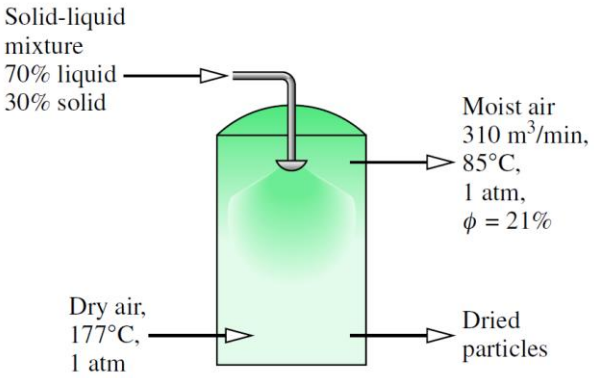
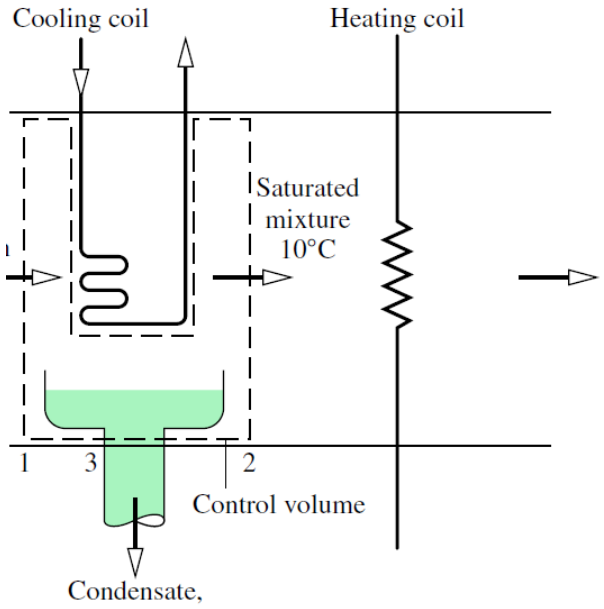
Thermodynamics 2014 Fall Homework Assignment 7

1) The following Figure shows a spray dryer operating at steady state. The mixture of liquid water and suspended solid particles entering through the spray head contains 30% solid matter by mass. Dry air enters at 177°C, 1 atm, and moist air exits at 85°C, 1 atm, and 21% relative humidity with a volumetric flow rate of 310 m^3 /min. The dried particles exit separately.
Determine
(a) the volumetric flow rate of the entering dry air, in m^3 /min.
(b) the rate that dried particles exit, in kg/min.



2) Moist air enters an air-conditioning system as shown in the Fig at 26°C, f=80% and a volumetric flow rate of 0.47 m^3 /s. At the exit of the heating section the moist air is at 26°C, f=50%. For operation at steady state, and neglecting kinetic and potential energy effects, determine
(a) the rate energy is removed by heat transfer in the dehumidifier section, in tons.
(b) the rate energy is added by heat transfer in the heating section, in kW.



3) Analyzing Cooling Towers: Liquid water at 50°C enters a forced draft cooling tower operating at steady state. Cooled water exits the tower with a mass flow rate of 80 kg/min. No makeup water is provided. A fan located within the tower draws in atmospheric air at 17°C, 0.098 MPa, 60% relative humidity with a volumetric flow rate of 110 m 3 /min. Saturated air exits the tower at 30°C, 0.098 MPa. The power input to the fan is 8 kW. Ignoring kinetic and potential energy effects, determine
(a) the mass flow rate of the liquid stream entering, in kg/min.
(b) the temperature of the cooled liquid stream exiting, in °C.