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An Experimental Study on Copper Plates Using Friction Drilling.

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Abstract: ***Friction drilling is a novel hole-making method that can be performed on thin-walled sheets. In recent years of study, the thrust force and torque under numerous process conditions were performed to demonstrate the benefits. In recent years of study, the thrust force and torque under various process conditions were performed to demonstrate the benefits. Our objective is to review the behavior of the material with the use of friction drilling by variation of thickness, Spindle speed, and feed rate. Our objective is to study the behavior of the material with the use of friction drilling by variation of thickness, Spindle speed, and feed rate. The friction between a rapid rotating conical tool and a sheet metal workpiece generates heat to soften and displace the metal to form a whole. Friction drilling is a non-traditional hole-making process in which a conical rotating tool is applied to penetrate the workpiece and make the outlet in a single step, without generating chips. the process relies on the heat generated thanks to the resistance force between tool and workpiece, to soften, penetrate and deform the work material into a bushing shape. Generally, friction drilling is applied to thin-walled materials owing to increasing connection length and clamping strength. The generated resistance heat cause softening piece of work material, increase its ductility, and providing it to flow, that extruded onto both the front and back sides of the holes.***

Keywords: Friction Drilling, Conical Tool, Material Displace, Temperature, Hardness & Thickness.

I. INTRODUCTION

Friction drilling is a chip-less hole-making process. during drilling, the friction between a rotating tool and the sheet metal work generates vital heat and plastic deformation to make a hole. the method is additionally Friction drilling uses a conical bit product of a very heat-resistant material like cemented carbide. This device is pressed against a target material with both high rotational speed and high pressure. That way, there's a high local production of heat that softens the object, creating it plastic. The tool then "sinks" through the object, making a hole in it. Lubricants help prevent work-material from adhering to the bit. unlike drilling, material that's flowed isn't lost however it kinds a sleeve around the hole. The length of that sleeve is up to three times the initial thickness of the material. The presence of this metal lip around hole edges makes connections stronger known as thermal drilling, flow drilling, form drilling, or friction stir drilling. several choices are out there with this technology. Bits may include a cutting device that removes the typical "collar" of classified material that flows upwards so that an even top surface is a result. drilled starter holes may be used to reduce the required axial force and to leave a smooth finish in the bushing's lower edge. the method is clean and chipless, which is named flow drilling, form drilling, and friction stir drilling. the most necessary goal of the bushing is to increase the thickness for threading and offered clamp load. Friction drilling is suitable to apply to ductile materials. The petals and cracks formations are generated at the bushing which is obtained at the end of friction drilling of brittle cast metals.

A. History

In 1923, the Frenchman Jean Claude de Valière tried making a tool that could make holes in metal by friction heat, instead of by machining. It was an only a moderate success because at that time the right materials were not yet available. Moreover, he hadn't yet discovered the right shape for this kind of tool. While the previous publications investigated the effects of various process parameters on the thrust force and bushing quality, a more thorough study on the characteristics of the force curve is needed to better understand the details of the hole-making process.

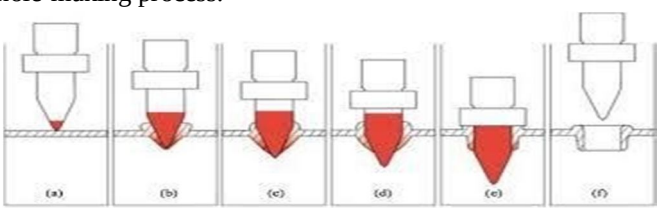


Fig -1: Process of Friction Drilling

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B. The Beginning of the Friction Drilling

This will be attributed to the excessive affinity of the workpiece and tool materials. The quality of the friction-drilled hollow has been significantly investigated Crack and petal formation are each unwanted for threads to be trapped within the drilled holes. Efforts had been made to enhance the bushing quality with adjustments in feed charge and spindle pace. It became discovered that the feed charge had a confined impact on bushing quality, at the same time as spindle speed can bring about both fantastic or poor outcomes on crack formation, relying on the workpiece material. It became determined that for steel, petal formation became decreased with a high spindle pace. It became additionally concluded that brittle solid steel became much less appropriate than ductile sheet steel for friction drilling applications. While the previous publications investigated the results of numerous process parameters on the thrust force and bushing quality, a more thorough observation of the traits of the force curve is needed to higher apprehend the information of the hole-making process. The present work additionally targets evaluating the application of a counter-bore die to control material flow and improve bushing quality.



