ME 338
Manufacturing Processes II
HW#2

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Assigned Date: Sep 5, 2018
Due Date: September 9, 2018

1. You are grinding steel, which has a specific grinding energy (u) of 35 W-s/mm^3. The grinding wheel rotates at 3000 rpm, has a diameter (D) of 120 mm, thickness (b) of 20 mm, and (c) 5 grains per mm^2 (c). The coefficient K_2 is 0.2°K-mm/N. The motor power is 2 kW and maximum permissible grinding temperature is 1220°C. Room temperature is 20°C. The work piece moves (v) at 1.5 m/min. The chip thickness ratio (r) is 10.
   a. Determine the allowable depth of cut.
   b. Derive the expression for maximum chip thickness, t, if the grain is considered to be a triangle and its value for the above process conditions.
   c. Let the grain be a SiC grain modeled as a continuously varying circular beam as shown in Fig. 1. Assume the force/grain is acting as a point load in the end. Use cantilever beam theory to find the stress as a function of x and the magnitude and location of maximum stress. Are these stresses sufficient to fail the grain? What should be the strength of the binder to avoid uprooting the grain?

   Assume sintered α-SiC has a strength of 4.6 GPa.

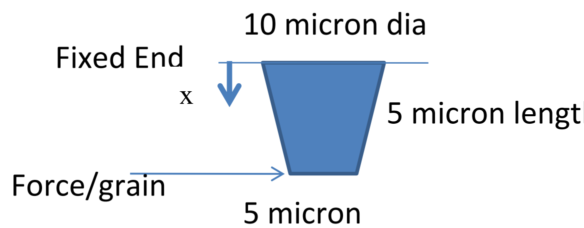

Fig. 1. SiC grain geometry.

2. Blind holes 10 mm diameter; 15 mm deep are drilled in a component. The drill has a point angle of 120 degrees. Axial feed during the operation is set to 0.2 mm/rev. An experiment was conducted in the shop to study the effect of spindle speed (N) on the number of holes (H) produced before the tool change.

Spindle Speed (N) rpm	**No of holes produced (H)**
318	802
1120	213

   a. Calculate the Taylor's tool life equation ($VT^n = C$) from the above data. (Choose V – m/min, T – min)
   b. Shop engineers feel that it will be more useful to get an equation between **H** and **N**. Suggest the form of equation and compute its coefficients. Draw a graph to show the nature of variation of the curve (H-N) approximately

3. Machining Economics

The unit cost is given by:

$u = u_o + u_m + u_t = k_o t_p + (k_o + k_m)\, t_m + [k_t + k_o t_c]\,(t_m/T)$. Machining time, t_m, is given by $\dfrac{\lambda}{f \cdot V}$,

where λ is a constant, f is the feed and V is the cutting velocity. The maximum spindle power available is P the specific cutting energy is u. Note that *r* is the tool edge radius.

– Taylor tool life equation $T = CV^{-p} f^{-q}$

Using the modified Taylor's tool life equation, first find the expressions for cutting velocity and tool life for lowest cost and highest production rate.