CHAPTER-7

CONCLUSIONS

AND

SCOPE OF THE FUTURE

WORK
7. CHAPTER

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7.1 CONCLUSIONS

1. Experimental results show that the friction surfacing could be used as a method for obtaining coatings of dissimilar materials. Friction surfacing is the best method for obtaining deposits of stainless steel over low carbon steel for critical applications. Adequate bond strength and good coating integrity of deposit is obtained by optimizing of process parameters.

2. The width of the deposit is always less than the diameter of the mechtrode used and lies between 0.6 to 0.87 of it and its value depends on process parameters used. This response is more important in depositing the consumable in slots.

3. The height of the deposit lies between 1 to 2.7 mm and its value depends on the magnitude process parameters used. The surface roughness is 1.72µ which is equal to the surface roughness of the substrate, obtained by milling machine operation.

4. The tensile strength of the stainless steel deposit over the low carbon steel lies between 0.6 to1.0 (equal value) of its substrate value. Shear strength lower value is 25% of the substrate value.
5. The microstructure reveals good bond between stainless steel and low carbon steel which is obtained by the results of the combined forging and shear action of mechtrode at the plastic state with low carbon steel. The interface layer zone is the intermixed materials of substrate and mechtrode.

6. The taper section reveals the mechanical interlocking between the stainless steel and low carbon steel intermixed layer with substrate. The microstructure towards the low carbon steel reveals that heat affected zone is less and hence minimum distortion is obtained.

7. The deposit observed by the metallography showed dense, clear and fine microstructure of ferrite and pearlite on low carbon steel side. This clearly proves the superiority of the process. Micro hardness survey revealed adequate ductility. In stainless steel side austenite grains and grain boundaries are free of carbides.

8. Mechanical properties under optimum welding conditions revealed the toughness of the deposit. This is demonstrated well by side bend test.

9. There were no cracks observed in the HAZ, showing the suitability of the parameters selected to give controlled heat input. Integrity of the deposit is excellent with good metallurgical bond.
10. It is a clean welding process, does not require fluxes or other consumables and produces no fumes or spatters or harmful radiation. This process also can be performed in the open air.

11. Friction surfacing is the best method for obtaining deposits of stainless steel over low carbon steel for critical applications. Adequate bond strength and good coating integrity of deposit is obtained by optimizing of process parameters. The optimum conditions of the friction pressure 47MPa, rotational speed 2400rpm and welding speed 190 mm/min, resulting higher tensile and shear strength.

12. More power is consumed at initial stage because of dry friction between the surfaces hence correct levels of parameters need to be set on the machine, during initial and running stages.

13. Trained operator is required to work on this sophisticated welding machine to monitor the process parameters which affect the quality of the bond.

14. Corrosion test and bend tests results proved that this method is can be for manufacture of petrochemical vessels, pumps for chemicals and other corrosion resistant applications. There is tremendous scope to extend this process to other dissimilar metal combinations for protection against wear and corrosion.
7.2 SCOPE OF THE FUTURE WORK

1. Study the characteristics and mechanical properties of the friction surfaced stainless steel deposits, when performed in water and inert gas.

2. Analysis of the stainless steel deposit over the low carbon steel when it is made in the form of pad. Determining the process parameters when the deposit is made over the pad with adjacent layer and multilayer.

3. Joining of materials by friction surfacing which are having large differences in thermal expansion. When these materials joined, high stresses are developed during the cooling. Hence intermediate expansion material is required to allow for the transition from high to low thermal expansion materials. Example refractory of metals, ceramics, and low-expansion iron-nickel and iron nickel-cobalt alloys may fail or be highly stressed during cooling when welded to high-expansion material such as austenitic stainless steels and nickel-base and cobalt-base super alloys.