Fig -2: Friction Drill Tool

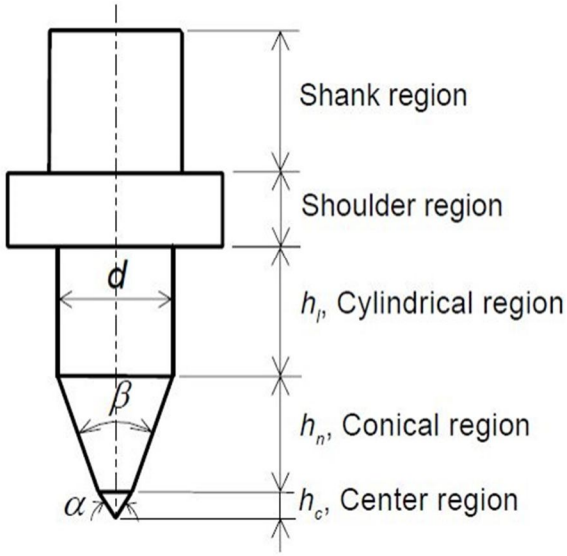


Fig -3: Different Regions in Friction Drill Tool

II. OBJECTIVES

In this Project, Our objective is to study the behavior of material i.e. Copper Plates with the use of friction drilling by variation of thickness, Spindle speed, and feed rate. We will measure the temperature by using a pyrometer, Bush height using Vernier Caliper and we also do the Thermal Analysis by using the ANSYS software.

III. METHODOLOGY

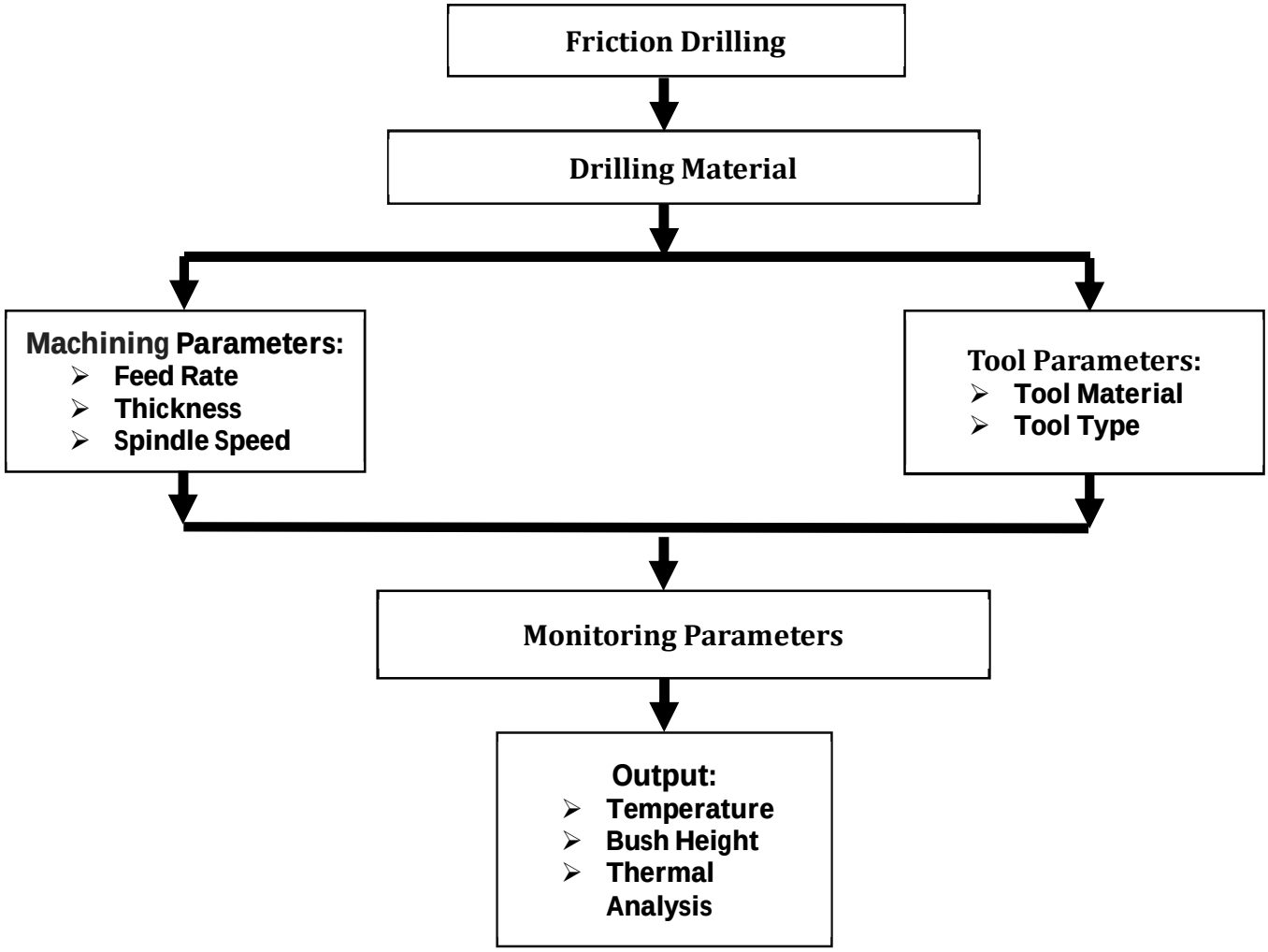
In this, we are using a vertical milling center for drilling, and the tool we are using the friction drill tool. The drilling tool will first approach the material after giving it a specific feed rate and spindle speed for a particular thickness of a material. When the tool touches the material, it gets softened due to high-temperature formation and the drilling process takes place. During this process, a sleeve is formed under the material surface where the hole is done. After making the hole, the drill tool gets backs to its initial position.

