Metallurgy

College of Engineering, Pune 5.
(An autonomous Institute of Government of Maharashtra, Pune 411005)

End Semester Examination
B. Tech. (Metallurgical Engineering) /M. Tech. - Physical/Process Metallurgy)

Powder Metallurgy

Time 3 hours] **[Max. Marks 50**

Instructions to candidates:
1) All questions are compulsory.
2) Neat diagrams must be drawn wherever necessary.
3) Use of non-programmable electronic pocket calculator is allowed.

Q.1 Solve **any 09**:

(a) Write the size and weight range in which P/M components are currently made. **[2]**

(b) Compute the compression ratio for an iron powder having apparent density of 2.4 g/cm^3, which when compacted at 500 MPa gives a density of 6.0 g/cm^3. **[2]**

(c) A 10 mm diameter final dimension powder compact is needed with a final density of 85% which is to be formed from an 82% dense pressing. What die diameter is needed for this process? **[2]**

(d) Check the suitability of using the electrical zone sensing technique for a spherical nickel particle of 20 μm size (density = 8.9 g/cm^3) in 1% salt water as the medium (density = 1.01 g/cm^3) **[2]**

(e) Which types of signals generated in BET are used for surface analysis? [2]

(f) Smallest particle size determined by laser particle size analyzer is at least twice the wavelength of laser light used for detection. Why? **[2]**

(g) To achieve a certain strip thickness, why is larger diameter rolls required in powder rolling as compared to the strip rolled from a solid stock? **[2]**

(h) What is dynamic ratio? Write the same for any two methods of particle size analysis. **[2]**

(i) An iron powder compact is sintered for 1h at 890°C and is found to have superior mechanical properties to the same material sintered at 930°C, with all other variables remaining the same. Why? **[2]**

(j) List out the various sintering variables. Which ones you would select to achieve a high density at a finer grain size? **[2]**

(k) Name the properties desired in electrical contact materials. **[2]**

(l) What microstructure differences are expected in the cemented carbides tools manufactured by conventional and hipping route? **[2]**

P.T.O.

Q.2 Solve **any 04**:

(a) Find the settling velocity for aluminium spherical particles (density = 2.7 g/cm^3) with average particle size of 20 μm settling in water (density = 1.0 g/cm^3, viscocity = 10^{-2} g/cm/s). Also check the validity of the Stoke's law for the system under consideration. **[4]**

(b) Will the compaction force required be same in forming the steel compact by pressing mixed iron and graphite powder versus using prealloyed steel powder?

(c) Why extrusion is preferred over hot pressing techniques for the consolidation of dispersion strengthened alloys. **[4]**

(d) Which type of porosity is desired in porous P/M bearings? How it is achieved? **[4]**

(e) Compare conventional P/M method and powder injection moulding for the following; **[4]**

(a) Powder particle size

(b) Porosity before sintering

(c) Lubricant/binder content

(d) Sintered density (%)

Q.3 Solve **any 04**:

(a) Write the principles on which the following methods are based (any 02): **[4]**

(a) Elutriation

(b) Powder surface area by gas permeability method

(c) Laser particle size analysis

(b) What powder characteristics might cause the surface area to differ when measured by permeability and by gas adsorption? **[4]**

(c) Why an agglomerated powder is difficult to sinter? What measures would you take to process such powders to minimize the negative effect? **[4]**

(d) During sintering of a metal powder, is there a uniform change in pore shape and size in all the three stages? **[4]**

(e) Write the different criteria governing the selection of the die materials. Name the different types of die materials you know. **[4]**

(f) What method would you suggest to remove closed porosity in sintered compacts? **[4]**

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