Anodic oxide layer formation on A357 aluminium alloy produced by Thixocasting

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**Abstract.** Anodizing is widely used in the surface treatment of aluminium alloys in order to preserve the integrity of the alloy surface, to minimize the need for maintenance and repair, and to maximize the component life. The aim of this work is to study the influence heat treatments (T5 and T6) have on the anodization of A357 aluminium alloy produced by a Thixocasting process. In particular the effect of shape, size and distribution of silicon and intermetallic phases on the anodic oxide film formation. SEM and EDS analyses were used to examine the microstructural features found on, within and under the anodic oxide layer. Experiments using a tribometer (pin-on-disc tests) were performed in order to evaluate the friction and wear properties of the different layers.

**Introduction**

One of the problems when hard anodizing cast aluminium alloys is being able to grow a sufficiently thick and homogeneous anodic oxidation layer. Recent research \cite{1} has analyzed the influence different as-cast substrates may have on the anodizing process, prompted by the fact that second phase particles have been associated to local reactivity variations that lead to the mentioned unwanted results. Some aluminium alloys despite containing second phase particles, like the widely anodized wrought alloy 6061, are capable of forming an acceptable anodic layer. On a different field of research, one advantage of semisolid processing technologies (like Thixocasting) is that castings can be heat treated without blistering and consequently the microstructure of the substrate can be modified. This work studies the influence heat treatments (T5 and T6) may have over the anodic oxidation layer formed on a thixocast A357 aluminium alloy substrate, which is a common alloy used for several semisolid processing technologies. This work also presents a tribological comparison (friction coefficient and specific wear rate) between as-thixocast and T6 samples.

**Experimental Procedure**

A controlled comparison of the effect that different heat treatments may have on the anodic oxide layer of a thixocast A357 aluminium alloy component began by first selecting three adjacent samples (\textasciitilde{} 6.5mm X 35mm X 25mm) from the same component. A T5 ageing heat treatment (aged at 170°C X 6h) was performed on one of the samples and a T6 ageing heat treatment (540°C X 5h, quenched in water, and aged at 170°C X 6h) was performed on another sample. The third sample was left as-thixocast for reference. The three samples were then placed at the same time in an industrial anodizing bath cell in order to reproduce commercial processing conditions and to assure similar hard anodizing variables (2°C, 15min, 200g/l of H$_2$SO$_4$).