By this method, various holes can be made on the material according to the orthogonal array. An orthogonal array is a deciding factor for making the number of holes on a particular material. Again for a material of different thicknesses, the feed rate and spindle speed will differ.

By making several holes, we will observe the behavior of the material by varying different parameters like spindle speed, feed rate, and thickness of material.

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IV. ADVANTAGES

A. The process is very quick.
B. The process reshapes all the material so that no material is lost in operation.
C. The sleeve that is about three times longer than the original diameter of the target material makes it possible to make very strong bolt joints in thin material.
D. It is a clean process because no litter (particles) is produced.
E. Works in almost every kind of metal.
F. Self-welding process.

V. DISADVANTAGES

A. Friction Drilling isn't possible in large materials since displaced metal should be ready to flow somewhere.
B. The utmost material thickness is often 1/2 the opening diameter with bit manufacturers providing specific guidance.
C. It needs higher motor capability and rotational speed than conventional drilling machines.

VI. CONCLUSION

In this project, we have made holes on four copper plates of thicknesses 1mm, 1.5mm, 2mm, and 2.5mm by using Friction Drilling. By Taguchi Method, we have decided the number of holes to be made on the plates. We have performed this experiment by using a Vertical Milling Center (VMC) machine and the tool that we have used in this experiment is a conical drill tool which is made up of Tungsten Carbide which is one of the hardest materials and its boiling point is more than 2,870 °C. For taking temperature readings during the drilling process, we used Pyrometer.

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We have also done a Thermal Analysis of the copper plates by using the ANSYS software. We have preferred Friction Drilling over Normal Drilling because Friction Drilling is a chip-less process and no material is lost in this process which is the main advantage. Also, the sleeves formed, makes it possible to make very strong bolt joints in thin material. Thus, we can use say Friction Drilling is much useful than normal drilling and can be used for several purposes.



Fig-5: Experimental Set-up.

