MEASUREMENT OF SURFACE ROUGHNESS OF GEARS MADE BY UNCONVENTIONAL TECHNOLOGIES

MJERENJE HRAPAVOSTI ZUPČANIKA PROIZVEDENIH NEKONVENCIONALNIM POSTUPCIMA OBRADBE

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Ključne riječi: ozubljenje zupčanika, obrada laserom, plazmom i vodenim mlazom, hrapavost površine

Key words: toothing, laser, plasma, water jet and surface roughness

Sažetak: U članku se analizira proizvodnja zupčanika nekonvencionalnim tehnologijama obrade i usporedba mjerenjem postignutih hrapavosti površine ozubljenja. Uspoređene su obradbe laserom plazmom i vodenim mlazom. U svim slučajevima obrađivan je materijal S 355 J2 G3. Mjerenje površinske hrapavosti izvedeno je s pomoću uređaja SURFTEST SJ-301 tvrtke MITUTOYO.

Abstract: The article analyzes production and confrontation of toothing by nonconventional technologies with measuring surface roughness. Toothing is manufactured by laser, plasma and water jet. Material for cutting of toothing are selected S 355 J2 G3. Measurement of surface roughness was transferred to the device SURFTEST SJ-301 from the company Mitutoyo.

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1 INTRODUCTION

Mechanical engineering has begun to apply high speed machines that should work with high efficiency and with low noise; that is why gear wheels must meet higher requirements. Where recently gear wheels cut by conventional manufacturing processes were sufficient, nowadays gear wheels produced by non-conventional technologies can be implemented.

The presented contribution contains analysis of non-conventional technologies that can be applied for gear wheels manufacturing, these include laser, plasma, and water jet cutting. Gear wheels were manufactured according to gear wheel sample produced by conventional technology (machining).

2 TOOTHING MANUFACTURED BY UNCOVENTIONAL TECHNOLOGIES

The samples were designed in a way that makes it possible to manufacture the samples by all mentioned non-conventional technologies. Samples were manufactured from the same material as was used at laser, plasma and water jet cutting - machinery steel S 355 J2 G3.

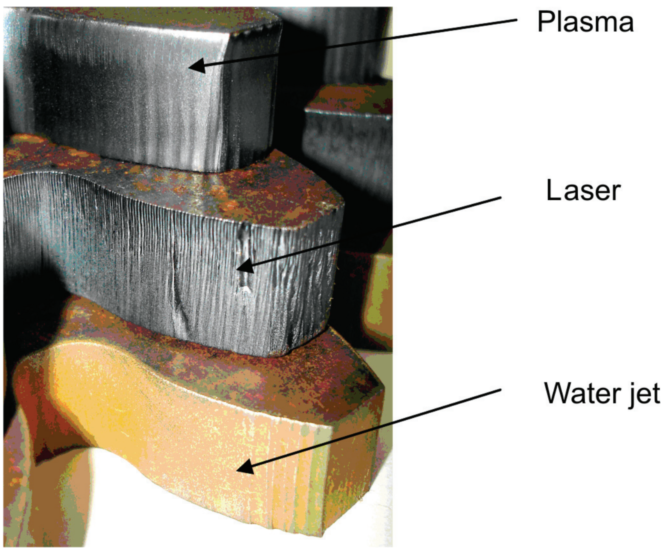

Fig. 1 The teeth of the gear wheel made by unconventional technologies

Figure 1 shows gearings cut by laser, plasma and water jet heat altered zone is clearly visible. Unlikely the laser-cut sample the samples produced by plasma show finer roughness (which is visible by bare eye). This apparently is an advantage: it is easier to achieve final accurate shape of the toothing. At the high-speed hydro-abrasive jet cutting, inaccuracies emerge. These inaccuracies manifest themselves as dimension, shape, and mutual position deviation, as well as increased roughness. The surface cut by water jet shows corrosion which arose after the cutting.

3 MEASUREMENT OF SURFACE ROUGHNESS

Measurement of surface roughness was transferred to the device SURFTEST SJ-301 from the Japanese company Mitutoyo. It's a portable device for measuring surface roughness with power from the grid and using batteries, which can directly perform measurements at the workplace. It corresponds to international standards DIN, ISO, ANSI and JIS.

