Characterization of chipping and tool wear during drilling of float glass using rotary ultrasonic machining

Ankit Sharma*, Vivek Jain, Dheeraj Gupta

Department of Mechanical Engineering, Thapar University, Patiala 147001, India

ARTICLE INFO

Keywords:
Float glass
Chipping
Tool wear
Coordinate measuring machine
Rotary ultrasonic machining

ABSTRACT

Float glass is being continuously used in a wide range of applications, and its processing is an essential aspect of the production process. The authors have developed an experimental study to investigate the relationship between selected machining parameters and tool wear. The study involves the use of a coordinate measuring machine (CMM) and a rotary ultrasonic machining (RUM) process. The results indicate that the interaction between these parameters significantly affects tool wear. The findings of this study can be used to optimize the process parameters and achieve better tool wear performance.

1. Introduction

The usage of float glass in the manufacturing industry is increasing due to its unique properties such as high strength, light weight, and transparency. The key application of float glass is in the manufacturing of solar panels, automotive glass, and building glass [1]. In order to obtain the desired quality, the glass must be processed using advanced machining techniques such as CNC milling, water jet machining, and ultrasonic machining. These techniques are being continuously improved to meet the demands of the industry.

1.1. Chipping

Chipping is a common issue during drilling processes, especially for hard materials. Chipping occurs when the cutting tool removes material from the workpiece, creating a hole of variable depth and diameter [2]. Chipping is influenced by a combination of factors such as the tool geometry, the material properties, and the process parameters [3]. Chipping can significantly affect the quality of the workpiece and the tool life. Therefore, it is essential to understand the factors that influence chipping and to develop strategies to minimize its occurrence.

1.2. Tool Wear

Tool wear is a critical issue in machining processes, as it affects the accuracy and quality of the workpiece. Tool wear occurs due to the interaction between the cutting tool and the workpiece material [4]. The rate of tool wear is influenced by the material properties, the process parameters, and the tool geometry. The authors have developed a method to measure tool wear using a coordinate measuring machine (CMM) and a rotary ultrasonic machining (RUM) process. The results indicate that the interaction between these parameters significantly affects tool wear.

1.3. Ultrasonic Machining

Ultrasonic machining (UM) is a non-traditional machining process that utilizes ultrasonic vibrations to remove material from a workpiece. The process is characterized by high accuracy, high quality, and high efficiency. The authors have developed a rotary ultrasonic machining (RUM) process, which combines the advantages of ultrasonic machining with the flexibility of a CNC machine tool. The RUM process has been shown to be effective in drilling float glass, and the results indicate that it is a promising technique for machining hard materials.

1.4. Research Objectives

The main objective of this study is to investigate the relationship between selected machining parameters and tool wear during drilling of float glass. The study involves the use of a coordinate measuring machine (CMM) and a rotary ultrasonic machining (RUM) process. The results indicate that the interaction between these parameters significantly affects tool wear. The findings of this study can be used to optimize the process parameters and achieve better tool wear performance.

*Corresponding author.
E-mail addresses: ankit.sharma@thapar.edu (A. Sharma), vivek.jain@thapar.edu (V. Jain), dheeraj.gupta@thapar.edu (D. Gupta).

https://doi.org/10.1016/j.measurement.2018.06.040
Received 2 March 2018; Received in revised form: 16 June 2018; Accepted 22 June 2018
Available online 27 June 2018
0263-2241/© 2018 Elsevier Ltd. All rights reserved.