

CHANGE THE STRUCTURE OF THE MATERIAL TECHNOLOGY OF THERMAL EFFECTS OF DRILLING FLOWDRILL

PROMJENA STRUKTURE MATERIJALA POMOĆU TEHNOLOGIJE TOPLINSKIH UČINAKA FLOWDRILL BUŠENJEM

Jozef MAŠČENIK, Eva BATEŠKOVÁ, Jozef HALKO¹⁾

Ključne riječi: toplinsko bušenje, mikroskopska analiza

Key words: thermal drilling, microscopic analysis

Sažetak: Cilj ovog članka je ukazati na promjenu strukture nehrđajućeg čelika koji se koristi u prehrambenoj industriji, uzrokovano korištenjem Flowdrill tehnike toplinskog bušenja, za analizu stanja i kvalitete materijala prije i nakon korištenja Flowdrill bušenja, za ocjenu i preporuku istih kako bi potencijalni korisnik mogao odlučiti na temelju dobivenih rezultata, produktivnosti i kvalitete zahtjeva.

Abstract: The aim of this article is to point out the structure change of the food stainless steel caused by using the thermal drilling Flowdrill; to analyse the state and qualities of the material before and after using Flowdrill drilling; to evaluate and recommend them to the prospective customer so that he could decide on the basis of obtained results, productivities and quality of requirements.

¹⁾ Faculty of Manufacturing Technologies, TU Košice with seat in Prešov, Štúrova 31, 08001 Prešov, Slovak Republic
jozef.mascenik@tuke.sk, eva.bateskova@tuke.sk, jozef.halko@tuke.sk

1. INTRODUCTION

Recently, we have often encountered supporting elements of steel constructions, which are produced from thin sheet plates or bands by bending, spatial shaping or forming by means of bending and pressing technology. Among them are also panel constructions, utilized for modern constructions of industrial objects, metal cover elements for building halls from different constructions.

The technology of thermal drilling Flowdrill represents an alternative and perspective way of production of precise cylindrical chucks of thin-walled materials such as sheet plates, different shapes of profiles and tubes.

Open and closed rolled profiles more and more substitute economical and light profile materials, produced from sheet bands, which with a substantially lower weight show similar, often even higher strength, or more precisely bearing capacity.

The technology principle starts from a platform on the basis of forming with hot. The rotating tool (forming drill) generates heat, which originates from friction between the tool and workpiece by the instrumentality of axial force. Due to the produced heat (600 – 800 °C) there occurs softening of the worked place and a simultaneous passing of the tool through the workpiece, which results in the final shape of chuck in the material.

2 TECHNOLOGY FLOWDRILL

The technology is suitable for production of chucks and screw threads by forming in thin-walled and poorly accessible materials such as square or rectangular profiles, tubes etc. Thermal drilling can be used for most types of steel, aluminium, copper, brass and some types of alloys.

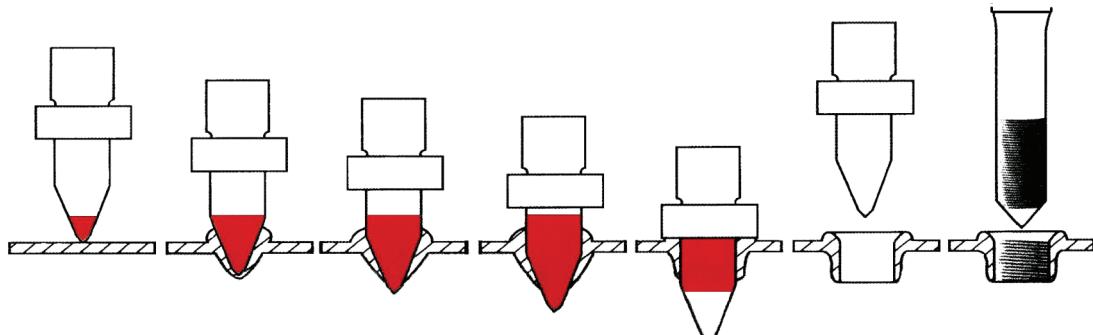


Fig. 1 Thermal drilling phases

2.1 Sample preparation

To produce the sample, we used a machine tool – drilling machine Flott P23 with the wattage of 0,7 kW. The examined sample is from steel 17 241. Flowdrill holes have the diameter of 10 mm and approximately 5 mm reprinted tail on the outer side of the Flowdrill holes. The sample was cut through the hole axis.

