A studing The Effect of Chemical Composition of Workpiece on Built Up Edge Formation And Surface Roughness

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Abstract
the phenomena built-up edge was the unwanted rough edge on cutting tool that is created by workpiece material welding onto the tool during cutting , occurs at the chip/tool interface when multiple materials are machined at low cutting speeds . under high compressive stresses, this study involve relation between the chemical composition of workpiece and the built-up edge (B.U.E) formation which is generated on cutting tool during machining at dfferent types of low carbon steel using turning machine , experments prove that increasing percentage of carbon on workpiece causes reduction in weight of cutting tool from (14.532g to 13.823g) at cutting speed 40 m/min and 0.10% and 014% carbon also to 12.672g at 0.20% carbon because built – up edge was disappear and surface roughness was improving from the value (5.43µm) at 0.10% carbon and to (3.362 µm) at 0.14% carbon and to (3.543µm) at 0.20% carbon .
Keywords: chemical composition , low carbon steel , built – up edge, surface roughness

دراسة تأثير التركيب الكيميائي للمشغولة على تكون الحد القاطع الناشىء والخشونة السطحية

الخلاصة
أن ظاهرة الحد الناشىء التي تؤدي الى خشونة غير مرغوب فيها للعدة القاطعة والتي تنتج من التصاق أو التحام معدن المشغولة أثناء القطع وتحدث عند التصاق النحاتة بالعدة أثناء تشغيل معادن مختلفة بأستخدام سرع قطع واطئة وتحت أجهادات ضغطية عالية . لقد تضمنت هذه الدراسة علاقة مابين التركيب الكيميائي للمشغولة والحد الناشىء الذي ينمو على سطح العدة القاطعة من خلال التشغيل بأستخدام ماكينة الخراطة مع عدة قطع وتشغيل أنواع مختلفة من الفولاذ الواطىء الكاربون ذات التركيز الكاربوني المختلف , التجارب أثبتت أن زيادة نسبة الكاربون في المشغولة تؤدي الى نقصان في الوزن للعدة القاطعة من (14.532 غم) الى(13.823غم) عند سرعة قطع (40م/ دقيقة) ونسبة كاربون (0.10% وكذلك 0.14%) بسبب أختفاء الحد القاطع الناشىء والذي يؤدي الى تحسن خشونة السطح من (5.43 مايكرون) عند نسبة كاربون الى 0.10% الى 3.362 مايكرون عند 0.14% والى(3.543 مايكرون) عند 0.20% كاربون .

Introduction

Seisure at the interface does not always give rise to aflow – zone at the tool surface , an alternative feature,commonly observed, is abuilt –up edge . when cutting many alloys with more than one phase in their structures , then hardened work material accumulates , adhering around the cutting edge and on the rake face of the tool ,

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At lower cutting speeds , when machining steel containing more than about 0.08 % carbon , and there fore having an appreciable amount of pearlite in the stracture [1,2,3], abuilt – up edge is formed which has amajor influence on all aspects of machinability As cutting speed is increased , alimit is reached above which abuilt –up edge is not formed . this limit is dependent on the feed rate , and the conditions under which abuilt – up edge is formed for three tyes of steel in machining tables . V. Arshnove and G. Alekseev (1976) try to study the effect of cutting variables and built –up edge on surface roughness for carbon steel and prove that surface roughness was redused at high cutting speed (60-80m/min) ,
aflow surface finish then compare theoritical result with expermental then there is agree between them .
T.E. Gustafsson and J. Kosinen (2006) use shape meomery alloys (SMA) which is ahard by using equation (1)

Ra=f ²/ 32. r …(1)

also ,containing martensite phase in chemical composition then experments show that built –up edge effect on tool wear and increasing feed rate cause with astrain harding . then compare theoritical result with absence of built – up edge . [4,5,6]
.The built –up edge is not a sepaerat body of metal during the cutting operation, the built- up edge is a dynamic structure, being constructed of successive layers greatly hardened under extreme strain conditions as shown in fig(7) . at lower cutting speeds , when machining steels containing low Carbon and having amount of pearlite in structure ,{7,8,9] a built – up edge is formed which has amajor influence on all aspects of machinability , a cutting speed is increased , a limit is reached a bove which a built – up edge is not formed . this limit is dependent also on the feed , the conditions under which abuilt – up edge is formed are shown for three steels in machining, there is a wide range of speed and feed where steel may be machined successfully with these tools. Continous chipes are generally produced , which are often strong and not easily broken . the form of the chip depends not only on the composition.[10,11,12,13,14] and structure of steel (used for workpiece), but also on the speed , feed rate and depth of cut .

