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Monitoring deep twist drilling for a rapid manufacturing of light high-strength parts

L.N. López de Lacalle [a,*], A. Fernández [a], D. Olvera [a], A. Lamikiz [a], D. Olvera [b], C. Rodríguez [b], A. Elias [b]

[a] Dpto. Ingeniería Mecánica, Universidad del País Vasco, Spain
[b] Dpto. Ingeniería Mecánica, Tecnológico de Monterrey, Mexico

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ABSTRACT

In this work the manufacturing of high strength and/or high functional components is presented, using a new technique based on considerably long twist drills, called Deep Twist Drilling (DTD). This technology opens a rapid and economical method to manufacture parts for structural applications. Components made with this technique can reach high mass reduction and better stress distribution in comparison with welding or bolted parts with the same weight.

However the application of DTD must be optimized to improve the reliability of the process and to make it economically feasible. In order to reach it, previous optimization by process monitoring was performed in AISI 1045, stainless steels, Ti6Al4V and nodular cat iron GGG70(AISI A536, SAE-ASTM 100-70-03). These materials are commonly used for structural applications in several sectors. Monitoring opened the way to improve cutting conditions and allow the application of the DTD technique focusing on a new design concept. In the same way monitoring makes drilling process reliable enough to be systematically used in industrial applications by a controlled increase of the performance demanded from the tool. In this manner, not only the objective to produce high-strength and light pieces is achieved, but also a high repetitive process is reached.

In this research work a case of study is presented. A monolithic satellite-type component, its mass were reduced from 25 to 4.5 kg. The structural behavior of the component was studied under FEM analysis and the results showed high strength to compression and shear forces. During the machining of this element there was a serious risk of drill breakage due to the depth of the holes and crossing points between them; however, the previous process optimization eliminated this drawback.

As a matter of fact, this paper brings out a good example where manufacturing technology allows a better performance of mechanical components within the philosophy of "new processes drive to new products and better performances".

1. Introduction

In the field of the material removal processes, the drilling process itself does not allow direct observation and it can only be studied as a subsequent analysis [1]. For this reason, the applied research on the hole making process can be considered scant and trends to be intuitive; this provokes important repercussions on the process efficiency with

* Corresponding author.
E-mail address: norberto.lzlacalle@ehu.es (L.R. López de Lacalle).

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