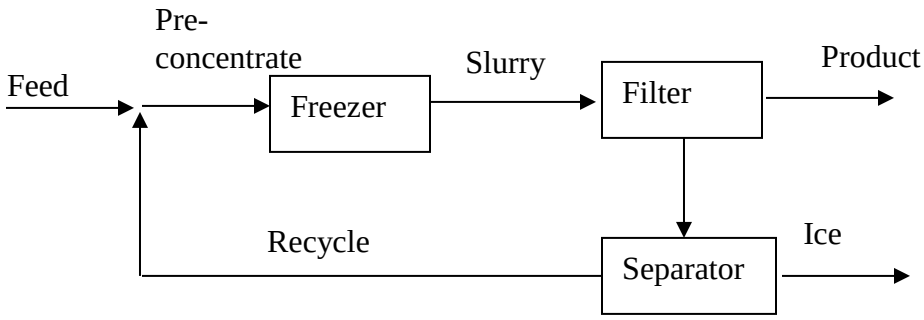
ABE – 201 Fall 2016

Homework 10
Due Monday 10/17 with you Exam at the End of Class

1. (10 pts) Freeze concentration is used to produce a fruit-juice concentrate. A stream of fresh juice containing 12 wt% soluble solids in water at 20ºC is combined with a recycle stream to form a preconcentrate, which is fed to a crystallizer. The mixture is cooled in the crystallizer to –7ºC, thereby crystallizing ice at a rate of 20,000 kg/h. A slurry leaves the crystallizer containing 10 wt% ice and is fed to a filter. The filtrate, which contains 45 wt% dissolved solids, is removed as the concentrate product. The remaining slurry, which contains all the ice and some concentrate (also containing 45% dissolved solids), is sent to a separator that cleanly removes all of the ice. The residual liquid is the recycle stream that combines with the fresh feed to form the preconcentrate.
   (a) Determine the rates (kg/h) at which fresh fruit juice is fed and concentrate is produced, and the mass flow rate (kg/h) and solids concentration of the preconcentrate.
   (b) Calculate the cooling requirement (kW) for the freezer, assuming that the temperature of the recycle stream if 0ºC and the heat capacity of all solutions is 4.0 kJ/(kg·ºC).



3. (10pts) Before freezing, breaded chicken patties with the composition below are cooled to 0°C from an initial cooked temperature of 82°C (180°F).

Breaded Chicken Patty	
Water	60%
Carbohydrates	15%
Protein	15%
Fat	8%
Ash	2%

a) What is the heat capacity (Cp) of the cooked chicken (not frozen)? Estimate using the Choi-Okos equation.
b) How much heat must be removed to cool 5 kg of breaded chicken patties?