Dry hobbing – more information (2)

Continuing the description of *dry hobbing - more information (1)* it's necessary to specify that every hob has a longer life if it's works with cutting oil.
The refrigeration and lubrication have a positive effect in order to reduce the wear of the cutting edges.
The difference of the life between dry cutting and wet cutting is more important if the cutting speed is higher. The figure N°1 shows an example.

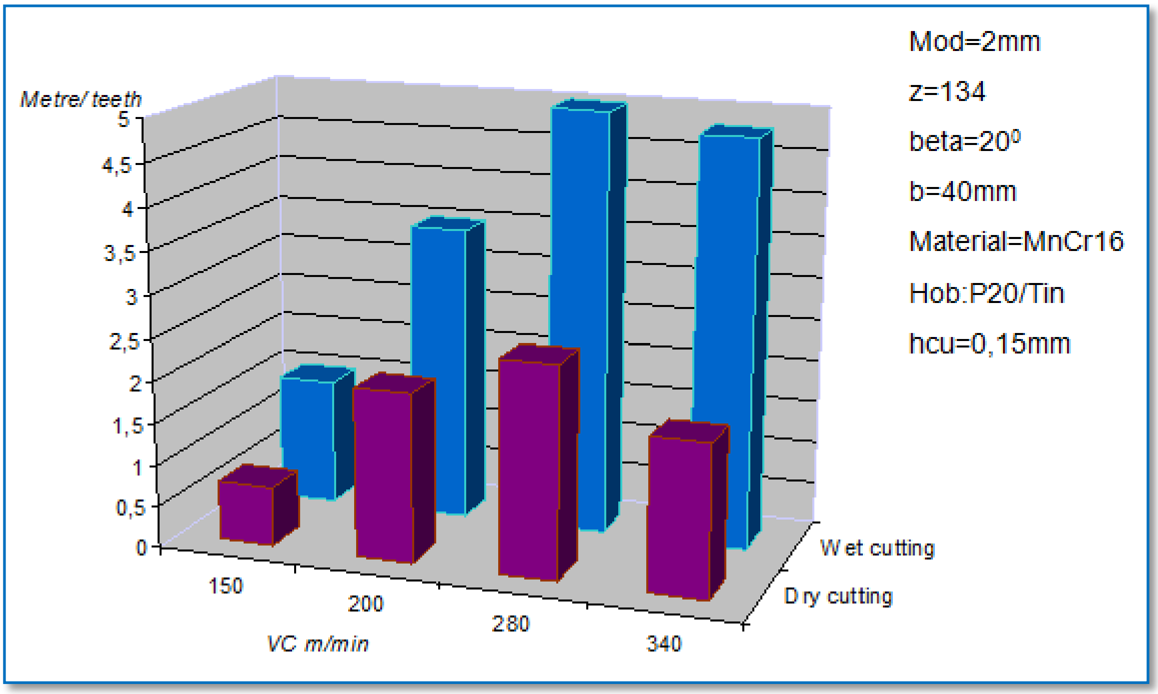


Figure N°1

Another important parameter to consider is the machinability of the material of the workpiece.
In the following table the most common steel used for to make gears is divided in three groups in according of the level of machinability:

Machinability		
Good	Normal	Difficult
16 Mn Cr 5	42 Cr Mo 4	30 Cr Ni Mo 8
20 Mn Cr 5	17 Cr Ni Mo 6	14 Ni Cr 14
15 Cr 3	18 Cr Ni 8	36 Ni Cr 6
34 Cr 4	CK 45	34 Cr Ni Mo 6 V
CK 15 to 35	C 60	30 Cr Mo V 9 V
30 Mn 5	Cf 70	40 Ni Cr Mo 7
15 Cr Ni 6	28 Ni Cr Mo 4	
20 Mo Cr 4	37 Mn Si 5	
21 Ni Cr Mo 2		

Different types of steel have great influence in the cutting speed as shown in the diagram of the figure N°2

