**Investigation of microstructural and mechanical properties of additively manufactured 17-4ph stainless steels compared to conventional processes**

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**ABSTRACT**

This study investigates the microstructural and mechanical properties of additively manufactured (AM) 17-4PH stainless steels in relation to those annealed and conventionally manufactured 17-4PH stainless steel. The 17-4PH specimens were processed through Additive Manufacturing process at optimized settings to fabricate parts for testing. Some of the fabricated specimens were tested under ASTM standard for various post-processing conditions including solution treatment and age hardening. Each specimen (heat treated, and none heat treated) were separately analysed for microstructural type and morphology using scanning electron microscope, while the X-ray diffraction was used for phase identification and energy-dispersive X-ray spectroscopy for phase chemical composition. The mechanical testing done on the specimen (heat treated, and none heat treated) were strength, hardness, three-point bending test and axial fatigue test according to the ASTM standards of each attribute.

The microstructural characteristics formation of AM 17-4PH stainless steel components results in some austenite phases together with fine martensitic features, this is due to non-equilibrium thermodynamics and thermal cycle of additive manufacturing process. The properties of the as-built would present anisotropy in the microstructural with high strength and low ductility having either similar or even better mechanical properties than conventional processes. The bending and axial fatigue tests is hypothesized to be of comparable quality to that of conventional manufactured 17-PH stainless steel. Tensile tests revealed that as-build parts corresponded with values published but results from age hardening were much lower than wrought components aged to the H 900 condition. On the other hand, the hardness was found to decrease during solutionizing and only increased marginally during aging. This study will contribute towards the research status of 17-4 PH in AM to provide knowledge sharing for future industrial or commercial application of AM processes.

*Keywords:* *Additive Manufacturing; 17-4PH Stainless Steel; Microstructural Properties; Mechanical Properties.*