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THERMAL DRILLING – NEW PROGRESSIVE TECHNOLOGY

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ABSTRACT: The paper deals with the production of holes and bushes in various types of materials by new technology of thermal drilling. By using of new friction joining technologies we can shortage the production time, provide automation in operations, increase the quality of joining, spare of economical expenses and also we can protect the environment. This contribution was made with cooperation with production firm Commerc Service, s.r.o. in Prešov.
KEYWORDS: flowdrill method, thermal drilling, material, threads, bushings

❖ INTRODUCTION

The product increasing of automobile industry, pipe industry, development of mechanical products, materials, design of joining in civil engineering force the producers to accelerate the production and to utilize new technologies. The thermal friction method is using in joining of materials such as sheets, pipes, hollow profiles. The strong pressure from the side of automobile producers appeals and motivates the tool producers respectively automobile part producers to find new possibilities in joining of automobile parts by using of new types of tools. The pressure of automobile producers is the biggest at the side of economy and quality. The automobile producers try to simplify the production and to use new progressive technologies of joining of automobile components.

The presented paper deals with the problem of material joining by thermal drilling by flow-drill method. We can compare this technology with production of smooth cylindrical and conical bushings and compare the production of threads in thin materials with classical technologies.

❖ PROGRESSIVE METHODS OF MATERIAL JOINING

Classical joining methods of materials are not always possible to provide works for required functions and quality of joints. Therefore it is necessary to investigate the alternative joining methods of materials. Based on experiments and experiences we can divide from the technological view and according to mode of joining on:

- ❖non-permanent joints – mechanical joints ;
- ❖permanent joints – welding joints, adhesive joints.

The most often material joining technologies in automobile industry are laser welding, resistance spot welding, soldering, adhesive joining, clinching or combination of each technologies and mechanical joining. In the practice there is often occurred the requirement to use also non-permanent joints. Various alternatives of joint production exist for the production of these joints with help of threads and screws and riveting.

The joining, where are using friction and temperature, belongs to progressive technologies of joining. These technologies we can divide from various points of view:

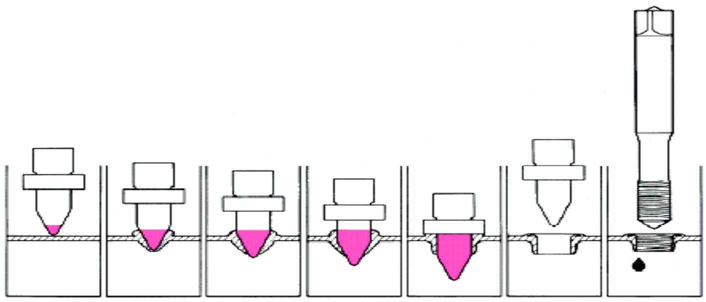


Figure 1. The method of thermal drilling by Flowdrill method

a) according to thickness of processed material:
- thermal drilling into thin sheets to widths 2 mm – direct assembly without pre-hole
- thermal drilling to thin sheets with width above 2 mm, see Fig. 1.

b) according to joining place:
- thermal drilling in one point with creating of partial non-permanent joint, see Fig. 2
- thermal drilling/welding in one point with creating of permanent joint – spot friction welding,

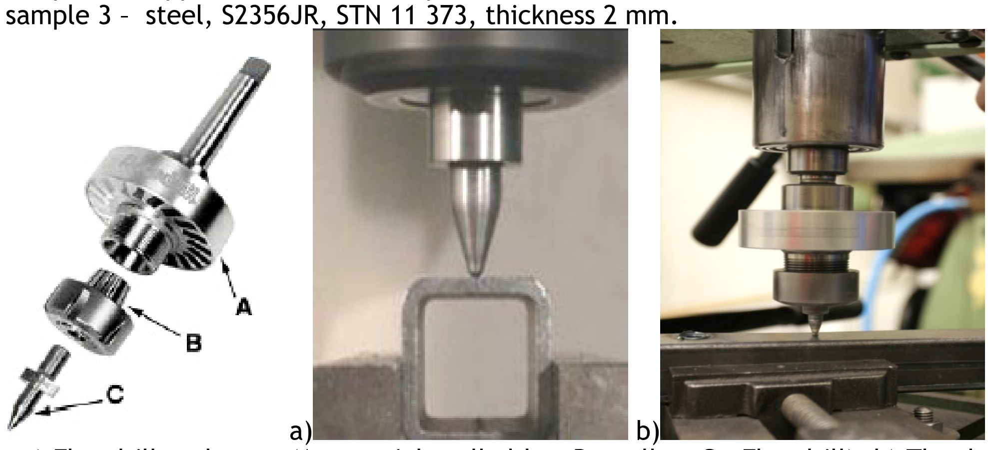
- thermal drilling joined with welding and following creating of permanent joint in defined longitude – friction stir welding.