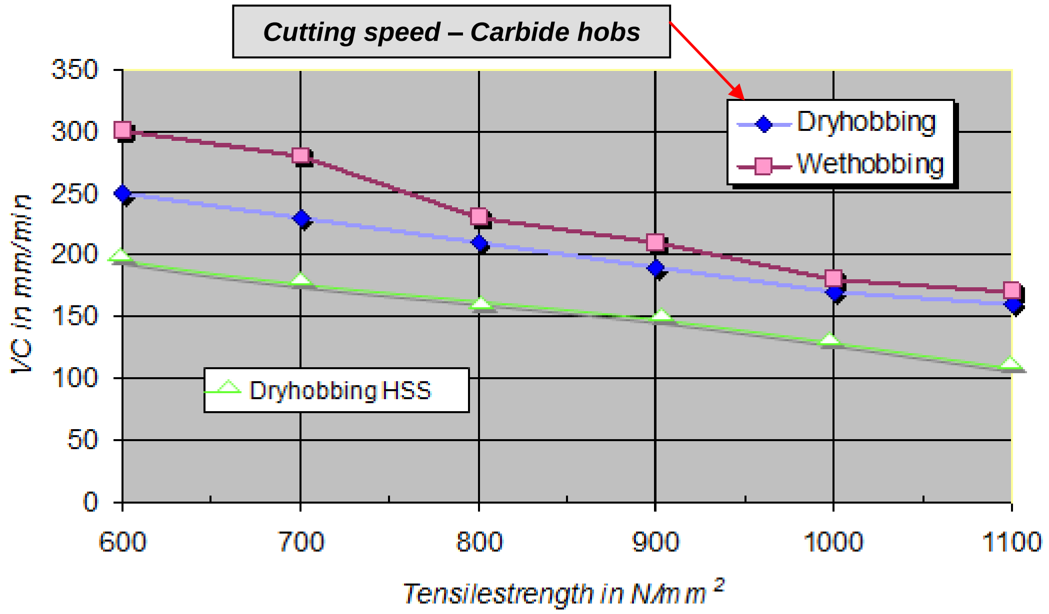


Figure N°2

In order to optimize the life of the hob, in both case, dry or wet hobbing, it's important to cut with a chip thickness not to large.
The Hoffmeister formula allows to calculate the chip thickness in according with a lot of parameters. The following table summarizes the most important relationship between some cutting parameters including the material from which the hobs are constructed.

Material	Carbide		HSS (PM)		
	Grade K	Grade P	S390	RexT76	Rex 121
Cutting speed	240 m/min (N) 320 m/min (T)	240 m/min (N) 320 m/min (T)	125 m/min (N) 160 m/min (T)	130 m/min (N) 160 m/min (T)	135 m/min (N) 180 m/min (T)
Chip thickness *min* *max*	0,00 (N) | 0,12 (T) 0,15 (N) | 0,16 (T)	0,00 (N) | 0,12 (T) 0,18 (N) | 0,16 (T)	0,00 (N) | 0,00 (T) 0,30 (N) | 0,22 (T)	0,00 (N) | 0,00 (T) 0,30 (N) | 0,22 (T)	0,00 (N) | 0,00 (T) 0,30 (N) | 0,25 (T)
Typ of coating	All (N) TiAIN (T)	All (N) TiAIN (T)	All (N) TiAIN (T)	All (N) TiAIN (T)	All (N) TiAIN (T)
Can it be recoated?	yes (N) no (T)	yes (N) no (T)	yes (N) yes (T)	yes (N) yes (T)	yes (N) yes (T)

The values shown above are based on a material tensile strength of approx. 700 N/mm² and a normal module of approx. 2,0

key
(N) = Wet cut
(T) = Dry cut

Also the pressure angle has some influence on the life of carbide hob, especially with tools that work with very high cutting speed. The diagram of the figure N°3 shows an example.

