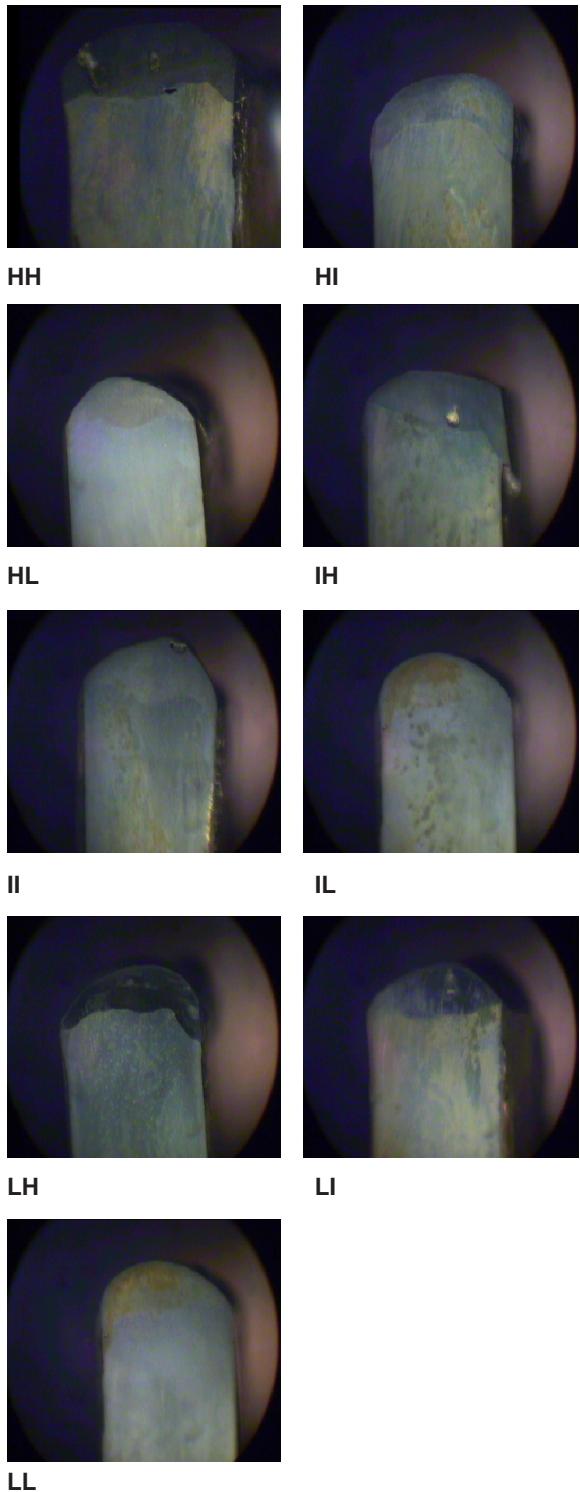
### Dilution Test

Formula for calculating dilution was already discussed earlier in the materials and methods. The readings are as shown in Table

**Table 2: Dilution Results for all Samples**

Sample No	Sample Name	Dilution in mm square
1.	HH	24.17
2.	HI	29.1
3.	HL	39.35
4.	IH	27.11
5.	II	32.01
6.	IL	36.11
7.	LH	18.78
8.	LI	25.53
9.	LL	31.11

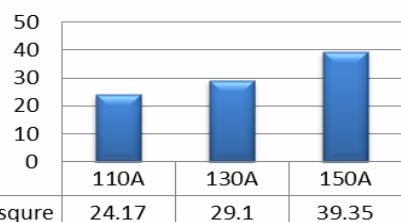
From above observation we can conclude that dilution is higher at higher current as compare to intermediate and lower levels of current. The dilution basically depends upon heat input given. It is due to the fact that current density increases with increase in welding current as a result higher melting of the electrode takes place. The melting of electrode is due to arc heat and resistance

**Figure 2: Bead Geometry Diagrams used to Calculate Dilution According to Sample Names**

**Figure 3: Comparison of Dilution of 90% Cr using Three Current**

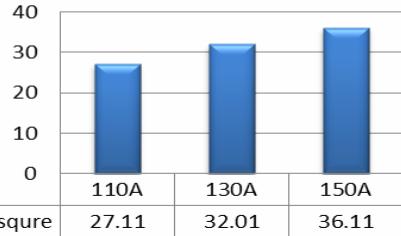
**Comparison of dilution using 90% Cr and three current**

Dilution

**Figure 4: Comparison of Dilution of 80% Cr using Three Current**

**Comparison of dilution using 80% Cr and three current**

dilution

**Figure 5: Comparison of Dilution of 70% Cr using Three Current**

**Comparison of dilution using 70% Cr and three current**

dilution



heat. With an increase in welding current, there is a linear increase in arc heat, while the resistance heat increases exponentially which are responsible for electrode melting, resulting increased area of penetration hence dilution.

## CONCLUSION

It has been also observed that dilution increasing when welding current increasing. It is due to the fact that current density increases with increase in welding current as a result higher melting of electrode because with an increase in welding current there is a linear increase in arc heat while the resistance heat increase exponentially which are responsible for electrode melting resulting increase the area of penetration hence dilution.

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