

IE-352

Section 2, CRN: 48706/7/8

Second Semester 1435-36 H (Spring-2015) – 4(4,1,2)

“MANUFACTURING PROCESSES – 2”

Wednesday, April 06, 2016 (28/06/1437H)

Tool Life Exercises **ANSWERS**

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**Answer the following questions.**

1. Let  $n = 0.5$  and  $C = 90$  in the *Taylor* equation for tool wear. What is the percent increase in tool life if the cutting speed is reduced by (a) 50% and (b) 75%?

*Solution:*

*Taylor Equation for tool life:*

$$VT^n = C$$

$$n = 0.5; C = 90$$

$$\Rightarrow VT^{0.5} = 90 \Rightarrow V_1 T_1^{0.5} = V_2 T_2^{0.5}$$

$$\text{a) } V_2 = 0.5V_1$$

$$\Rightarrow V_1 T_1^{0.5} = 0.5V_1 T_2^{0.5}$$

$$\Rightarrow T_1^{0.5} = 0.5T_2^{0.5}$$

$$\Rightarrow \left(\frac{T_2}{T_1}\right)^{0.5} = 2$$

$$\Rightarrow \sqrt{\frac{T_2}{T_1}} = 2$$

$$\Rightarrow \frac{T_2}{T_1} = 4$$

$$\Rightarrow \text{increase in tool life} = \frac{T_2 - T_1}{T_1} = \frac{T_2}{T_1} - 1 = 3$$

**$\Rightarrow$  i.e. increase in tool life is 300%**

$$\text{b) } V_2 = 0.25V_1 \text{ (since speed decreases by 75\%)}$$

$$\Rightarrow T_1^{0.5} = 0.25T_2^{0.5}$$

$$\Rightarrow \left(\frac{T_2}{T_1}\right)^{0.5} = 4$$

$$\Rightarrow \frac{T_2}{T_1} = 16$$

$$\Rightarrow \text{increase in tool life} = \frac{T_2 - T_1}{T_1} = 16 - 1 = 15$$

**$\Rightarrow$  i.e. increase in tool life is 1500% (i. e. 15 – fold)**

2. For a turning operation using a ceramic cutting tool, if the speed is increased by 50%, by what factor must the feed rate be modified to obtain a constant tool life? Use  $n = 0.5$  and  $y = 0.6$ .

*Given:*

$$V_2 = V_1 + 0.5V_1 = 1.5V_1$$

$$T_2 = T_1$$

$$n = 0.5; y = 0.6$$

*Required:*  $\frac{f_2}{f_1} = ?$

*Solution:*

*Taylor tool life equation for turning operation:*

$$VT^n d^x f^y = C_1 \Rightarrow$$

$$V_1 T_1^n d_1^x f_1^y = V_2 T_2^n d_2^x f_2^y$$

*since  $T_2 = T_1$ , and assuming constant depth of cut ( $d$ )  $\Rightarrow$*

$$V_1 f_1^y = 1.5 V_1 f_2^y \Rightarrow$$

$$\left(\frac{f_2}{f_1}\right)^{0.6} = \frac{1}{1.5} \Rightarrow$$

$$\frac{f_2}{f_1} = 1.5^{-\frac{1}{0.6}} = 0.509$$

**$\Rightarrow$  feed must be modified by a factor of 50.9%**