Clean HIP Processing to Minimize Surface Oxidation

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PowderMet 2024, June 16-19, Pittsburgh

ABSTRACT

The Hot Isostatic Process (HIP) has often been coupled with oxidation of surfaces due to high oxygen partial pressure at the HIP pressure. Oxygen originating from several different individual sources, all which must be controlled to avoid surface oxidation and various forms of contamination. This contamination may have detrimental effects on critical components that are exposed to fatigue. This has led to the need to wrap components with different types of metal foils gettering the contaminants before these can react with the part surfaces. The need for getters of course consumes resources placing a demand to develop a viable solution to this challenge.

Quintus Technologies has developed a new toolbox under the High-Pressure Heat Treatment umbrella called Quintus Purus®, a combination of best practices in way of working with the HIP system, new equipment capabilities, and fit for purpose oxygen getter cassettes. This concept promises the opportunity to reduce oxygen species in the HIP process by over 95%. The result is a path for significantly less part surface oxidation and contamination. This will increase the efficiency and accuracy of further post processing techniques such as chemical milling to allow for a more uniform surface finish.

INTRODUCTION

When determining the conditions and specifications for a given heat treatment process, clean and unoxidized surfaces could be expected, and often regarded as necessary. This is especially true if the part performance is critically affected by the surface state, or if thermal processing is, or has the potential to become, the final processing step for the part [1].

However, for users of HIP (HOT ISOSTATIC PRESSING), this is unfortunately not always the case. When working with material systems having high oxygen affinity such as e.g., aluminum, titanium, and chromium (Figure 1), especially in humid environments, or when processed together with damp surfaces goods, or using insufficient process gas purity, discoloration from surface oxidation is often the outcome [2]. The consequences of this cannot be underestimated for e.g., intricate part geometries such as trabecular structures on medical implants for bone ingrowth in cementless systems (Figure 2), or components having narrow and complex shaped channels [3]. This as current machining and polishing