CHL-331 :   Minor-2 Examination: Fluid Particle Mechanics

Time:1 hour; Full Marks:20. Answer All the Questions . Use necessary assumptions if required and state clearly in answer booklet. Do not ask questions to invigilators.

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1.   A suspension in water (density: 1gm/cc; viscosity: 1cp s) of uniformly sized sphere (diameter 150 μm, density 1140 kg/m^3) has a solids concentration of 5% by volume. Height vs time data obtained for this slurry in a batch sedimentation experiment is as follows.

(a)   Find out the rate at which the water/initial suspension interface settles from height vs time data. Compare this result with the theoretical prediction using Richardson Zaki relation and equation of velocity of interface, assuming particles are falling Stokes regime.
(b) determine the velocity of the interface between clear liquid and suspension of volume fraction 0.2.
(c) determine the velocity at which a layer of solid volume fraction 0.2 propagates upwards from the base of the vessel. Write down the assumption of determination of this velocity. (d) determine the final sediment concentration. (e) Find the V_{ps} for the layer with volume fraction 0.2.

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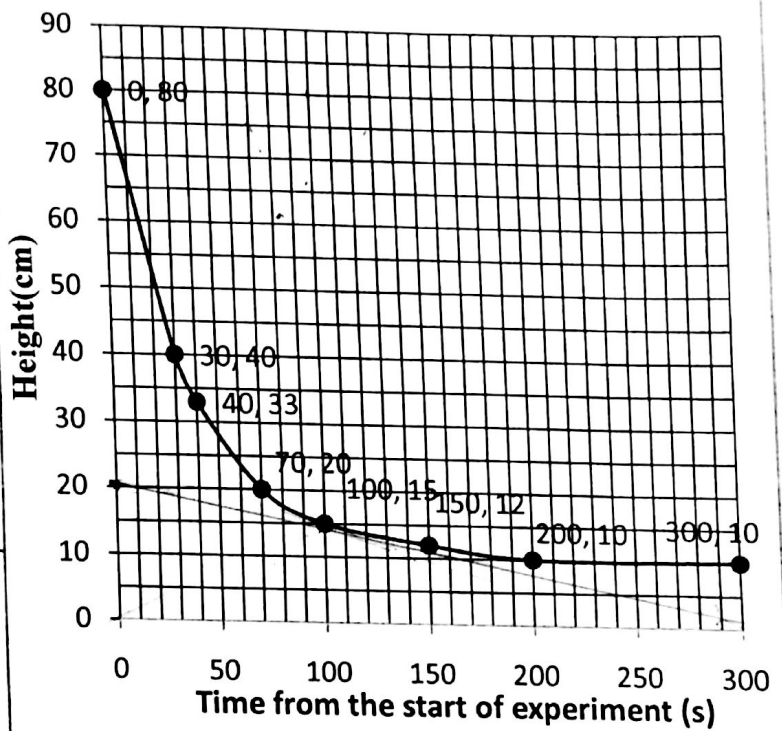
Marks:(0.5+2)+1+(0.5+0.5)+0.5 +1

2.   (a)Compare the characteristics of motion of bubbles (air), liquid droplets (density 2gm/cc) through water in detail in the tabular form.(b)How **porosity** varies with particle size, particle shape? Explain through the diagram.(c)Compare the major differences among various particles in Geldart chart with examples in detail in the tabular form.(d)How porosity varies with different arrangement of monodisperse spherical particles? (e)Explain inversion point of a fluidized bed (f) What are the design principles of thickener and clarifying section of a continuous flow thickener? (g) Write down expression of $\Delta P/L$ of a fluid passing through a packed column. Explain the two terms with physical significance. **(Marks will be awarded for "To the point, correct, complete answers")**   Marks : 1.5+1.5+1.5+0.5+2+1.5+1.5

3.   Spherical polypropylene particles (d_p=1mm, true density 0.95g/cc) are to be coated uniformly with a liquid chemical in liquid phase (density 1gm/cc, viscosity 1cp). It is proposed to do the coating using a fluidized bed. Draw schematic diagram of the proposed fluidized bed which you think might work. Find out the required velocity of liquid. (Guideline for operation: the velocity should be twice the minimum fluidization velocity). Given the bulk density of the polymer powders 0.62 gm/cc. State assumptions clearly to solve this problem.   Marks : 4