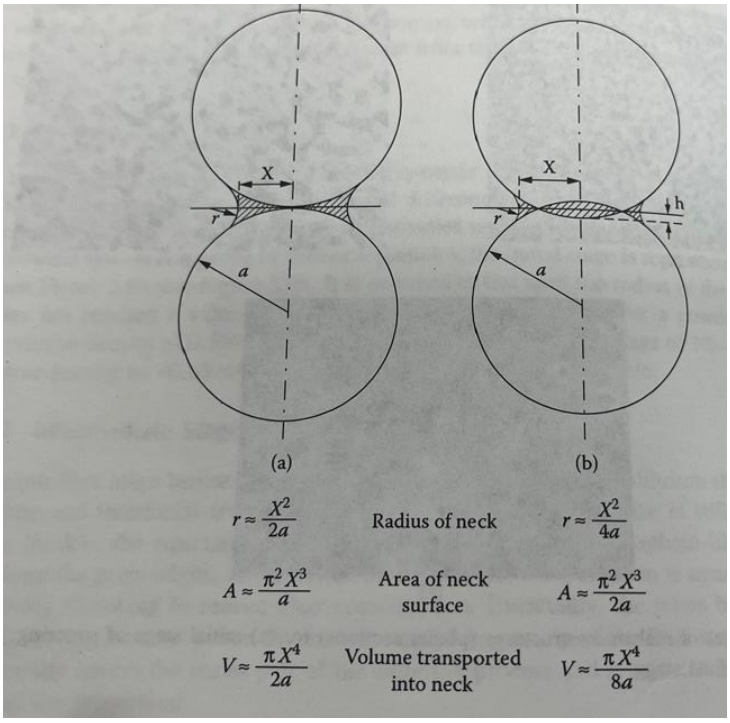
ME 323
Instructor: Ramesh Singh
HW# 4

Date assigned: 29.10.2025
Date due: 06.11.2025

1. Find the rule of mixture for density of a composites. If the volume fraction of fiber is f and densities of fiber and matrix material are
2.
3. An extruder has a barrel with an inside diameter of 30 mm and rotates at 50 rpm (for simplicity, assume that the barrel rotates). The screw has a channel depth of 4 mm, a channel width of 20 mm, and a flight angle of 18 degrees. The pumping section of the screw is 1.25 m long, and is used to extrude a flat polyethylene sheet. When melted, the polyethylene has a viscosity of 80 N-s/m^2. The die has a thickness of 2 mm, a width of 75 mm and is 25 mm long. In other words, the resulting sheet is 2 mm thick and 75 mm wide. Determine the speed of the sheet through the die.

4. An injection molding machine has a barrel diameter of 25 mm and rotates at 75 rpm (for simplicity, assume the barrel rotates). The reciprocating screw has a channel depth of 5 mm, a channel width of 20 mm, and a flight angle of 18 degrees. The pumping section of the screw is 1 m long. Determine the back pressure required to make a shot with a volume of 20 cm^3 in 10 seconds for a polymer with a viscosity of 150 N-s/m^2.

5. Find the radius of neck, area of neck surface and volume transported to the neck for the two configurations shown in Fig. 1.



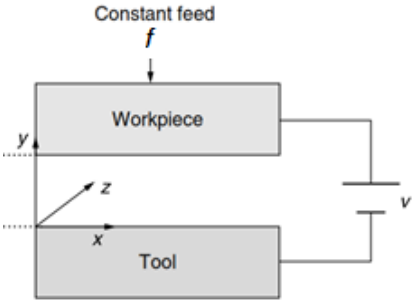
6. What will be the material removal rate in ECM of alloy consists 70% nickel, 20% chromium and 10% iron. Chemical equivalent of nickel, chromium and iron is 29 g, 26 g and 28 g respectively. What will be the MRR in g/sec for a current value of 500 A at 100% current efficiency. Faraday constant is equal to 96500 A-sec.
7. In Electro-chemical machining (ECM), the material removal rate is governed by Faraday's laws. For a machining of SS-316 using ECM process, calculate the material removal rate (m^3/min) for a current of 500A and 100% current efficiency. The Faraday's constant (F) is 96500As.

Composition of SS-316L alloy

ELEMENT	%	VALENCY	ATOMIC MASS (g/mole)	DENSITY (g/cm^3)
Iron (Fe)	68.2	2	55.85	7.86
Chromium (Cr)	17.2	2	51.99	7.19
Nickel (Ni)	10.9	2	58.71	8.90
Molybdenum (Mo)	2.1	3	95.94	10.28
Manganese (Mn)	1.6	2	54.94	7.43

If the constant gap voltage (V) is applied and the steady state is allowed to establish, how different alloy constituents will affect the surface roughness of the machined surface? Further, using the steady state relations for feed rate, indicate whether high or low value of feed rate will yield better surface finish? Plot approximate representative curves (no calculations required) between gap (y) and feed rate (f) to justify your conclusion.

Useful equations:



- Volume of material removed (cm^3) = CIt
- Electrochemical constant, $C = \frac{A}{ZF\rho}$

At the feed rate f (cm/s), in the direction of decreasing y, the workpiece rate of change of position dy/dt can be written as:

$$\frac{dy}{dt} = \frac{CVk}{y} - f$$

where,
I = current (A); t =time (s); A = atomic mass; Z = number of valence electrons;
F = Faraday's constant (As); ρ = density of work material (g/cm^3);
k = electrolyte conductivity ($\Omega^{-1}cm^{-1}$)

8. What will be the Electrochemical Equivalence of the Brass containing 90% copper and 10% zinc. Valency of Copper and Zinc are 1 and 2 respectively. Atomic weight of Copper and Zinc are 63.55 and 65.38 respectively. (Use superposition of charge method)

9. Write the condition for maximum permissible current during the ECM process.

10. For a RC type generator to get maximum power dissipation condition during charging, determine idle time or charging time in milliseconds for Rc = 10 Ω and C = 200 μF.

11. The duty cycle of a pulse power supply is 40% with spark on time of 10 millisecond, what will be the frequency (Hz) of the power supply.

12. In a RC type generator, the maximum charging voltage is 80 V and the charging capacitor is 100 μF. Determine spark energy.