Chapter 1

Introduction

Thermal spraying or 'metal spraying' as it was known, first became a tool of industry in the early 1920s with the introduction of the gas wire process. This technique enabled low melting point materials, such as zinc, brass, bronze and various steels, in small diameter wire form to be melted and atomized in an oxygen and then propelled by compressed air onto a grit blasted component to form a coating [1]. Thermal spraying is a technique in which molten or semi-molten particles are deposite onto a substrate to form a coating, the microstructure of which depends on the thermal and momentum characteristics of the impinging particulates. Thermal spraying combines particle melting, quenching and consolidation in a single operation. Original interest in thermal spraying stemmed from the ability of this technology to generate coatings that are chemically and metallurgically homogeneous [2]. Thermal spray applications have now penetrated virtually every type of industry. The aerospace industry is probably the largest user of thermal spray. For instance, in the aerospace industry, the ever increasing demand to manufacture lighter aircraft that can travel at high speeds and can withstand a higher payload capacity has fueled the development of high strength/low density materials with improved damage tolerance and enhanced temperature capabilities. The automobile industry have relied on molybdenum and molybdenum-based materials for more than 30 years as wear resistant coatings on piston rings, sector forks and syncro cones. From its humble beginnings, the thermal spray industry has truly grow into an important, global industry. Other applications of various thermal sprayed coatings are widely used in the electronic industries, powder gerneration plants, marine gas-turbine engines in marine industries, ceramic industries, and printing industries [3].

Arc spraying is known to be one of the simplest spraying techniques and the less expensive ways of thermal spraying processes with an ability to produce dense coatings with a wide rate of material deposition. Actually, it is proven that the microstructure of these coatings mainly depends on the spray parameters. For example, it has been established for a long time that the higher the velocity of the spray gas, the smaller and the quicker the particles. More, recently, relationships between spray parameters and microstructure have been clearly pointed out by analyzing the porosity and oxidation contents of by calculating the lamellae thickness, which in turn influence the mechanical properties of the coating. The originality of this work is to better understand the elaboration of the coating in relation with working parameters. In this way, an analysis of particle behavior within the spray jet has been carried out. This investigation was achieved using optical microscope to determine the characteristics of in-flight particle, i.e. their sizes. As the coating is built up by the succesive deposition of a stream of molten particles, the individual splat is a basic cell, which constitutes a coating. Consequently, the individual splat formation has a significant effect on coating structure and property. It is known that the depositon of an individual droplet forms a splat through the processes of impacting, flattening, rapid cooling and solidification. And for a given system, the only factors that can control the coating microstructure are velocity, temperature and particle size distribution of the spray droplets at the impact. It is the reason why some correlations were established between the particle characteristic and the characteristic of the splat versus the input parameters. Arc spraying has been restricted to the deposition of metals for applications involving mainly corrosion protection and part restoration. Although some wires have been proposed during the last decade, most of arc- sprayed coatings produced have been used to limited extent in applications involving abrasion wear. One of the traditional applications is to produce protecting coatings for infrastructure. Moreover, the technological development of wire arc spray systems opens other ranges of applications, such as mould spray forming. Compressed air is commonly used in the wire arc process because of its low cost and ability [4, 5].

Stainless steel present many variations in their alloying elements which give to them different physical and mechanical properties, offering great possibilities to satisfy the needs of a certain piece in service in a great number of industries. Therefore, the use of stainless steel coatings to protect plain steels against corrosion is an economic solution because the total cost of the final product will be cheaper than using a bulk stainless steel piece [6].

The chemical compositions of commercial stainless steel weld wire and arc wire comparable, however, arc wire is usually about 5-10 times more expensive than weld wire. Therefore, the difference of these two types of wire will be investigated interm of spraying characteristics. In this study, the varying of parameters is also studied. The following are the objectives of this work;

1. To correlated spray parameters to the characteristics of the in-flight particles, splats and coatings of stainless steel weld wire and arc wire.
2. To characterize and compare microstructure and properties of stainless steel coating prepared by stainless steel weld wire and arc wire.