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The effect of minimum quantity lubrication in the intermittent turning of magnesium based on vibration signals

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Abstract. The present work shows an experimental investigation on intermittent turning based on vibration signals. The dependence of vibrations on the feed rate, minimum quantity lubrication (MQL) flow rate and the type of the interruption of the workpiece is evaluated. The results indicate that a part of the vibrations depends on the flow rate of the MQL system and its interaction with the feed rate, finding no dependency on the type of interruption. The influence of the MQL system is greater when machining at the lower feed rate. In addition, a strong relation between surface roughness and vibrations is identified. However, this relation is quite different depending on the environment used. In general, under dry conditions, the higher the vibrations the higher the surface roughness, while the opposite occurs when the MQL system is used.

Keywords: dry machining, intermittent turning, magnesium, MQL system, vibration.

1. INTRODUCTION

Since the late 1980s the use of light materials is attracting a great attention because of their suitability to improve the fuel economy [1]. Among main lightweight materials, the use of magnesium has being increased due to its low density and other properties such as its specific strength, good castability [2] and good damping capacity [3]. Automotive industry is one of the main sectors in which magnesium is being used in applications such as transmission casings, valve covers, intake manifolds, brackets or pumps [4], but magnesium is also finding applications in industries such as aerospace, electronics and biomedical devices [5].

Magnesium alloys are easy to machine when considering the power required, attainable cutting speeds and expected tool life compared to other usual structural materials [6]. Good surface finish can be achieved in magnesium machining [7]. However, there are several problems to consider in magnesium machining such as the ignition risk and its reactivity with water [8].

Surface integrity, particularly, the surface topography plays a major role on the final functional performance of the machined components in terms of fatigue resistance, surface friction, wearing, light reflection and heat transmission [9,10]. A wide range of parameters are identified by Zhang et al. [11] as influential factors for surface roughness in ultra-precision machining. Among them, cutting conditions (cutting speed, depth