The selected sample was polished by means of a water-cooled grinding wheel up to 1 micron using standard metallographic polishing procedures and finishings. The device for grinding is a grinding machine functioning on the basis of abrasive. In Fig. 2 is the sample prepared for a microscopic analysis.

After polishing, the parts of sample were electrolytically corroded for 10 seconds in the 10 % solution of nitric acid in methylalcohol at 6V DC and examined under a metallurgical microscope. Sample polishing is performed to remove the flutes left after the grinding.

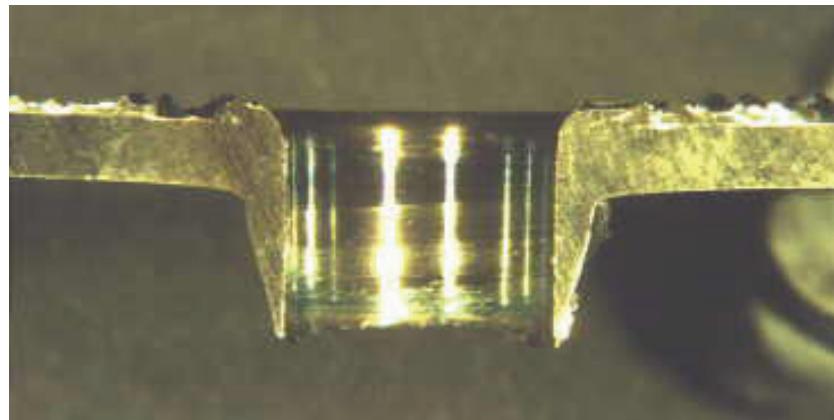


Fig. 2 Sample prepared for microscopic analysis

3 MICROSCOPIC ANALYSIS

The distance between the basic material from the Flowdrill holes and their zones influenced by heat indicates a typical austenitic noncorrosive single-phase microstructure of clean polyhedral double austenitic grains. It is typical for materials formed at low temperatures which were repeatedly cooled in the cooling solution (cooled by water approximately at the temperature of 1050 °C). The sample contained a small amount (<1 %) of delta ferrite fibres, common for this material.

Granular edges were only sparsely uncovered by corrosion, showing a very low content of carbon and insignificant granular edge of carbide depositing in the zone influenced by the heat as a result of heat effects of the thermal drilling Flowdrill process.