Expermental procedure: There are a several experments were done using three types of low carbon steels as workpiece material with turning machine to perform the experments as flow :

2-1 Material : low carbon steel was used

2-2 Turning Machine was used

2-3 Chemical composition for three types of low carbon steel as shown in tables (1,2,3)

2-4weightometer apparatus was used for weighting cutting tool.

2-5Roughness measurement

apparatus Result and discussion

Tables (5,6,7) shows the main effects of chemical composition and cutting speed interactions between the cutting speed and built –up edge , and percentage of carbon , as it difficult to show the effect of carbon percentage on the built up formation only using tool weights method after machining ,then at low percentage carbon 0.10% and low cutting speed (40, 50,60) m/min was generated built-up edge then weight of tool was (14.532g, 12.342g, 11.576 g) at 0.10% carbon and the same weight of cutting tool before machining (10.555g) at cutting speeds (65 , 80) because built up edge was disappear when cutting speed increasing also weight of tool were (13.823g,12.013g , 10.721g) at 0.14% carbon and (12.672 g , 11.453g , 10.865 g) and (10.555g) at 0.20% carbon , thus, increasing carbon percentage lead to reduce the built – up edge and improving surface roughness at cutting speed 65 and 80 m/min but when percentage of carbon increase the built-up edge was disappeare and improving surface roughness as shown in figures (4,5,6) graphic postively relation between carbon percentage and surface roughness and negatively relation with built-up formation at all points which represented in graphics and higher .

Conclusions

1-To improve machinability of low carbon steel with out built-up formation on cutting tool recomaended use high cutting speed more than 60m/min during machining .

2- Increasing percentage of carbon causes decreasing of built-up formation..

3- Anew relation was generated between built-up edge and percentage of carbon .

4- When cutting steels at low speed and feed recomanded using carbide tools instead of high speed steel.

5- Maximum weight of built-up edge with tool was(14.532g) at cutting speed 40 m/min and 10% carbon .

6-Minimum weight of built-up edge with tool was (10.865g) at cutting speed 60 m/min and 20% carbon .

7-Increasing percentage of carbon improving surface roughness .

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Table (1) Chemical Composition of low carbon steel 0.10% carbon

Din1.5752	C	Si	Mn	Cr	Mo	Ni	Others
	0.10	0.3	0.4	0.7	----	---	-------

Table (2) Chemical Composition of low carbon 0.14% carbon

Din1.5752	C	Si	Mn	Cr	Mo	Ni	Others
	0.14	0.3	0.5	0.7	----	3.5	

Table (3) Chemical Composition of low carbon 0.20% carbon

Din1.5752	C	Si	Mn	Cr	Mo	Ni	Others
	0.20	0.3	1.3	1.2	----	-	S 0.028
Din1.5752	C	Si	Mn	Cr	Mo	Ni	Others
	0.20	0.3	1.3	1.2	----	-	S 0.028

Table (4) mechanical properties of low carbon steel

Brinel hardness	Proof Stress N/mm^2	Tensile strength N/mm^2	Elongation % min	Reduction of area % min
131	390	640 - 790	13	40

Table(5) Weight of cutting tool during machining workpiece 0.10% C

No of operation	Cutting speed m/min	Feed rate rev/min	Rake angle 0	Weight of cutting tool befor machining g	Weight of cutting tool with B.U.E g	Surface roughness µm
1 -	40	0.25	4 °	10.555	14.532	5.447
2 -	50	0.25	4°	10.555	12.342	4.875
3-	60	0.25	4°	10.555	11.576	3.323
4-	65	0.25	4°	10.555	10.555	2.769
5-	80	0.25	4°	10.555	10.555	2.562

