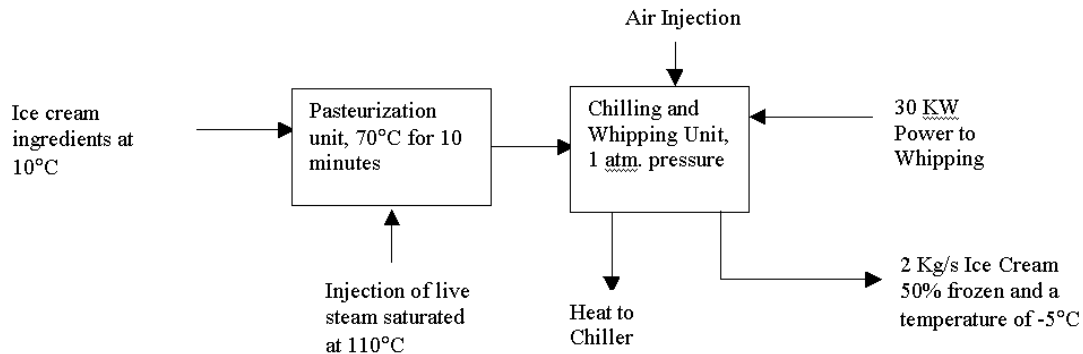


10.213 Homework
10/6/99

Problem 11 Due 10/8

You are to design a continuous ice cream maker in which a liquid feed stream of a mixture of milk, cream, eggs, sugar, etc. continuously flows and ice cream is produced after Pasteurizing, chilling, and whipping in air. The process looks something like that shown below.



Assume that the ice cream ingredient mixture has the properties of approximately that of water and that 50% of the water in the final mixture must be frozen. Air is supplied to the unit at 10 atmospheres of pressure and does not dissolve into the mix, but it forms small air pockets. The ice cream doubles in volume during the freezing and air injection process. To produce 2 Kg of ice cream per second, it takes 30 KW of power to the whipping unit.

- For a ice cream production rate of 2 Kg/s of ice cream, what flow rate of steam is required assuming that the Pasteurization unit is well insulated?
- What chiller capacity is required in terms of heat flow assuming that the unit is well insulated?
- What air injection flowrate is required?
- How much work is done on the system defined by the mixture in the pasteurization unit?
- How much work is done on the system defined by the mixture in the Chilling and Whipping Unit?
- What is the amount of kinetic energy associated with all feed streams and output streams.
- If the ice cream comes out 2 meters below the input of the ice cream ingredients, what is the potential energy change associated with this system?