Thesis Title	Effect of Chemical Composition and Microstructures on Surface Hardening of Steel
Thesis Credits	15
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Degree of Study	Master of Engineering
Department	Materials Technology
Academic Year	1998

Abstract

The aim of this research is to investigate the influences of process parameters and types of steels on surface hardening of steels. The processes employed in this study were plasma nitriding and carburizing. The parameters investigated were nitriding and carburizing temperatures and time. The results studied were surface hardness, case depth and microstructure. Experimental materials were low carbon steels, medium carbon steels, low alloy steels, carburizing steels, hot work tool steels and cold work tool steels.

In the plasma nitriding process, samples were nitrided at 520, 550 and 570°C for 20 hours. It was found that for low alloy and medium carbon steels the optimum nitriding temperature was 550°C at which the maximum hardness was achieved. It was also found that the case depths were greater at higher nitriding temperatures. For low carbon steel, it was found that maximum hardness was achieved at 520°C. For tool steels, it was found that the higher nitriding temperature the higher the surface hardness. Predominant phases in the surface microstructure were $Fe_{2-3}N$ and Fe_4N and nitrides of alloying elements such as chromium and aluminium.

As for the nitriding time, it was found the optimum time was 20 hours (compared with 15 and 40 hours) at which maximum hardness was achieved for most steels except the low carbon grade.

In the gas carburizing process, it was found that for low and medium carbon steels, carburizing at 900 $^{\circ}$C yielded higher surface hardness that at 920 $^{\circ}$C. For other steels i.e. Low alloy and tool steels, it was found that higher surface hardness were obtained at carburizing temperature 920 $^{\circ}$C compared with those at 900 $^{\circ}$C. Microstructures in all cases were martensite and carbide

As for the carburizing times, different results were obtained for different grades of steels. For medium carbon and low alloy steels, it was found that carburizing for 2 hours yielded higher hardness than 4 and 6 hours. For low carbon and tool steel, maximum surface hardness was achieved when carburizing for 4 hours. There was no significant variation in microstructure.

It is concluded that surface hardening by plasma nitriding and carburizing yield different microstructures and surface hardness. Type of steels, chemical compositions as well as process parameters have as effect, to greater and less degree, on the hardness achieved.

Keywords: Surface hardness/Plasma Nitriding/Carburizing/Effect of Temperature surface hardness/ Effect of Times surface hardness