Table(6) Weight of cutting tool during machining workpiece 14% C

No of operation	Cutting speed m/min	Feed rate rev/min	Rake angle o	Weight of cutting tool before machining g	Weight of cutting tool with B.U.E	Surface roughness μ m
1 -	40	0.25	4 °	10.555	12.672	3.362
2 -	50	0.25	4°	10.555	11.453	2.512
3-	60	0.25	4°	10.555	10.865	2.154
4-	65	0.25	4°	10.555	10.555	1.640
5-	80	0.25	4°	10.555	10.555	1.387

Table(7) Weight of cutting tool during machining workpiece 20% C

No of operation	Cutting speed m/min	Feed rate rev/min	Rake angle 0	Weight of cutting tool befor machining g	Weight of cutting tool with B.U.E g	Surface roughness μ
1 -	40	0.25	4 °	10.555	13.823	3.543
2 -	50	0.25	4°	10.555	12.013	3.332
3-	60	0.25	4°	10.555	10.721	2.659
4-	65	0.25	4°	10.555	10.555	2.364
5-	80	0.25	4°	10.555	10.555	1.532

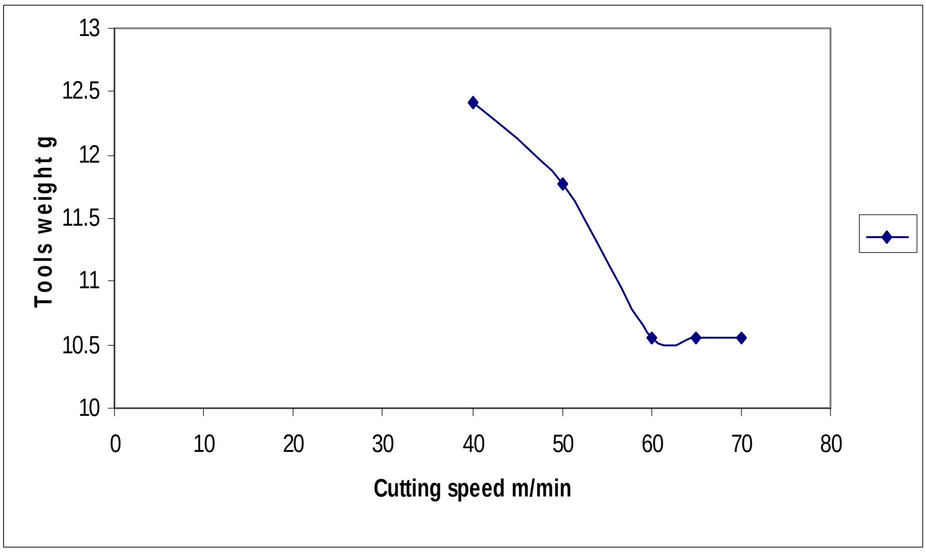


Figure (1) Relationship between cutting speed and weight of tool with B.U.E at 10% carbon

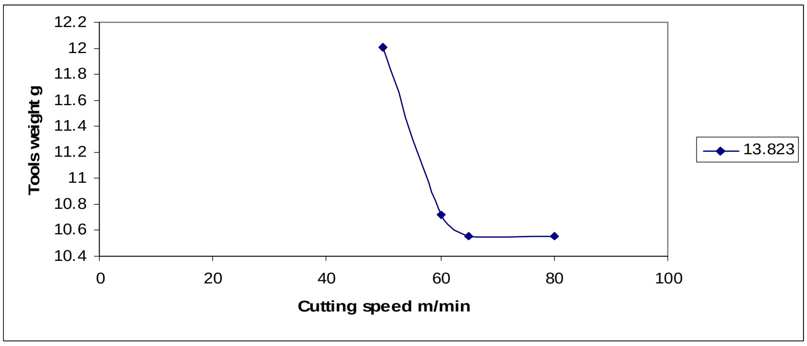


Figure (2) Relationship between cutting speed and weight of tool with B.U.E at 0.14 % carbon

