APPLICATION OF GRINDING PROCESS OF LARGE MODULE GEAR WHEELS WITH FINGER ABRASIVES STONE

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Annotation. A copy transfer method using toothed the wheels grinding , processing to give of the process stability despite the tooth profile across cutting depth uneven being , this of the process efficiency reduces Real cutting in the depths differences tooth involute profile across down , they again processed the work to the surface moved . of the process technology with depends processing to give error appear it has been . Polishing conditions improve and processing to be given of the teeth quality improve for to him effect doer factors control to do through real cutting of depth stability provide need Offer being carried out the instrument analysis to do based on tooth profile across cutting depth relatively one different distribution provide through thought out to the result achieved shown .

Key words : cutting depth, copy grinding, teeth grinding, fingered abrasive touchstone, profile, attempt.

Competitiveness provide for in technology wide applied modern toothed transmissions mainly, gear the wheels work release quality with determined high work indicators have to be need

Geared of wheels teeth copy the way with grinding , this high accuracy and processing to give quality which provides and products make up the most efficient and reliable technologies is one This method using grinding next door the wheel teeth between of space to the profile complete suitable coming to the profile have has been fingered using an abrasive stone done increased Processing to give for permission done surface purity Ra = 0.6...0.7 mm. Polishing three or four in transition done increased

Figure 1. Fingered abrasive stone views

Technological of factors cutting to the depth effect determination for copy transfer method using teeth again work for surface cleanliness with research was conducted . Experience as a result It was found that the tooth in the parameters errors cause emits of reasons one processing given of surfaces elementary in places real cutting of depth uneven distribution is considered

That's why we are the first in line tooth outline analytical dry we went out

Geared do not pass contour tooth again work for his separately points tooth outline coordinate of the {0} ordinate in the system arrow the wheel your teeth A is the starting point of the contour from the point passable with to be determined need (Figure 2)

i = 1. . . n. (1)

Contour consecutively of points radii the following from Eq determination possible (Fig. 1):

$$\frac{d_i}{2} = \frac{d_b}{2} + \frac{d_a - d_b}{2(n-1)}(i-1),$$

Contour of i-point diameter and of contour corners as follows is expressed .

$$\alpha^{(i)} = \cos^{-1}\frac{d_b}{d_i}$$

where a $^{(i)}$ - profile of the involute desired at the point profile corner

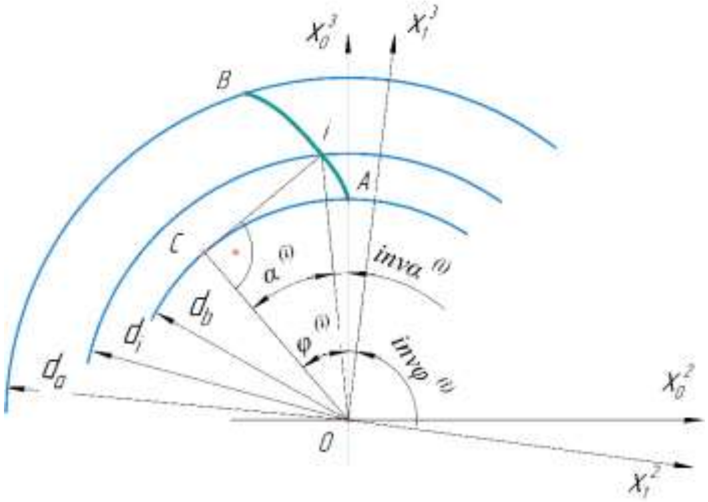


Figure 2. Tooth outline : tooth the left side of the profile .