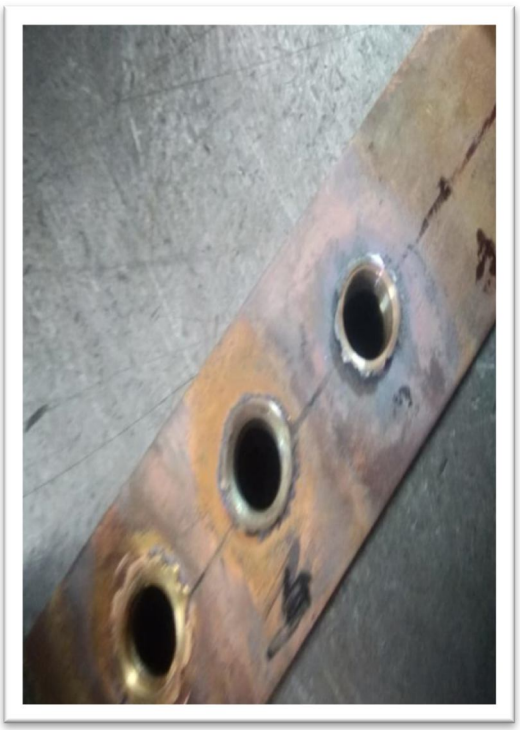
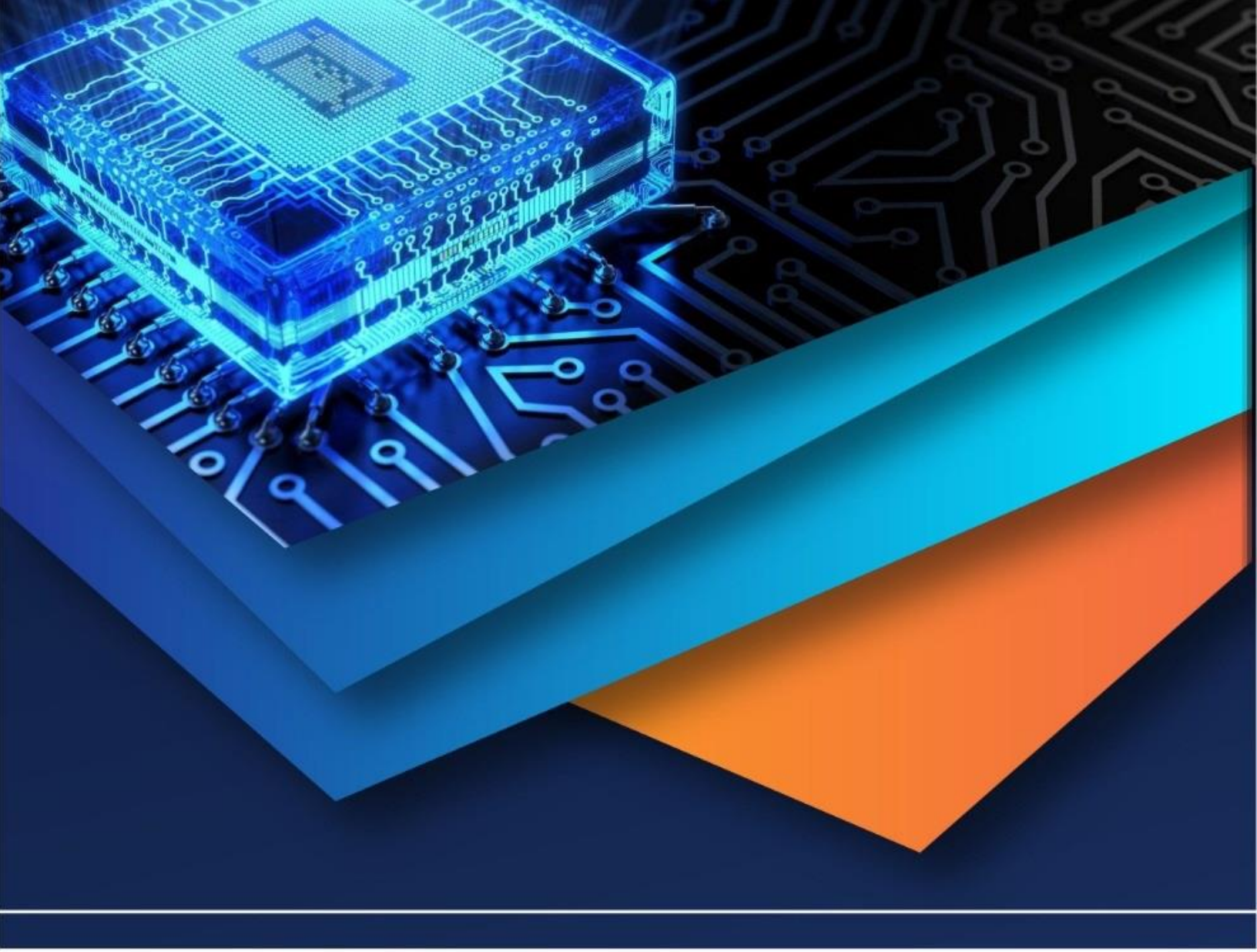


Fig-6: Holes made on Copper Plates By Friction Drilling.

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