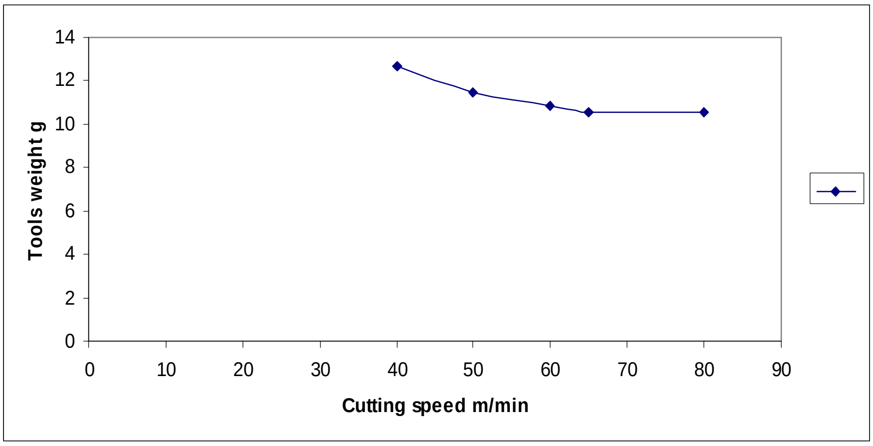


Figure (3) Relationship between cutting speed and weight of tool with B.U.E at 20% carbon

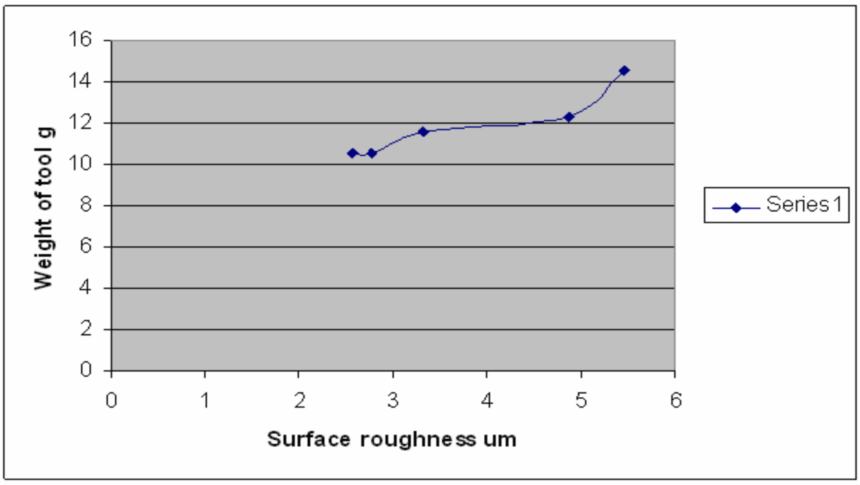
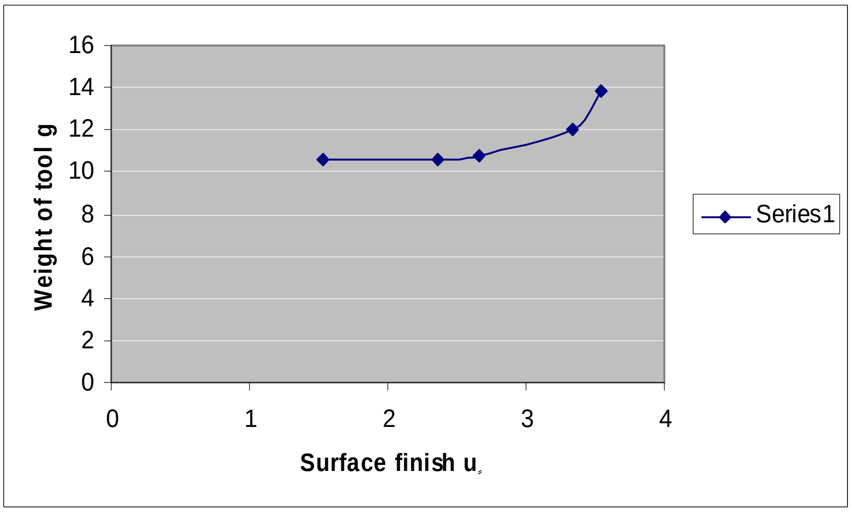
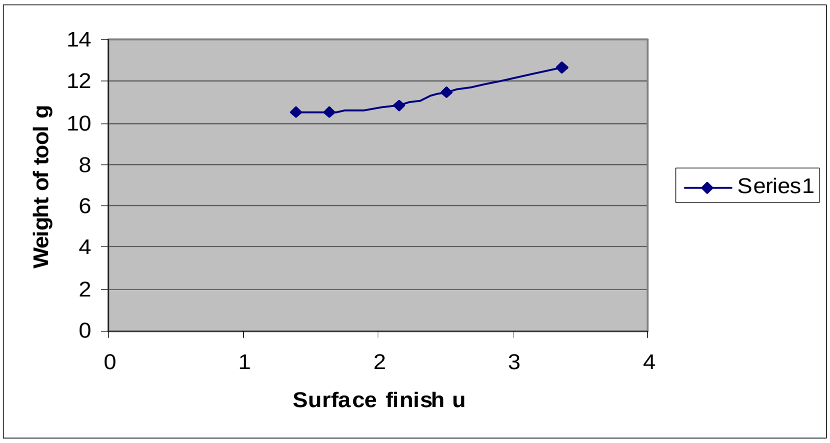