Ordinate arrow and attempt of the point radius between corner this at the point main circle with the normal on the contour is as follows is expressed (Fig. 2):

$$\varphi^{(i)} = \alpha^{(i)} + \text{inv}\alpha^{(i)} = tan\alpha^{(i)},$$

φ - (i) at the point contour radius and attempt point radius between corner

Finally , the coordinates {0} and {1} are shown in Figure 1 in systems tooth left side of profile for tooth of the outline desired of the point coordinates as follows writing can :

$$x_0^{2(l)} = \frac{d_b}{2}(\sin(-\varphi^{(i)}) + \varphi^{(i)}\cos(-\varphi^{(i)})),$$

$$x_0^{3(l)} = \frac{d_b}{2}(\cos(-\varphi^{(i)}) - \varphi^{(i)}\sin(-\varphi^{(i)})),$$

$$x_1^{2(l)} = x_0^{2(l)} \cos\varphi_0 - x_0^{3(l)} \sin\varphi_0,$$
$$x_1^{3(l)} = x_0^{2(l)} \sin\varphi_0 + x_0^{3(l)} \cos\varphi_0,$$

The tooth contour equation for the left side of the tooth profile looks like this:

$$r_1^{(r)} = r_1^{(r)}(\varphi, u) = \left[u, \frac{d_b}{2}(\sin(\varphi + \varphi_0) - \varphi cos\,(\varphi + \varphi_0)), \frac{d_b}{2}(\cos(\varphi + \varphi_0) + \varphi sin\,(\varphi + \varphi_0))\right]$$

Involute outline so is characterized by its normals basis around touching stands That is , the contour consecutively for points (L. i). circle so rotate maybe the main one circle (dot. C) with normal contact to the involute points always of the basis intersection at the point will be (Figure 3)

From this come it turns out that it is vertical to the arrow have , processing to be given to the outline try , in a row points for toothed horizontal from the arrow constant in the distance is installed and only his horizontal bullet direction according to shift will change .

Vertical milling on the RDB machine each of the plane for cross-section ($d_b/2$). diaper circle in radius toothed of the screw vertical from the plain x_f exclusion in the distance horizontal rotation arrow across placement need Geared wheel ε angle under is converted .

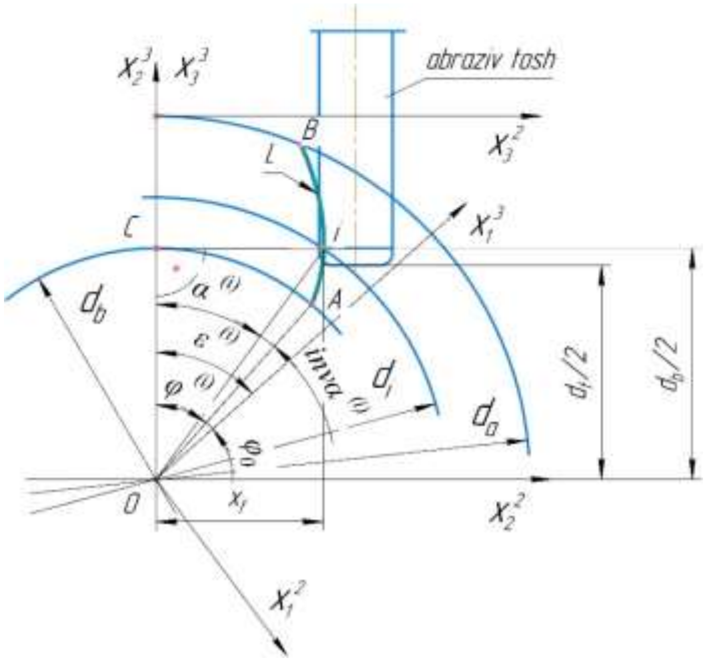


Figure 3. Processing to give in the process fingered abrasive stone tool installation

Normal horizontal of tooth profile to the situation suitable coming tooth turning corner to the following equal to :

$$\varepsilon^{(i)} = \varphi_0 + \alpha^{(i)} + \mathrm{inv}\alpha^{(i)} = \varphi_0 + tan\alpha^{(i)},$$

Here $e^{(i)}$ - at the i-point the profile sharpening for tooth rotation corner

As shown in Figure 3 , the left tooth profile contour (right tooth contour) for this as follows to express can :

$$x_2^{2(il)} = x_1^{2(il)} \cos \varepsilon^{(i)} + x_1^{3(il)} \sin \varepsilon^{(i)},$$
$$x_2^{3(il)} = -x_1^{2(il)} \sin \varepsilon^{(i)} + x_1^{3(il)} \cos \varepsilon^{(i)},$$
$$x_3^{2(il)} = x_2^{2(il)},$$
$$x_1^{3(il)} = x_2^{3(il)} - \frac{d_a}{2} = \frac{d_b}{2} - \frac{d_a}{2},$$
$$\varepsilon^{(il)} = \varepsilon^{(i)}.$$

