Effect of organic acid anodizing treatment for A390 aluminum alloy

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ABSTRACT

A390 aluminum alloy is heat treatable alloy and belongs to hypereutectic Al-Si alloys. Though A390 aluminum alloy possess low thermal expansion coefficiency, high hardness and good wear resistance, its surface is easily oxidized to form very thin film with compact feature. In the severe environment, the thin film of A390 aluminum alloy casting will be peeled by thermal fatigue and the protective role for internal aluminum matrix will be disappeared. The anodizing treatment was usually used to solve this problem in the industry. By the electrochemical method matched with different organic or inorganic acid electrolytes, the properties of oxide layer was controlled and enhanced, the color appearance was also changed. The aims of this study are to investigate the effects of casting thickness and anodizing time on the anodic oxide film thickness and color of A390 aluminum alloy castings in the citric acid or tartaric acid electrolytes. The microhardness and color difference were measured and compared by Vicker hardness tester and color spectrophotometer. In addition, the OM and SEM+EDS observations of microstructure and morphology of oxide film and matrix were conducted to understand the reasons that casting thickness and anodizing time affect anodized oxide film thickness and color. The results show that the condition to obtain the maximum oxide film thickness of A390 aluminum alloy castings anodized by citric acid or tartaric acid was a fixed anodizing voltage of 225 V and 15mins anodized time. The oxide film thickness was increased with the increase of anodizing time or casting thickness. In addition, with the increase of anodizing time, the CIE L*, a* and b* values of color on oxide film were reduced. Through OM and SEM + EDS observations and analysis, the oxide films of A390 aluminum alloy castings anodized by the tartaric acid were found to be a loose flakelike morphology with many cracks, while for citric acid, the oxide films were a dense flakelike morphology with few cracks and tortoise shell-like regions. These two types of morphologies are different from that of oxide films of A390 aluminum alloy castings anodized by sulfuric acid, which is a honeycomb-like morphology with hexagonal holes. The small and large piston castings of A390 aluminum alloy were anodized in citric acid or tartaric acid by using the conditions of a fixed anodizing voltage of 225 V and 15 mins anodizing time based on the maximum oxide film thickness of stepped castings with same alloy. The results show that the appearance of large piston casting was shiny silver-white color, which retained original as-cast color, since the large piston casting wasn ’ t machined and very fine equiaxed grains chill zone still existed at the substrate. While the appearance of small piston casting was gray-black color with shiny spots since the small piston casting was machined and very fine equiaxed grains chill zone didn ’ t existed at the substrate. The citric acidic oxide film was brighter and the tartaric acidic oxide film was darker.

Keywords : A390 aluminum alloy、piston、citric acid、tartaric acid

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