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PII: S0264-1275(15)30946-1
DOI: doi: 10.1016/j.matdes.2015.12.087
Reference: JMADE 1111

To appear in:

Received date: 9 December 2015
Accepted date: 14 December 2015

Please cite this article as: A.B. Abibe, M. Sônego, J.F. dos Santos, L.B. Canto, S.T. Amancio-Filho, On the feasibility of a friction-based staking joining method for polymer-metal hybrid structures, (2015), doi: 10.1016/j.matdes.2015.12.087

ON THE FEASIBILITY OF A FRICTION-BASED STAKING JOINING METHOD FOR POLYMER-METAL HYBRID STRUCTURES

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ABSTRACT
The increased use of hybrid structures to reduce weight currently faces the limitations of traditional joining methods. Consequently there is a niche for development of new joining techniques, which can reduce or overcome some of the existing limitations. This paper presents for the first time the new Friction-based Injection Clinching Joining technique (F-ICJ), describing the microstructure and changes in local properties of joints between polyetherimide (PEI) and aluminum alloy 6082-T6. A shear layer around the rotating tool composes a polymer thermomechanically affected zone (PTMAZ), which presents pores as a result of evolution of gaseous products. The PTMAZ shows decreases of 8% to 12% in local strength compared to the base material, as measured by microhardness. Ultimate forces of 1419±43 N in lap shear and 430±44 N in cross tensile were achieved for F-ICJ joints. These levels are similar to ultrasonic staking joints of the same material combination, but the hollow design of F-ICJ stakes accounts for improved strength-to-weight ratio (18% in lap shear, 21% in cross tensile). Although the F-ICJ process currently requires longer cycles (7.5 seconds) than state-of-the-art ultrasonic staking (2.8-2.9 seconds), generated results indicate that the F-ICJ process is a competitive staking joining method with potential for improvement.

KEYWORDS: processing technologies; staking; polymer-metal structures; hybrid joining; friction joining; polyetherimide

1 Introduction

There is an increasing trend to reduce vehicle weight in the transportation industry because of environmental issues such as the requirement to reduce CO_2 emissions [1], and