Figure 2. The examples of using of bushings and threads in automobile and pipe industry [4]

❖ VERIFYING OF THREAD PRODUCTION BY FLOWDRILL METHOD

In the frame of experiments in the Department of Technology and Materials, Faculty of Mechanical Engineering, TU in Košice, there were verified the suitability of thermal drilling technology, it means Flowdrill method for chosen materials for evaluation of quality of produced bushings, holes, threads at various conditions and for investigation of macro and micro structures of mentioned materials. For experimental purposes there were proposed three types of materials:

- ❖ sample 1 – aluminium, AlMgSi, Slovak standard STN 42 4401, thickness 2 mm,
- ❖ sample 2 – copper, STN 42 3001, U profile with thickness of material 2 mm,
- ❖ sample 3 – steel, S2356JR, STN 11 373, thickness 2 mm.



a) b) c)

Figure 3. a) Flowdrill tool parts (A - special toolholder, B - collet, C - Flowdrill). b) The detail of tool without cutter. c) Testing workplace.

The experiments were made on box-column drilling machine of type Flott P 23, with hand operating. The one part of experiments was made in firm Commerc Service, s.r.o. Prešov, as documented on the Fig. 3. There were used the conical drill of type Flowdrill Short with diameter Ø 7,9 mm and drill Flowdrill Short Flat with diameter Ø 7,9 mm with cutter and tapping tool. At the same time there were compared the behaviour of materials according to three spindle speeds: 1470 rpm, 2 490 rpm and 3 420 rpm.

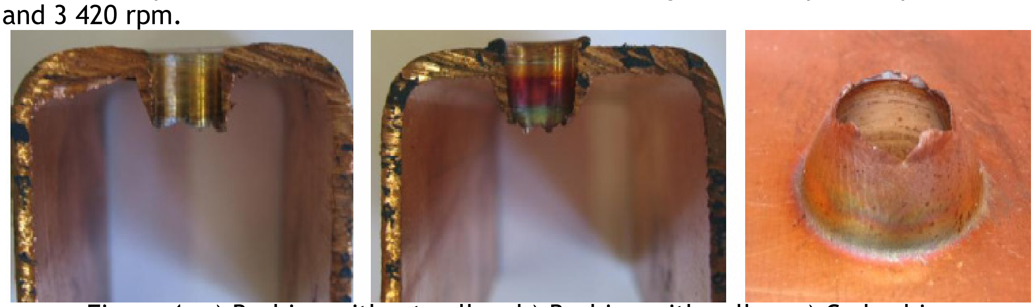


Figure 4. a) Bushing without collar. b) Bushing with collar. c) Cu bushing

In the Fig. 4 a) is shown the cross section of bushing without collar from material cooper at operating speed 2490 rpm. The similar is the Fig. 4 b) with cross section of bushing, but with collar, from the same material at operating speed 2490 rpm. In the Fig. 4 c) is shown the bushing from bottom side. Its high is 7.2 mm at operating speed 2490 rpm.

In the Fig. 5 a) is shown the bushing without a collar and with threads, which were made by forming operation. The Fig. 5 b) shows created threads in bushing with collar. As we can see from figures the threads are in good quality. The bottom margin is not finished in the plain, it is wrapped, but that fact is not changing the quality function of joint with screw. It can be grind in one plane.

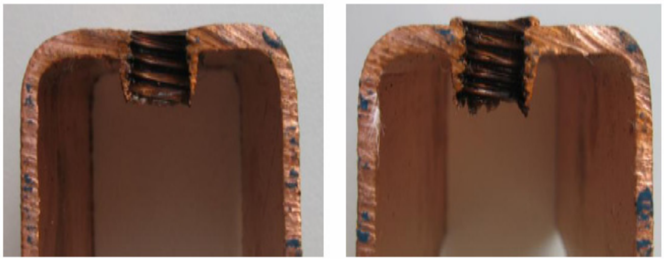


Figure 5. a) The forming threads in bushing. b) The forming threads in bushing with collar

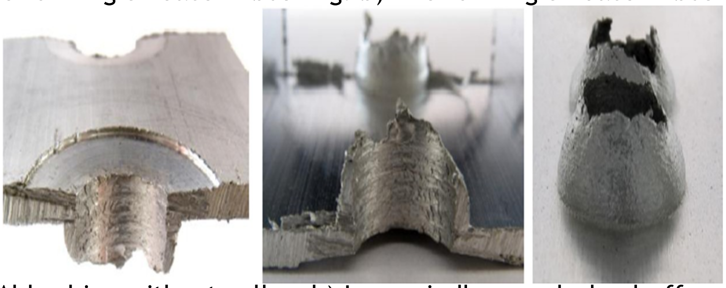


Figure 6. a) Al bushing without collar. b) Low spindle speed, dandruffs. c) Al bushings

In the Fig. 6 a-c are shown the cuttings of each bushing without and with formed threads.

❖ CONCLUSIONS

By development of new technologies we can use other properties of progressive technologies as temperature, friction and also new materials. From the reached results we can make the conclusion that the most important parameter for thermal drilling by Flowdrill method is:

- ❖ material of bushing and collar,
- ❖ material of drilling tool, resistant against the wear and temperature,
- ❖ technological parameters: spindle speed, friction, operating time,
- ❖ automation of operations, if it is made by hand or on automated drill.

The best quality of bushing and collar was created from material steel, also the strength properties was the best from this material. From copper and brass sheets, the bushings and collars were not so smooth; the bottoms were wrapped with comparison of steel ones, but are satisfied for mechanical screw non-permanent joints. The worst material was aluminium from used materials, where the following creating of threads shows the most deviation from defined shape and there were occurred more fractures on the bottom border of bushing.

❖ ACKNOLWLEDGEMENT

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