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Study of the Boriding Drill point Subjected to Machining

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Boriding by boron dehydrated paste is an efficient process to obtain mechanical and physical properties for potential industrial applications [1-2]. Boriding treatments are shown to be an alternative, in order to obtain a sacrificial monolayer and/or bilayer to improve the performance of metallic materials [3-4].

The present work the morphological degradation and wear of boron coated drill bit on 6061T6 aluminum alloy is analyzed. A 3/16 diameter drill bit made of high speed AISI M2 steel; Manufacturer Truper-Mexico (FTM) and a 3/16 diameter drill bit made of high speed AISI M2 steel; Manufacturer Truper-Mexico under boriding (FTMB) were used. The borurazion treatment on the FTM was performed using dehydrated paste in box, with temperature of 1173 K and exposure time of 6 h. The FTM and FTMB were machined for 72 min creating 1800 blind holes per tool, using a 3-axis CNC vertical machining center, under the following machining regime: cutting speed 60 m/min and feed rate 0.0635 mm/r. At the end of the machining time, morphological characterization of the drill tip was performed using a JEOL JSM-IT100 scanning electron microscope (SEM). Similarly, burr growth evaluation criteria were used on the machined part to demonstrate morphological degradation in the tip angle using a Mitutoyo code 215-511 digital comparator.

Figure 1a) shows the wear micrograph of the FTMB by SEM the analyzed section is the main cutting edge of the drill after 72 min of machining, 1b) and 1c) show wear and the presence of non-uniform sharpness at the corners of the cutting edge. These types of wear occur when the coating peels off exposing the substrate. Figure 2 shows the holes formed in the 6061 T6 aluminum plate, Figure 2a) shows the angle of the twist drill which is 130° and 9.242g mass for the FTM, and for the FTMB 132°18' and 9.2666g, Figure 2b) shows the process of measuring the height of the burr generated at the entrance of the holes, these readings were taken at four different locations spaced at 90° intervals around its circumference. The arithmetic mean of the four measurements was determined to determine the average value of the burr height [4]. The Military Standard 105E quality tool was used to determine the sample size. A sample size of 13 holes from a batch of 1800 was established for each of the drills, with a confidence level of 2.5. The average burr height was higher for the FTMB 0.04502 µm due to the 15 to 30 % increase in thickness due to the coating [5]. Figure 2c) shows the change of drill mass and tool tip angle during the machining of 1800 holes, the FTMB originated higher loss 0.07% (0.0064g) of its initial mass, the FTM generated higher loss in cutting angle with a loss of 1.99% (2°35') of the initial angle.

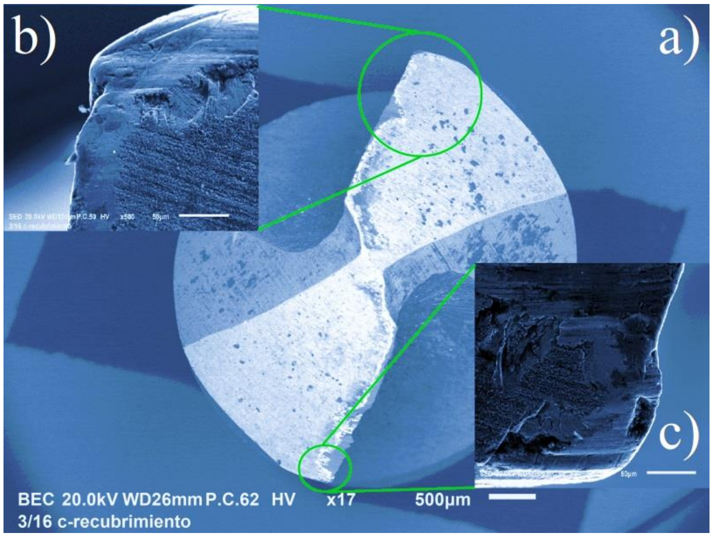

Figure 1. a) Drill bit with boron atoms after 72 min of machining, b) and c) FTMB wear by SEM at 500 µm; the section analyzed is at the comers of the cutting edge.

