ANALYSE OF GEAR TOOTH SURFACE ABOUT THE METHOD GRINDING REISHAUER

Cristiana MURESAN

Author: ***Cristiana Muresan***
Workplace: ***Technical University of Cluj-Napoca, Department of Manufacture Engineering, Faculty of Machine Building,***
Address: ***B-dul Muncii nr. 103-105, Cluj-Napoca, ROMANIA***

Abstract

Is concerned with the characterization of the gear tooth surface obtained with such processes. The characterization is performed with respect to the surface functional properties. These parameters which are interesting due to the noise activity were identified when the literature available in the field of interest was reviewed. Since the main aim of this paper is to discuss how to produce with optimal noise consequences the principle Reishauer grinding. Optimal strategies concerning all processes for production of low noise gears are suggested. The validity of arguments and results regarding the Reishauer process was examined while gears from a real manufacturing shop-floor were evaluated.

INTRODUCTION

It is widely known that gear tooth geometry highly influences the dynamics of the system.In general design of a gear with respect to the dynamic behavior occurs by modifying the gear geometry, such as tip relief lead crowing. Accordingly it is desirable to manufacture the shape of the gear tooth to follow the calculated form. It is important to realize that the micro geometry of the tooth is accomplished by the finishing processes.On Thomas [1] discussed the noise generated by surface interaction in bearings classifying in into three groups according to its origin:

- noise generated by the elastic deformation and release of form and waviness feature during rolling;
- shock noise caused by the elastic deformation and release of asperities within the hertzian contact zone;
- shock noise from asperity collisions and debris collisions.

PRINCIPLES OF REISHAUER GRINDING

The process is similar to a worm gear drive. The tool has a number of inverted worm threads formed by a diamond master. These worm threads interact internally on the gear teeth surface of the workpiece. The tool and the workpiece are controlled by two separate motors. Their respective angular velocities are synchronized so respective angular velocities are synchronized so that the workpiece rotates the distance of a number of gear teeth while the tool rotates a full revolution.The kinematics of the process involves three major velocities. These velocity components are shown in fig.1.

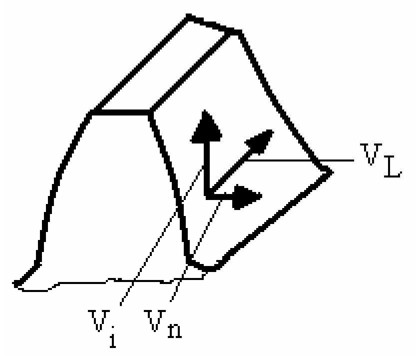

Fig. 1. *Velocity components*

The first component is the periphery velocity of the tool V_L in lead direction,which is tangential to the rotational direction of the tool and perpendicular to the involutes direction. V_L increases linearly towards the periphery of the tool since
$V_L = \Omega \cdot r$,where r is the tool radius. The second major velocity
(V_i) is perpendicular to V_L and acts along the involute direction.

The velocity V_i is usually very low compared to V_L. V_i is a linear function of the angular velocity of the workpiece with a positive gradient, V_i increases from the tooth root to the tip of the tooth. Workpiece notation ω_2, ω_2 dependents upon the angular velocity of the tool ω_1 on z_1 the number of teeth of the workpiece and on z_2 the number of worm threads in the tool given by the relation $\omega_2 = \frac{z_1 \cdot \omega_1}{z_2}$ .According to this simple relation the velocity component V_i can be mainly influenced by the number of thread starts. If ω_1 is exactly synchronized with ω_2 no grinding will take place. If a synchronization is introduced a third major velocity V_n starts to act in normal direction of the surface. A surface pressure between the tool and the work is been generated thus making grinding work feasible. The magnitude of the velocity V_n is proportional to the magnitude of the synchronization error. The synchronization error is therefore nothing else but the feed read of this process and measures the absolute value of V_n. Depending on the sign of V_n either the left sides or the right sides of the workpiece are ground.

SURFACE STRUCTURE

It is reasonable to believe that interaction of contact surfaces main direction can play a significant role. Lubricant retention volume surface wavelength measured relative sliding speed direction, penetration depth and all other tribological properties will be affected. The relative speed direction and the contact line direction are conditioned by the macro form and the assembly of the gears, but the surface lay direction can be affected by the manufacturing procedures through the design of the tool parameter set up and also assembly condition mainly the axis cross angle.

The ration V_i / V_L determines the surface structure in all processes under all operating conditions. the instantaneous angle of scratches measured from the centerline of the surface in lead direction is equal to $a\tan(V_i / V_l)$. This ration is also important in the case applying one of these processes after grinding. Because the efficiency of the process is correlated with the cutting direction relative to the existing surface main direction.

RZP-GRINDING WITH RESPECT TO RQ-VALUE

In figure 2, it is shown that the area under spectral density curve is a linear function of the surface Rq-value in square. In this diagram, area values were calculated based on frequency measurements and Rq-value from the large measurement calculated in soft.The relation presented in this figure is based on randomly selected gear surfaces

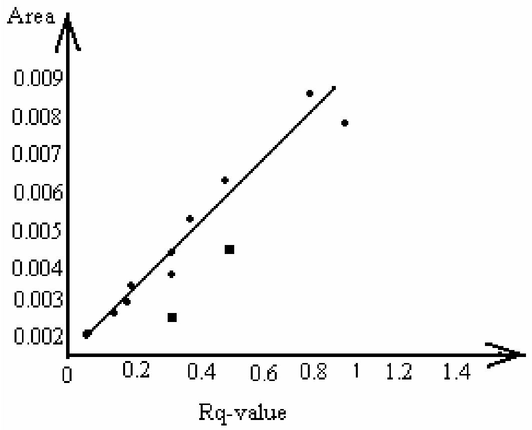

Fig. 2. *Correlation between the spectrum and the surface Rq-value*

The high degree of correlation offrs the opportunity of evaluating surfaces by a simple and rapid measurement, while the ability of extrcting the same information is still preserved.In fact,as it shown for the RZP-process in the following the information extracted in this way is more valuable,since the information of corresponding wavwlenghts are simultaneously included.The method is also more stable than is Rq-value,as long as the measurement is performed perpendicular to the surface waviness.In other words,it is actually the waviness of the surface that reflects itself in the Rq-value.

The other advantage from the relation presented in figure 2 is the increased reliability of this method used for evaluating gear surface.The repeatability of this method was also examined in practice,the estimation was performed for two different teeth of one gear.in this process a CBN-tool is used which maps its topography directly on the work surface.

Therefore,the optimization is concerned with compromising between the tool life cycle and the surface topography obtained which is a question of overall operation cost.

CONCLUSION

Surface parameters to noise activity are profile ondulation properties surface main direction and amplitudes. It was also shown that the method has a viable repeatability at the same time as it is in good correlation with the conventional surface parameters. Finishing processes principles were reviewed and a general conception to be analyzing these operations were presented. Their signifiant parameters were identified to be the relative velocity components involved.

Surface trated by Reishauer are dominated by a fundamental wavelength. This wavelength is determined by the master gear involved in this process. Due to this fact it is proved that the cut-off length of 0,8 mm used in this study has been proper to be utilized.

References

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