Abstract *Index No. 39/22/E*

Electroless nickel (EN) plating is a deposition process by chemical reaction of reducing agent present in the coating bath itself without the use of electricity. It has received widespread attention for industrial applications due to its high hardness, good corrosion resistance, uniformity of coatings, etc. EN coatings can be classified into three main categories, namely pure nickel, alloy, and composite coatings. Several research studies have been already carried out to investigate the characteristics of EN Pure coating, binary (Ni-B, Ni-P, etc.), and ternary alloy coatings (Ni-W-P, Ni-Cu-P, etc.). Metallic elements like tungsten (W), Cobalt (Co), molybdenum (Mo) have been incorporated to form binary, ternary, or quaternary alloys to improve the properties like thermal stability, hardness, tribological behavior, and corrosion resistance. Nanoparticles like Al_2O_3, SiO_2, ZrO_2, TiO_2, and SiC are being widely used due to their excellent wear resistance and hardness. TiN also can be an ideal candidate for coating due to its high hardness, chemical resistance, and high melting point. Carbon nanotube (CNT) and Carbon nanofibers (CNFs) are being used since they possess outstanding electrochemical and mechanical properties including high tensile strength and elastic modulus. The electroless nickel-based alloy coatings were investigated based on coating deposition rate, coating thickness, surface morphology, phase structure, tribological and mechanical behaviors of coatings. The deposition rate and coating thickness were observed to vary with coating bath parameter concentration as well as operating conditions. The surface morphology and phase structure were also observed to depend on coating bath composition. The surface morphology, as well as phase structure ultimately, lead to a change in coating characteristics.

It was observed from the literature survey that electroless Ni-B (ENB) coatings deposited with low sodium borohydride in the coating bath exhibit a crystalline structure. The same transformed into an amorphous structure with the rise in sodium borohydride concentration leading to an increase in surface hardness of the coatings. The surface hardness also improved due to the rise in boron content in the coatings with the increase in sodium borohydride concentration in the coating bath solution. Hence, the variation of the coating bath parameters and concentration may impact the coating composition. The coating composition may lead to a change in surface roughness, surface morphology, and phase structure which may ultimately lead to a change in coating characteristics. The present work explores the dependencies of bath parameters on the coating characteristics of different electroless nickel coatings such as Ni-B,

Ni-B-W, and Ni-B-Mo.

In the present work, an attempt is made to deposit Electroless Ni-B, Ni-B-W, and Ni-B-Mo coatings on mild steel substrate. Analysis of the performance of the coatings in terms of mechanical properties and tribological characteristics are made. The surface roughness of the coatings is compared with the surface roughness of the uncoated substrate. The friction and wear behavior of coatings are evaluated using a tribo-tester. Surface hardness, as well as scratch test, are carried out. Mechanical properties like Elastic modulus, nano-hardness are evaluated using the nanoindentation technique. Scanning electron microscope (SEM), X-ray diffraction technique (XRD) and energy dispersive X-ray (EDAX) analysis are used to study surface morphology, microstructure, and composition, respectively. Finally, a comparative study is conducted to compare the performances of Ni-B, Ni-B-W, and Ni-B-Mo.