

Material Balance Laboratory

FABE 481 – Dr. Gönül Kaletunç

TAs –Boon Lee Tee

Spring 2006

I. Objectives :

- a) To apply the principles of mass balance to formulate ice cream
- b) To determine air incorporation into ice cream during mixing and apply material balance to ice cream process

II. Concepts: mass balances.

Ice cream process

III. Equipment: Ice cream maker

IV. Materials:

Ice cream ingredients: Heavy cream, whole milk, sugar, vanilla, salt

V. Pre-Lab Assignment

Calculate the amount of ingredients necessary to be mixed to produce 0.7 kg of vanilla ice cream. Use either MATLAB or Excel spreadsheet INDEX, MINVERSE (matrix inverse), MMULT (matrix multiplication) functions to determine the amounts of heavy cream, milk, sugar, vanilla, and salt that must be used to prepare the ice cream mixture according to the required composition.

The compositions of the raw materials are:

Heavy cream – 36% fat, 64% water.

Whole milk – 3.2% fat, 4.8% carbohydrate, 3.2% protein, 88.8% water.

Sugar – 100% carbohydrate

The ice cream mixture should contain:

10.4% fat, 19.66% carbohydrate, and 67.1% water, 0.86% vanilla, 0.2% salt, 1.87% protein.

VI. Procedure:

- ✓ Calculate the amounts of ingredients
- ✓ Weigh the ingredients and mix all ingredients in a bowl
- ✓ Weigh the ice cream mixture of a fixed volume
- ✓ Assemble the ice cream maker and turn it on
- ✓ Pour the ice cream mixture into the freezer bowl of the ice cream maker.
- ✓ Put the thermometers in.
- ✓ Collect temperature (center and side), mixing speed, and mixing force data
- ✓ After 30 minutes turn the machine off
- ✓ Weigh the ice cream of a fixed volume

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VII. Calculations:

- 1) Calculate the density of ice cream mixture and ice cream
- 2) Calculate the overrun

Note: The change in ice cream volume or weight during process is called overrun. Overrun is calculated based on weight or volume.

$$\% \text{ Overrun by weight} = \frac{(\text{weight of ice cream mix}) - (\text{weight of ice cream})}{(\text{weight of ice cream})} * 100$$

$$\% \text{ Overrun by volume} = \frac{(\text{volume of ice cream}) - (\text{volume of ice cream mix})}{(\text{volume of ice cream mix})} * 100$$

VIII. Questions:

What is the significance of volume change in ice cream manufacturing from the technical and economical perspectives?

IX. Report:

You are expected to submit one report for each group. The report must be typed.

Your report will include:

- 1) A table showing the ingredients used and their amounts.
- 2) Calculations
- 3) Answers to the questions.

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Ice cream experiment

Time (min)	Center T (F)	Surface T (F)	RPM	Weight (g)
0				
0.5				
1				
1.5				
2				
2.5				
3				
3.5				
4				
4.5				
5				
5.5				
6				
6.5				
7				
7.5				
8				
8.5				
9				
9.5				
10				
10.5				
11				
11.5				
12				
12.5				
13				
13.5				
14				
14.5				
15				
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				

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Time (min)	Center T (F)	Surface T (F)	RPM	Weight (g)
19.5				
20				
20.5				
21				
21.5				
22				
22.5				
23				
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				

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Lab Groups

Lab:2-4pm	<u>Group 1</u>	Matt Lang Ronald Wilder Thais De Nardo
	<u>Group 2</u>	Mo Somboonvechakarn Jeremy Somerville Jamie Nickell-Whaley
	<u>Group 3</u>	Nancy Timms Andrea Scales