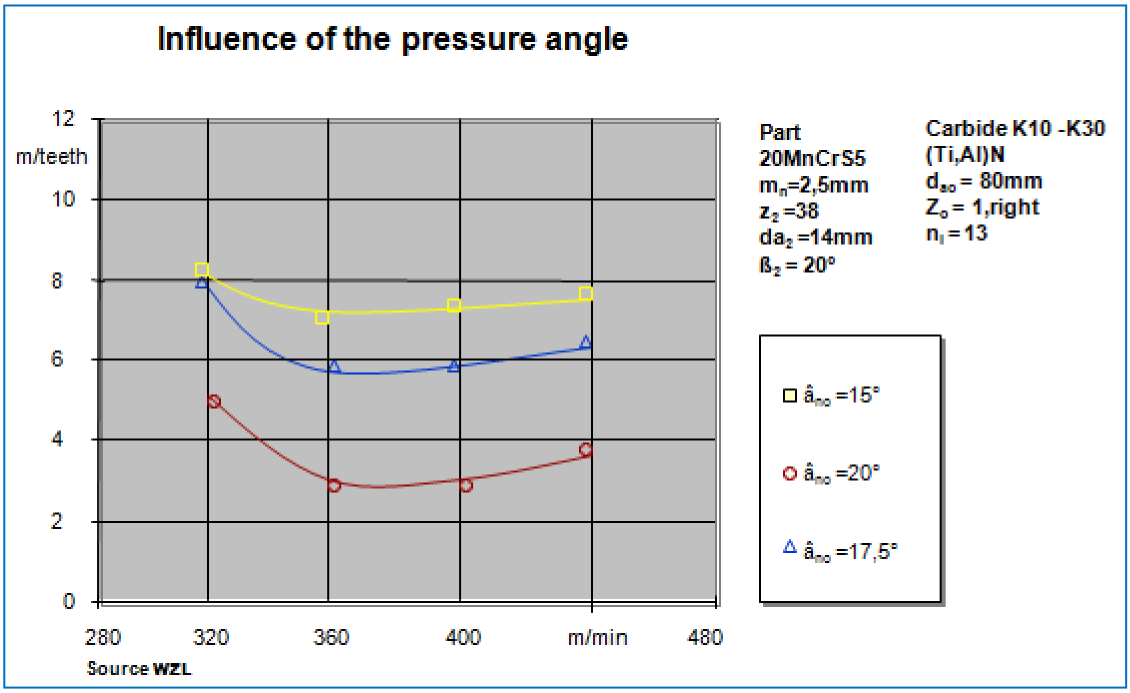


Figure N°3

Normally the now all hobs are coated with different types of films. But the carbide hobs usually are coated with TiAlN; the question is: it's better recoating after each resharpening, and if yes, it's better to remove the old film before to recoating?
The experience shows that it's better to stripping the hob before to apply a new film of TiAlN.

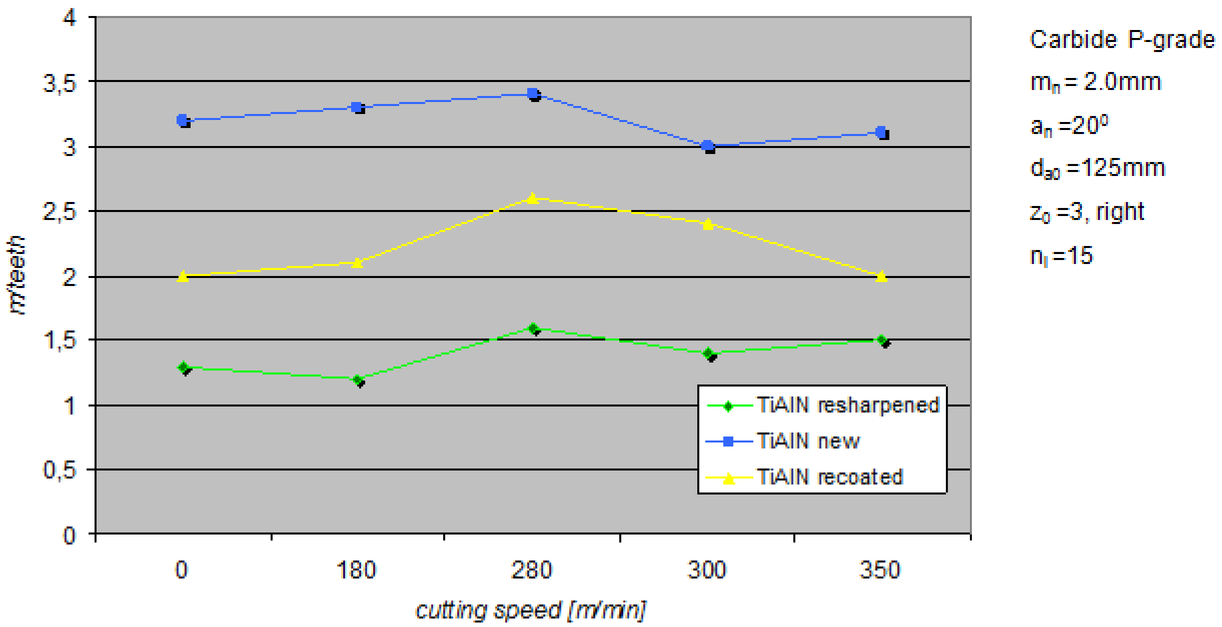


Figure N°4

The carbide is a very fragile material, hard but fragile: for this reason if the edges are sharp edge, it's very easy to produce small breakage, and quickly wear.
The best way is to protect the edges with a small radius, about of 15 microns, obtained with a glass pearl blasted operation, in this case it's possible to modify the sheering effect of the cutting edge.

