CHAPTER I

INTRODUCTION

1.1 Introduction

In recent years, the industrial use of surfacing technique has grown considerably. Hardfacing, one of the surfacing techniques, is the process of applying a layer or edge of wear resistant metal part to increase its resistance to abrasion, corrosion and impact or any other combined wear [1]. It mainly deals with the preservation of machinery parts from destructive forces in chemical and fertilizer plants, nuclear and steam power plants, pressure vessels etc.

Among the materials used to improve the surface properties of metallic parts, cobalt-base alloys enjoy a leading position. These alloys are designated as stellite a trademark registered throughout the world [2]. In valve industries, Stellite grade 6 is being chosen to enhance resistance to wear and corrosion at elevated temperatures.

Welding is one of the hardfacing techniques widely used in fabrication of hardfaced components. Among the various welding processes employed for hardfacing, gas tungsten arc welding (GTAW) and plasma transferred arc welding (PTAW) processes are widely used for industrial applications. GTAW process has advantages like superior quality weld, high accuracy and low equipment cost [3]. Defects free deposits can be made without preheat by the GTAW process [4] and argon be used as shielding gas for GTAW process [5].
1.2 Hardfacing of valve seat ring

In valve industries, Stellite grade 6 is being deposited on both the sides of wedge and seat faces of a steam globe valve. A typical used valve wedge is shown in Fig.1.1. Stellite Grade 6 is chosen for its excellent resistance to wear and corrosion at steam temperatures ranging from 565°C and above. Stellite is deposited on ASTM-A105 grade low carbon steel rings and welded to the surface after machining operation. When the valve is opened or closed the wedge moves up and down causing degradation of material due to normal load of the fluid flow.

Fig. 1.1. A typical used valve wedge of a globe valve

1.3 Motivation

K.G. Budinski [6], in his work described that hard facing should be a part of the repertoire of tools used by engineers had encountered wear problem. According to John R. Yochum [7], hardfacing proves to be an
economical way to prolong the service life of parts that were subjected to severe wear conditions. Costs are lowered because fewer replacement parts need to be carried in stock, due to the increased service life of each part. Wu and Redman [8] noted that different application methods resulted in different dilution levels with the base metal and this changed the chemistry and hence the properties. Ravi Menon [9] recommended cobalt base alloys for valve industries due to their excellent elevated temperature properties. The process selection depends on the size and complexity of the component to be surfaced, level of dilution that can be tolerated, deposition rate and thickness of surfacing required. The properties of the deposits may differ depending on the process employed due to varying dilution levels as well as cooling rates that may change the microstructure of the deposit. Albert et al [4] found that defect free deposits can be made without any preheat by the GTAW process.

Babu [10], reported that the single biggest difference between a joint and surfacing is that the base metal and the weld overlay will have very different compositions. Obviously, one of them (usually the base metal) will dilute the other material (usually the surfacing deposit). Therefore the surfacing deposit will not have the properties as required. The dilution of deposit with substrate material depends on welding process and parameters used. When cobalt and Nickel base alloys deposited on steels, the pickup of iron causes a drop in erosion resistance and some change in corrosion resistance depending on the corrosive medium involved [11]. These changes are relatively small when the dilution in the
region is of 5%, a level commonly achieved in good quality deposits. For many purposes upto 8 - 10%, dilution can prove acceptable in service.

The above problems motivated to conduct this research study and the major research objectives are:

1. To develop mathematical models for relating GTAW process variables to various weld bead quality parameters.
2. To analyse various direct and interaction effects of GTAW process parameters on deposit geometry and quality.
3. To optimize the process parameters for achieving the desired dilution level.
4. To study the wear behavior of the hardfaced layers deposited at optimum process parameters.
5. To study microstructure and corrosion behavior of the stellite overlay deposited at the optimum process parameters.

1.4 Plan and Sequence of Research

The study is organized as follows and the research work was carried out as per the plan shown in Fig. 1.2.


Chapter 3 deals with the Design of Experiments.

Chapter 4 deals with the Development of Mathematical Models.
Chapter 5 presents Optimization and Study of Sensitivity Analysis of Process Parameters.

Chapter 6 deals with the detailed Wear Behavior Analysis at Optimum Conditions.

Chapter 7 deals with the studies on Corrosion and Colour metallography.

In Chapter 8 the conclusions arrived out of this research work, the direction of future research work with limitations are presented.
Fig. 1.2. Plan and Sequence of Research Work