

Multiscale surface texture and fractal analysis of straight bevel gears finished by PECH and PECF process

Ștefan Țălu^a, Slawomir Kulesza^b, Mirosław Bramowicz^c, Sunil Pathak^d, and N. K. Jain^e

^a The Directorate of Research, Development and Innovation Management (DMCDI), Technical University of Cluj-Napoca, Cluj-Napoca, Romania

^b Faculty of Mathematics and Computer Science, University of Warmia and Mazury in Olsztyn, Olsztyn, Poland

^c Faculty of Technical Sciences, University of Warmia and Mazury in Olsztyn, Olsztyn, Poland

^d Faculty of Manufacturing and Mechatronics Engineering Technology, Universiti Malaysia Pahang, Kuantan, Malaysia

^e Discipline of Mechanical Engineering, Indian Institute of Technology Indore, Simrol, India

ABSTRACT

The present work was conducted to provide insights for an in-depth understanding of the straight bevel gears finished by pulsed-electrochemical-honing (PECH) and pulsed-electrochemical-finishing (PECF), using multi-scale surface texture and fractal analysis in order to give manufacturers a competitive edge when improving their tools. Unfinished bevel gears and bevel gears finished by PECF and PECH were analyzed on their surface texture characteristics and material properties. Surface characteristics of 20MnCr5 alloy steel gears were evaluated by computing four locations on regions of each sample. Field emission scanning electron microscopy (FESEM) was applied for surface material characterization. It was found that it can be discriminated between the PECF and PECH-finished bevel gears surface regions of samples and unfinished samples, using area-scale analysis and surface texture characteristics. The surface micro-morphology results can be applied in studies about improving the lifetime of tools and for mathematical modeling of lubrication processes between tool and workpiece.

KEYWORDS

Finishing; Gears; Microtexture; PECH; PECF; Surface

REFERENCES

1. Goch, G.
Gear metrology
(2003) *CIRP Annals - Manufacturing Technology*, 52 (2), pp. 659-695.
http://www.elsevier.com/wps/find/journaldescription.cws_home/709764/description#description
doi: 10.1016/S0007-8506(07)60209-1

2. Karpuschewski, B., Knoche, H.-J., Hipke, M.
Gear finishing by abrasive processes
(2008) *CIRP Annals - Manufacturing Technology*, 57 (2), pp. 621-640.
doi: 10.1016/j.cirp.2008.09.002
3. Pathak, S., Jain, N.K., Palani, I.A.
On surface quality and wear resistance of straight bevel gears finished by pulsed electrochemical honing process
(2015) *International Journal of Electrochemical Science*, 10 (11), pp. 8869-8885.
<http://www.electrochemsci.org/papers/vol10/101108869.pdf>
4. Pathak, S., Jain, N.K., Palani, I.A.
Effect of applied voltage and electrolyte parameters on pitch, runout, flank topology, and finishing productivity of the straight bevel gears in PECH process
(2017) *Materials and Manufacturing Processes*, 32 (3), pp. 339-347.
www.tandf.co.uk/journals/titles/10426914.asp
doi: 10.1080/10426914.2016.1198022
5. Pathak, S., Jain, N.K., Palani, I.A.
Investigations on surface quality, surface integrity and specific energy consumption in finishing of straight bevel gears by PECH process
(2016) *International Journal of Advanced Manufacturing Technology*, 85 (9-12), pp. 2207-2222.
<http://www.springerlink.com/content/0268-3768>
doi: 10.1007/s00170-016-8876-x