Figure (4) Relationship between surface roughness and weight of tool with B.U.E during machining workpiece 0.10% carbon

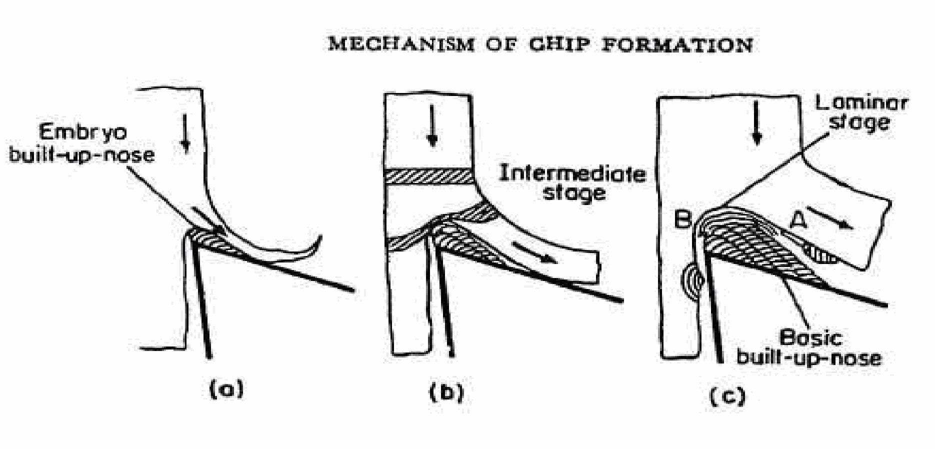


Figure(5) Relationship between surface roughness and weight of tool with B. U .E during machining workpiece 0.14% carbon



Surface finish μm

Figure (6) Relationship between surface roughness and weight of tool with B. U .E during machining workpiece 0.20% carbon



Formation of build up edge (Bahttacharyya, 1985)

Figure (7) Mechansim of chip formation

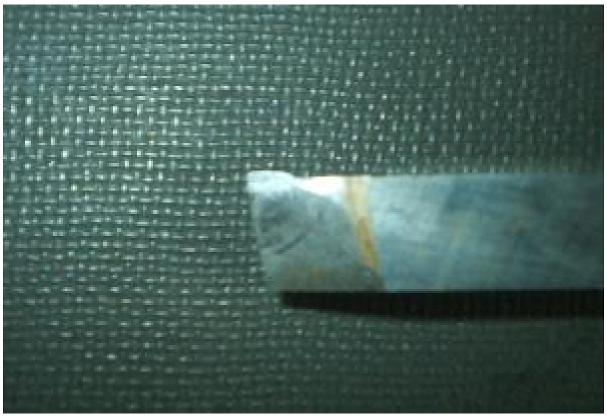


Figure (8) Cutting tool

Figure (9)Roughness measurement apparatus