Same so , right tooth tooth profile outline for (left tooth profile) this as follows to express can :

$$x_2^{2(ir)} = x_1^{2(ir)} \cos \varepsilon^{(i)} + x_1^{3(ir)} \sin \varepsilon^{(i)},$$
$$x_2^{3(ir)} = -x_1^{2(ir)} \sin \varepsilon^{(i)} + x_1^{3(ir)} \cos \varepsilon^{(i)},$$
$$x_3^{2(ir)} = x_2^{2(ir)},$$
$$x_1^{3(ir)} = x_2^{3(ir)} - \frac{d_a}{2} = \frac{d_b}{2} - \frac{d_a}{2},$$
$$\varepsilon^{(ir)} = \varepsilon^{(i)}.$$

Your tooth outline is symmetrical . Tooth profile symmetry arrow vertical bullet has been from case x follows is represented by (angle e practical not because we start determine but we can't tooth profile vertical bullet with symmetrical way suitable coming way our installation can):

$$x_f = x_3^{2(ir)} = -\, x_3^{2(il)},$$
$$\varepsilon^{(r)} = \varepsilon^{(l)}.$$

Program and processing to give process . Analysis based on changed of contour coordinates and accordingly respectively toothed processing to give for instrument trajectory to create supportive applications work (Figures 4 and 5).

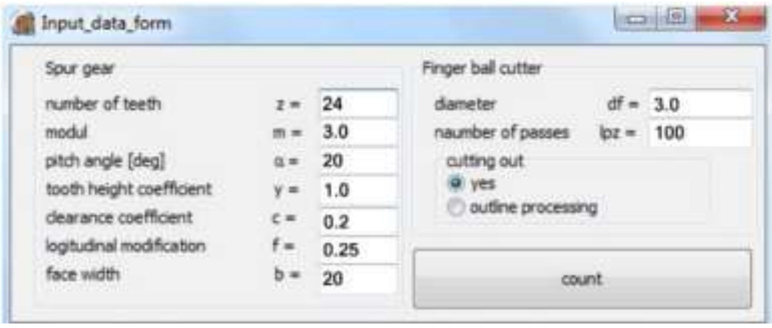
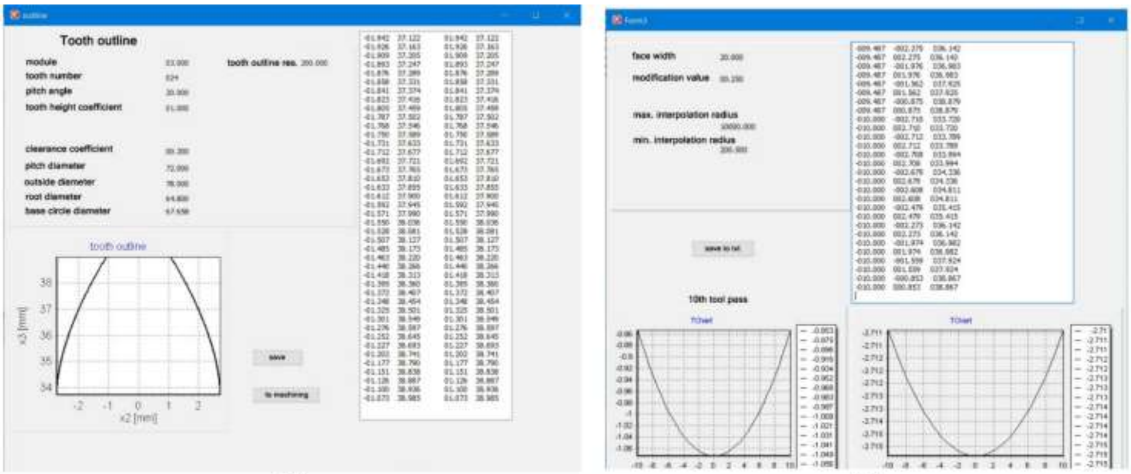


