Problems for drilling

Problem 1

In a drilling operation:

Hole diameter =30 mm
Hole depth = 100 mm
Cutting speed = 300 r.p.m
Feed = 0.25 mm/rev
Specific cutting resistance = 2000 N/mm^2

Calculate:

a- The chip area.
b- The main cutting force.
c- Machining time.
d- Material removal rate.

Problem 2

In a drilling operation using a twist drill, the lip angle is 120 degree (standard), the spindle speed is 300 rpm, the feed is 0.2 mm/rev and the drill diameter is 10 mm. Calculate:

a - the machining time to drill a through hole 30 mm long.
b - the drill torque in [N-m] assuming that specific cutting resistance for the work. material is 200 Kg/mm^2.
c - the amount of material removed in the first 10 sec after full engagement of drill.
d - the cutting power if cutting force is 2000 N.

Problem 3

A drilling operation is used to drill a 11 mm diameter hole to a certain depth. It takes 4.5 min to perform the drilling operation using high-pressure fluid delivery of coolant to the drill point. The cutting conditions are N = 300 rev/min at a feed = 0.254 mm/rev. To improve the surface finish in the hole, it has been decided to increase the speed by 20% and decrease the feed by 25%. How long will it take to perform the operation at the new cutting conditions?

Problem 1: drilling

$D = 30\ mm$

$L = 100\ mm$

$N = 300\ rpm$

$f = S = 0.25\ mm/rev$

$K_s = 2000\ N/mm^2$

(i) $A = ?$, (ii) $P_s = ?$ (iii) $t_m = ?$

(iv) MRR $= Q = ?$

(i) $A = \frac{D}{2} \times \frac{S}{2} = \frac{30 \times 0.25}{4}$

$A = 1.875\ mm^2$

(ii) $P_s = K_s A$

$P_s = 2000 \times 1.875$

$= 3750\ N$

(iii) $t_m = \frac{L + D/4}{SN} = \frac{100 + \frac{30}{4}}{0.25 \times 300}$

$= 1.43\ min$

(iv) $Q = \frac{\pi D^2 \times S \times N}{4}$

$= \frac{3.14 \times (30)^2 \times 0.25 \times 300}{4}$

$= 52987.5\ mm^3/min$

$= 52.99\ cm^3/min$

$1\ cm^3 = 10^3\ mm^3$

$1\ cm^3 = 1000\ mm^3$

Prob.2 drilling

N = 300 rpm

f = S = 0.2 mm/rev , D = 10mm

L = 30 mm, K_s = 200 kg/mm²

t_m = ? M = ?

MRR = ? after 10 sec

P_m = ? if P_s = 2000N

(i) $t_m = \frac{L+D/4}{SN} = \frac{30+10/4}{0.2\times300}$

$= 0.54$ min

(ii) $M = P_s \times D/2 = 2000\,N \times \frac{10\,m}{2\times1000}$

$= 10$ Nm

(iii) $Q = MRR = \frac{\pi D^2 \times S \times N}{4}$

$= \frac{3.14\times10^2\times0.2\times300}{4}$

$= 4712.38\ mm^3/min = 4.712\ cm^3/min$

60 sec — 4.172 cm³

1 sec — $\frac{4.172}{60}$

in 10 sec — $\frac{4.172}{60}\times10$

$= 0.785\ cm^3$

$P_m = P_s \times V$

$= P_s \times \pi DN$

$= 2000 \times 3.14 \times \frac{10}{1000} \times \frac{300}{60}$

$P_m = 314$ Watts

Problem 3 $D = 11\,mm$, $t_m = 4.5\,min$

$N = 300$, $f = 0.254\,mm/rev$

$t_m = 7$, increase speed by 20% and decrease feed by 25%

$$t_m = \frac{L + D/4}{fN} \Rightarrow 4.5 = \frac{L + 11/4}{0.254 \times 300}$$

$$\Rightarrow L = 4.5 \times 0.254 \times 300 - \frac{11}{4}$$

$$L = 340.15\,mm$$

New $N = 300 + 0.2 \times 300$

$N = 360$

New $f = 0.254 - 0.25 \times 0.254$

$= 0.1905\,mm/rev$

New $t_m = \dfrac{340.15 + 11/4}{0.1905 \times 360}$

$t_m = 5\,mins.$