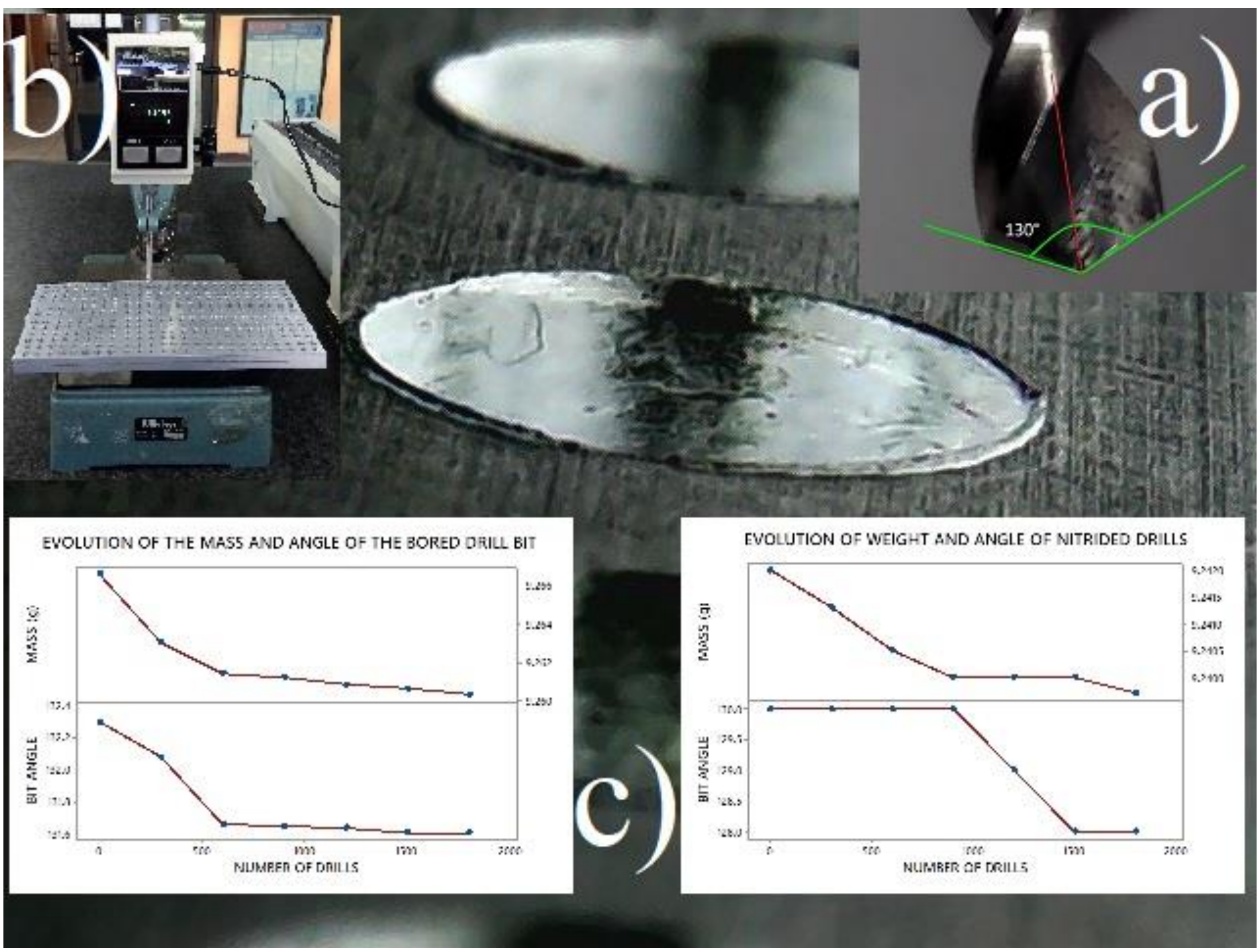

Figure 2. Holes formed in the 6061 T6 aluminum plate, a) Angle at the tip of M2 steel twist drill, b) Burr heigth obtained with Mitutoyo digital comparator, c) Change in mass and tip angle for FTM and FTMB vs machining time.

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