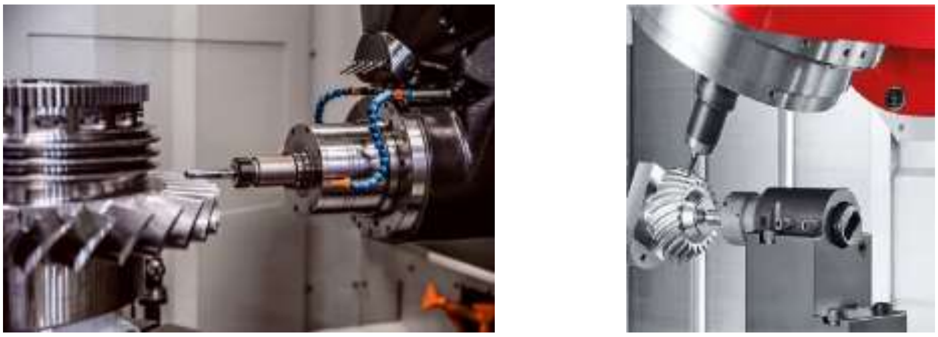
Figure 4. Software supply module: data input



(a) (b)

Figure 5. Software supply module: (a) tooth outline creator program ; (b) instrument trajectory creator software supply .

Software supply two from the module consists of First in the module main parameters for gear z = 24, m = 3, a = 20◦, c = 0.2, x = 0, y = 1 and guess done of extension modification f = 0.25 mm, modified of contour coordinates discrete writing was created (Fig. 5a). Next stage software supply to the previous one suitable coming instrument trajectory was created (Fig. 5b). Whole created program to the ISO code according to the car manage functions own into takes It is standardized to functions according to programming possible any that are bench to the tool customized to be possible with is universal .

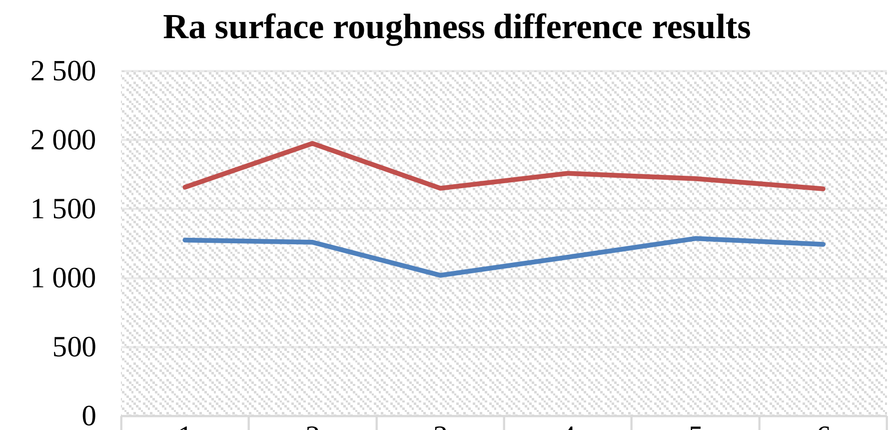


a) Horizontal b) Vertical

Figure 6. Grinding process with finger abrasive stone on RDB milling machines

A gear wheel was selected, some of its teeth were polished on a vertical RDB lathe with a finger grinding stone, and the rest of the teeth were polished on grinding machines using a disc stone. Later, the surface cleanliness of these teeth was measured using a TIME 3221 digital profilometer. 6 values were taken from 2 different teeth and analyzed.

Figure 7. Measurement of R_a using TIME 3221 digital profilometer



	1	2	3	4	5	6
Ra1	1 277	1 258	1 020	1 150	1 285	1 245
Ra2	1 657	1 974	1 651	1 758	1 720	1 645

Summary by doing In other words , we are squealing from machines without using special sparkling fingered abrasive the stone to make through surface cleanliness enough to accuracy reach we got From time to time we win , and from the bench we win , only RDB milling tooth on the machine we opened to him too that's it on the machine grinding their work do it we got

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