IE-352
MANUFACTURING PROCESSES - 2

Tool Wear Exercises Answers

Name:	Student Number: 42

Answer ALL of the following questions [2 Points Each].

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:

$$VT^n = C$$

$$n = 0.5;\ C = 90$$

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

a) $V_2 = 0.5V_1$

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

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

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

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

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

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

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

b) $V_2 = 0.25V_1$ **(since speed *decreases* by 75%)**

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

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

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

$\Rightarrow$ *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%