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)

Machining Economics Exercises ANSWERS

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Answer the following questions.

1. For a given metal cutting operation, it has been found that the economical durability is $64\ min$.
   a. Determine the cutting speed if $VT^{1/3} = 100$.
   b. Calculate then T_{opt} and V_{opt} if tool exchange time $T_C = 13.5\ min$

Given:

- In Taylor Tool-Life equation, $VT^n = C$,
- $n = \frac{1}{3}, C = 100$

Solution:

a)

$$V = \frac{100}{T^{1/3}} = \frac{100}{64^{1/3}} = \frac{100}{\sqrt[3]{64}} = \frac{100}{4} = \mathbf{25\ m/min}$$

b)

$$\boldsymbol{T_{opt}} = \left(\frac{1}{n} - 1\right)(T_c) = \left(\frac{1}{1/3} - 1\right)(13.5\ min) = \mathbf{27\ min}$$

$$\boldsymbol{V_{opt}} = \frac{C}{\left[\left(\frac{1}{n} - 1\right)(T_c)\right]^n} = \frac{100}{\left[\left(\frac{1}{1/3} - 1\right)(13.5)\right]^{1/3}} = \frac{100}{27^{1/3}} = \frac{100}{3}$$
$$= \mathbf{33.3\ m/min}$$

2. A tool used for a metal cutting operation shows a tool life-speed relationship of $VT^{0.125} = 44.5$. Originally, $15\ minutes$ were required to replace a dull tool, but a new tool holder has made it possible to reduce the time to $5\ minutes$. What is the resulting increase in cutting speed with regards to the maximum rate of production in this operation?

Given:

- $T_{c_1} = 15\ min, T_{c_2} = 5\ min$
- $VT^{0.125} = 44.5$

Required:

$\frac{V_{o_2} - V_{o_1}}{V_{o_1}}$ =? (based on max. production, i.e. based on $T_{p,min}$ equations)

Solution:

$$V_{o_1} = \frac{C}{\left[\left(\frac{1}{n} - 1\right)(T_{c_1})\right]^n} = \frac{44.5}{\left[\left(\frac{1}{0.125} - 1\right)(15)\right]^{0.125}} = \frac{44.5}{[(8-1)(15)]^{0.125}}$$
$$= \frac{44.5}{1.789} = 24.9\ m/min$$

$$V_{o_2} = \frac{C}{\left[\left(\frac{1}{n} - 1\right)(T_{c_2})\right]^n} = \frac{44.5}{\left[\left(\frac{1}{0.125} - 1\right)(5)\right]^{0.125}} = \frac{44.5}{[(8-1)(5)]^{0.125}}$$
$$= \frac{44.5}{1.560} = 28.5\ m/min$$

$$\frac{V_{o_2} - V_{o_1}}{V_{o_1}} = \frac{V_{o_2}}{V_{o_1}} - 1 = \frac{28.5}{24.9} - 1 = 0.1472 = \mathbf{14.7\%\ increase}$$