Casting Sheet 2

Q1. The optimum shape of a riser is spherical to ensure that it cools more slowly than the casting it feeds; however, spherically shaped risers are difficult to cast. (a) Sketch the shape of a blind riser that is easy to mold, but also has the smallest possible surface-area-to-volume ratio. (b) Compare the solidification time of the riser in part (a) with that of a riser shaped like a right circular cylinder. Assume that the volume of each riser is the same and the height of each is equal to the diameter.

Ans: (a) 5.21 (b) 0.037C

Q2. A round casting is 0.2 m in diameter and 0.75 m in length. Another casting of the same metal is elliptical in cross section, with a major-to-minor axis ratio of 2, and has the same length and cross-sectional area as the round casting. Both pieces are cast under the same conditions. What is the difference in the solidification times of the two castings?

Ans: 2.78

Q3. The constant C in Chvorinov's rule is given as 2.5 s/mm^2 , and is used to produce a cylindrical casting with a diameter of 50 mm and height of 125 mm. Estimate the time for the casting to fully solidify. The mold can be broken safely when the solidified shell is at least 20 mm. Assuming that the cylinder cools evenly, how much time must transpire after pouring the molten metal before the mold can be broken?

Ans: 271 seconds

Q4. When designing patterns for casting, patternmakers use special rulers that automatically incorporate solid shrinkage allowances into their designs. For example, a 12-in. patternmakers ruler is longer than 1 ft. How long should a patternmakers ruler be for making patterns for (a) aluminum castings and (b) high-manganese steel?

Ans: 12.156 in, 12.312 in

Q5. A disk 40 cm in diameter and 5 cm thick is to be cast of pure aluminum in an open mold casting operation. The melting temperature of aluminum = 660°C, and the pouring temperature will be 800°C. Assume that the amount of aluminum heated will be 5% more than what is needed to fill the mold cavity. Compute the amount of heat that must be added to the metal to heat it to the pouring temperature, starting from a room temperature of 25°C. The heat of fusion of aluminum = 389.3 J/g. Assume the specific heat has the same value for solid and molten aluminum.

Ans: 19,082,756 J

Q6. The downsprue leading into the runner of a certain mold has a length = 175 mm. The cross-sectional area at the base of the sprue is 400 mm^2. The mold cavity has a volume = 0.001 m^3. Determine (a) the velocity of the molten metal flowing through the base of the downsprue, (b) the volume rate of flow, and (c) the time required to fill the mold cavity.

Ans: (a) 1853 mm/s (b) 741,200 mm^3/s (c) 1.35 sec

Q7. A cylindrical riser is to be used for a sand-casting mold. For a given cylinder volume, determine the diameter-to-length ratio that will maximize the time to solidify

Q8. A riser in the shape of a sphere is to be designed for a sand casting mold. The casting is a rectangular plate, with length = 200 mm, width = 100 mm, and thickness = 18 mm. If the total solidification time of the casting itself is known to be 3.5 min, determine the diameter of the riser so that it will take 25% longer for the riser to solidify.

Ans: 47.5 mm

Q9. An 92% aluminum-8% copper alloy casting is made in a sand mold using a sand core that weighs 20 kg. Determine the buoyancy force in Newtons tending to lift the core during pouring.

Density of Al-Cu alloy = 2.81 g/cm^3

Ans: 148.5 N

Q10. A horizontal true centrifugal casting process is used to make aluminum rings with the following dimensions: length = 5 cm, outside diameter = 65 cm, and inside diameter = 60 cm. (a) Determine the rotational speed that will provide a G-factor = 60. (b) Suppose that the ring were made out of steel instead of aluminum. If the rotational speed computed in part (a) were used in the steel casting operation, determine the G-factor and (c) centrifugal force per square meter (Pa) on the mold wall.

Ans: (a) 406.4 rev/min (b) 406.4 rev/min (c) 10,914.7 Pa