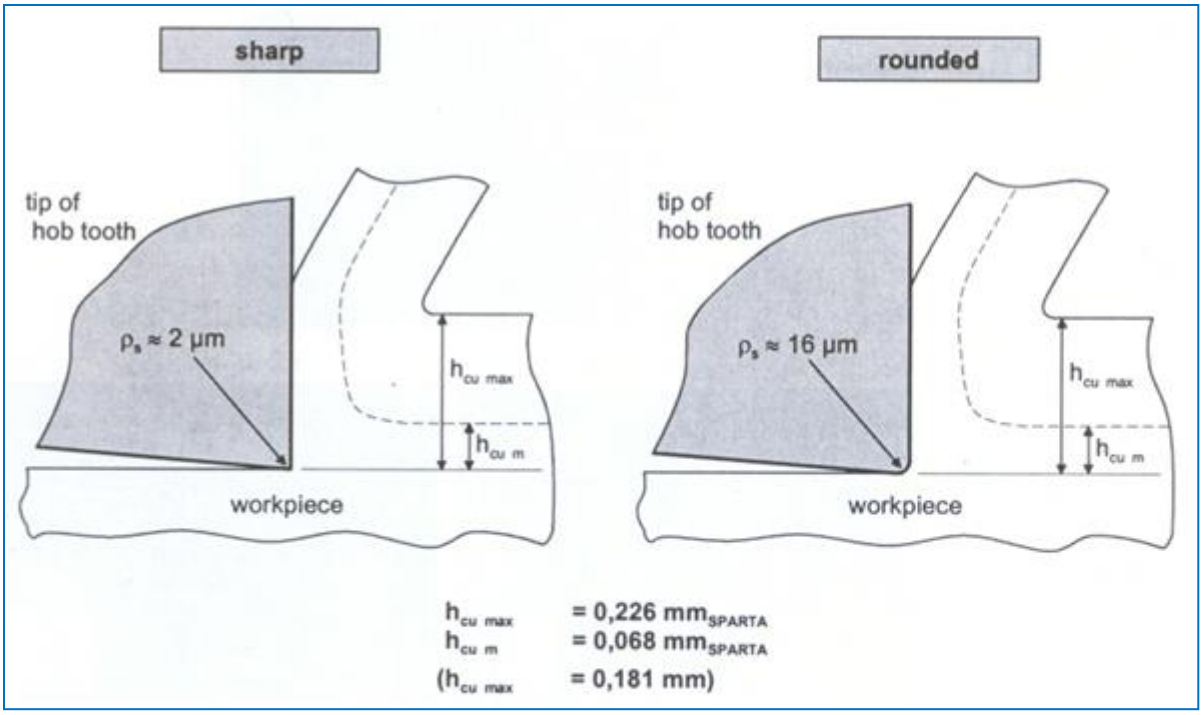


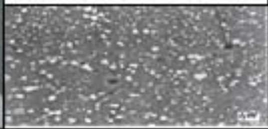
Figure N°5

The comparison of the life of the hobs with different radius of the cutting edges are shown in the figure N° 6:

Figure N°6

The last parameter to consider is the direction of the feed.
Is a well known that there are two systems to cut: climb hobbing and conventional hobbing.
With climb cutting the thickness of the chip grows from zero to its maximum thickness and it takes on the form of a prolonged comma.

With the conventional cutting method, the chip is cut from its largest part and the form of the chip is therefore that of a shorter comma. With this method, the performance of the hob is better.
Finally we can summarize the properties of HSS hob and carbide Hobs in the following table.

	HSS 	Carbide 
cost for tool	↓	↑
Re-conditionong costs	→	↑
Wear resistance	→	↑
Cutting speed	↓	↑
feed	↑	→
Toughness	↑	→
Process reliability	↑	↓

Also be considered an ever-present danger when using a carbide hob*: the complete breakage of the tool !*

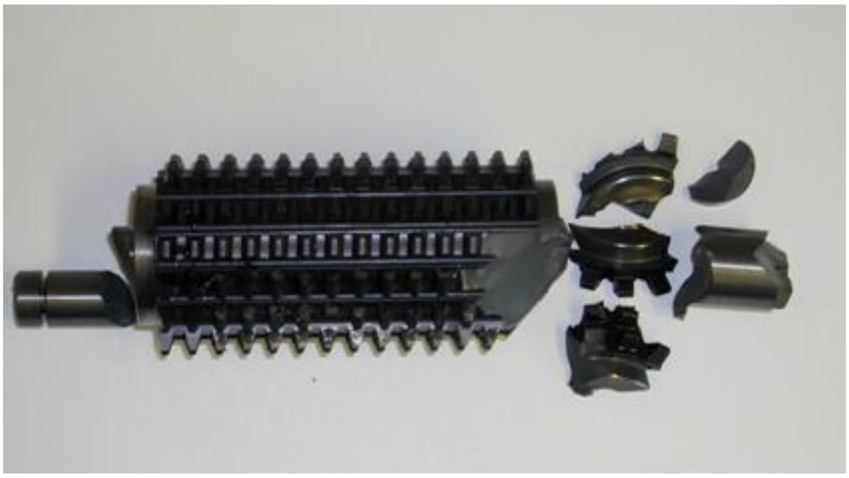


Figure N°7

Related writings: *Dry hobbing – more information (1)*
Dry hobbing and carbide hobs
Hob wear