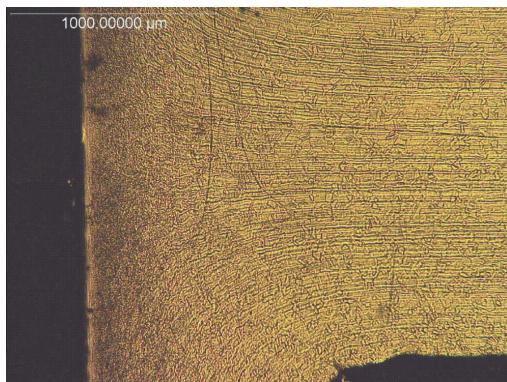


Fig. 3 Photomicrograph illustrating microstructure around the Flowdrill hole

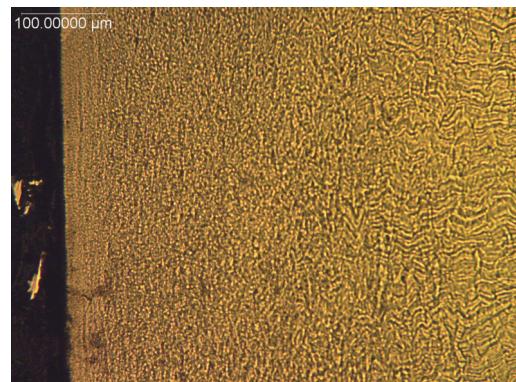


Fig. 4 Photomicrograph illustrating clarified microstructure on the hole surface

To obtain the photograph of the microstructure, we used Nikon Optiphot & Olympus Vanox metallurgical microscope which utilizes a digital camera together with an ocular. The structure change takes place gradually from the hole edge to 3 mm very distinctly and gradually up to 8 mm from the hole edge, the qualities still change. The gradual changes are can be seen in the photographs below.

4 MICROHARDNESS ANALYSIS

The change of hardness was determined by means of Vickers hardness test. Vickers tests of microhardness were performed through the hole profile reaching from the hole surface through the zone influenced by heat into the basic material using 500 g load. Microhardness was stated by means of a device for automatic stating of microhardness. Figure 5 shows, how the material hardness increased towards the hole.

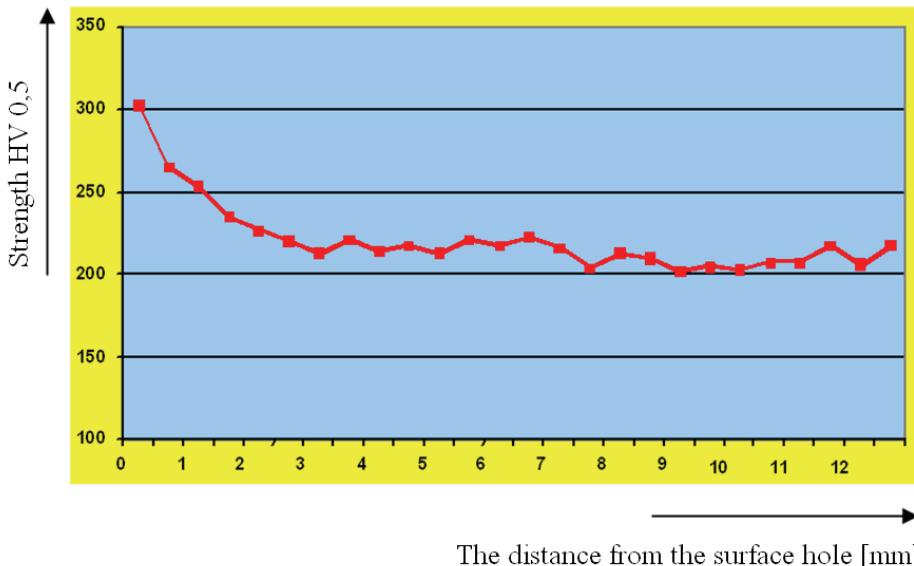


Fig. 5 Relation of distance from the hole surface and hardness

5 CONCLUSION

Flowdrill processes have caused improvement and deformation of the basic material microstructure with hardening of the austenitic grain to the depth of 3 mm around the hole surface. The effects of heat on the microstructure are minimal and no carbide deposits appear on the rims of grains and zones formed by heat, which could conversely cause corrosion of this type of material. Considering this fact, these specific corrosion tests, which confirmed our metallographic findings, could be recommended to this material type users. This contribution forms a part of the solution of the grant task VEGA 1/4156/07 and KEGA 3/6279/08.

6 REFERENCES

- [1] User's Guide Flowdrill, COMMERC SERVICE s.r.o., Prešov, pp 1 – 32.
- [2] JURKO, J.: "Technológia zmeny rozmerov I.", Prešov, FVT TU Košice, 2000, pp 15 – 21.
- [3] ROVŇÁKOVÁ, Sylvia; LÍŠKA, Ondrej: "Návrh a realizácia viacúčelového vrtacieho stroja." In: Transfer inovácií. č. 12 (2008), pp 118-120, ISSN 1337-7094.