Fig. 2 Device Mitutoyo Surftest SJ-301

Mean depth of roughness Ra is the arithmetic mean of the individual roughness depths adjacent to the representative of each measured striations. The depth of surface irregularities has been reported in mm. The results of measurements of roughness Ra was measured at three points each cut side. Measured areas are shown in Fig. 3.

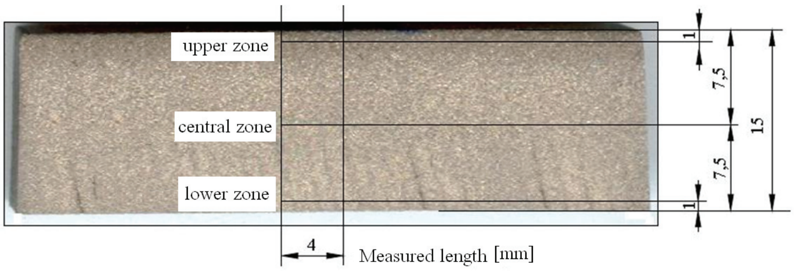

Fig. 3 Places where the measured surface roughness

- The first measurement was measured in the upper zone of 1 mm from the front sprocket,
- The second measurement was measured at the equatorial latitude sprocket,
- The third measurement was measured 1 mm below the zone opposite the front sprocket.

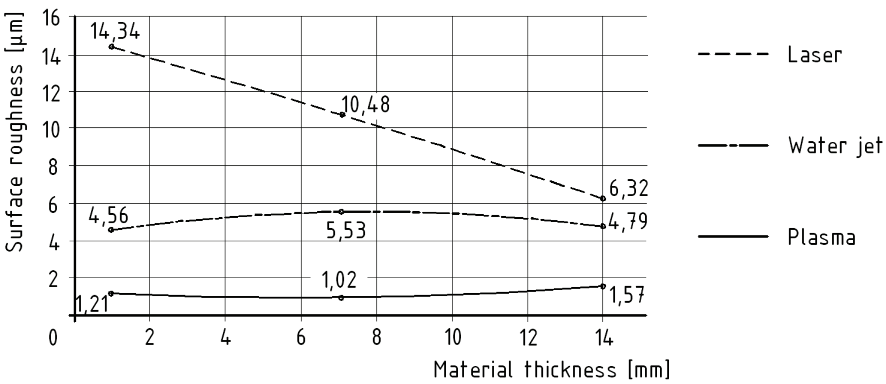

Diagram 1 Dependence of roughness on material thickness at laser, plasma and water jet cutting

Cut surface roughness at laser, plasma, and water jet cutting is shown in three curves according to three measurements in three different zones. Length of measurement is 4 mm on measured area. Measuring apparatus is adjusted so that it determines arithmetical mean Ra.

Diagram 1 shows curves describing comparison of non-conventional technologies as dependence of surface roughness Ra on material thickness, diagram width responds to the cut material thickness 15 mm.

4 CONCLUSION

Gear, which was produced by non-conventional technologies without the necessary precision, and therefore it is necessary to complete the conventional technology in milling and grinding. After comparison of described technologies it was concluded from the parameters which were taken into account that the most advantageous technology is plasma cutting. Toothing was cut with additional material layer thickness 1 mm because it must be finished by gearing cutter and fine grinding. Even though at plasma cutting the heat altered zone is the biggest, this technology is the most advantageous from two points: it is the fastest technology from the three mentioned technologies, and it offers the best surface roughness. From the point of view of manufacturing costs the plasma cutting is also the most favourable. This contribution forms a part of the solution of the grant task VEGA 1/4156/07 and KEGA 3/6279/08.

5 REFERENCES

[1] KRAJNÝ, Z.: Vodný lúč v praxi. Bratislava, EPOS, 1998, ISBN80-8057-091-4.
[2] VASILKO, K.: "Technológia zmeny rozmerov". COFIN Prešov, 2004, ISBN 80-8073-160-8.
[3] VASILKO, K., KMEC, J.: "Delenie materiálu", Datapress Prešov, 2003, ISBN 80-7099-903-9.