Vol. 37, No. 4 (2015) 434-439

Tribology in Industry

www.tribology.fink.rs

RESEARCH

Applications of Friction Stir Processing during Engraving of Soft Materials

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Keywords:

Frictions stir processing
Tool speed
Soft material
Carbonization

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A B S T R A C T

Friction stir processing has extensive application in many technological operations. Application area of friction stir processing can be extended to the processing of non-metallic materials, such as wood. The paper examines the friction stir processing contact between a specially designed hard and temperature-resistant rotating tool and workpiece which is made of wood. Interval of speed slip and temperature level under which the combustion occurs and carbonization layer of soft material was determined. The results of the research can be applied in technological process of wood engraving operations which may have significant technological and aesthetic effects.

1. INTRODUCTION

Friction stir processing is based on the friction stir welding (FSW) technique which was invented by The Welding Institute (TWI) in 1991 [1,2]. Friction stir processing (FSP) is a solid-state technique used for joining materials and as a tool for material processing (i.e., surface machining). Although the melting temperature of the material is never reached during FSP, severe plastic deformation occurs at extreme temperatures. The process is performed by traversing a rotating tool through fixed workpiece material along a desired path as shown schematically in Fig. 1. Generally, the FSP tool consists of a cylindrical shoulder and a concentric pin, although off-axis pins have been used successfully as in the study by Cantin et al. [3]. The tool pin is forced into the workpiece, and acts to increase the penetration depth of the weld or processed zone. The tool serves two primary functions: (a) heating of workpiece, and (b) movement of material to produce the joint. The heating is accomplished by friction between the tool and the workpiece and plastic deformation of workpiece. The localized heating softens the material around the pin and combination of tool rotation and translation leads to movement of material from the front of the pin to the back of the pin. The shoulder is positioned at the surface of the workpiece, consolidating material that flows around the pin.