

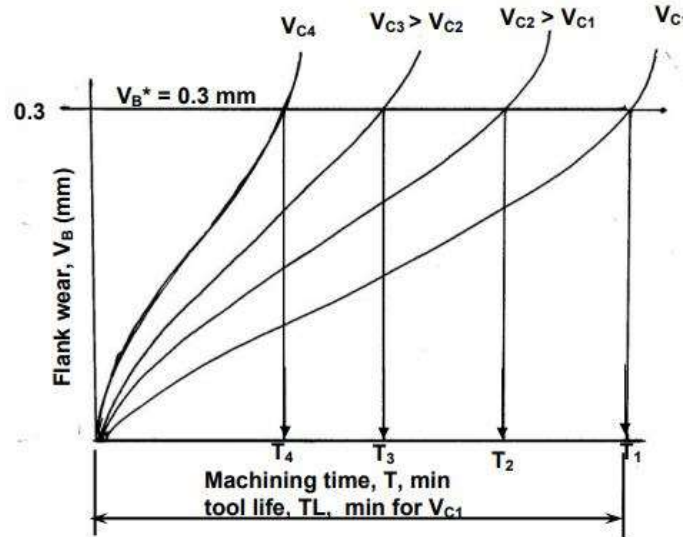


Figure 1: Growth of flank wear and assessment of tool life

The tool life obviously decreases with the increase in cutting velocity keeping other condition's unaltered as indicated in Fig.1.

If the tool lives, T_1, T_2, T_3, T_4 etc. are plotted against the corresponding cutting velocities, V_1, V_2, V_3, V_4 etc as shown in Fig.2, a smooth curve like a rectangular hyperbola is found to appear. When F.W.Taylor plotted the same figure taking both V and T in log-scale, a more distinct linear relationship appeared as schematically shown in Fig.3.

With the slope, n and intercept, c , Taylor derived the simple equation as

$$VT^n = C$$

Where, n is called, Taylor's tool life exponent. The values of both ' n ' and ' c ' depend mainly upon the tool-work materials and the cutting environment (cutting fluid application). The value of C depends also on the limiting value of V_s undertaken (i.e., 0.3 mm, 0.4 mm, 0.6 mm etc.)

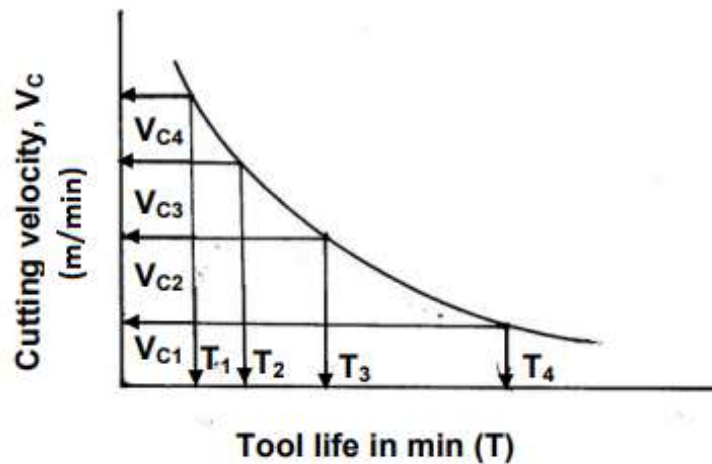


Figure 2: Cutting velocity - tool life relationship

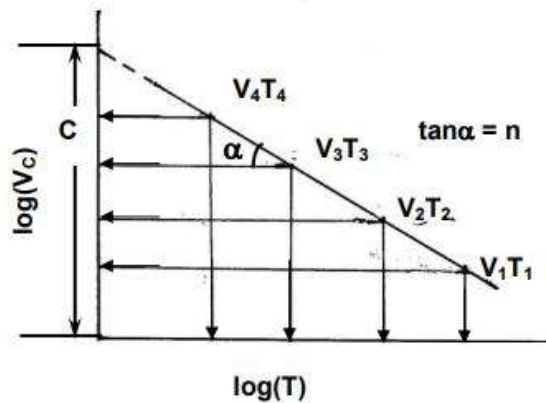


Figure 3: Cutting velocity vs tool life on a log-log scale

Example of use of Taylor's tool life equation.

If in turning of a steel rod by a given cutting tool (material and geometry) at a given machining condition (S_o and t) under a given environment (cutting fluid application), the tool life decreases from 80 min to 20 min. due to increase in cutting velocity, V_c from 60 m/min to 120 m/min, then at what cutting velocity the life of that tool under the same condition and environment will be 40 min?

Solution :

Assuming Taylor's tool life equation, $VT^n = C$

$$V_1 T_1^n = V_2 T_2^n = V_3 T_3^n = \dots = C$$

Here,

$$V_1 = 60 \text{ m/min}, T_1 = 80 \text{ min.}$$

$$V_2 = 120 \text{ m/min}, T_2 = 20 \text{ min.}$$

$$V_3 = ? \text{ (to be determined)}, T_3 = 40 \text{ min.}$$

Taking,

$$V_1 T_1^n = V_2 T_2^n$$

$$\text{i.e. } \left(\frac{T_1}{T_2}\right)^n = \frac{V_2}{V_1}$$

$$\text{or } \left(\frac{80 \text{ min}}{20 \text{ min}}\right)^n = \left(\frac{120 \text{ m/min}}{60 \text{ m/min}}\right)$$

from which, $n = 0.5$

$$\text{again } V_3 T_3^n = V_1 T_1^n$$

$$\text{or } V_3 = \left(\frac{80}{40}\right)^{0.5} \times 60 = 84.84 \text{ m/min ANS}$$

Problem:

If in turning of a steel rod by a given cutting tool (material and geometry) at a given machining condition (S_o and t) under a given environment (cutting fluid application), the tool life decreases from 100 min to 40 min. due to increase in cutting velocity, V_c from 80 m/min to 140 m/min, then at what cutting velocity the life of that tool under the same condition and environment will be 60 min?