PURDUE UNIVERSITY

CAPSTONE/DESIGN EXPERIENCE 2016

Spaghetti Production

Agricultural & Biological ENGINEERING

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Introduction:

We aim to develop a fast spaghetti production process that will produce spaghetti at a profitable scale which can be run by students.

Objectives:

- To produce 300 kg/h of pasta.
- To sell our pasta for $1.00 per 1lb bag.
- To run our plant for 22 hours/day, 365 days/year

Alternative solutions:

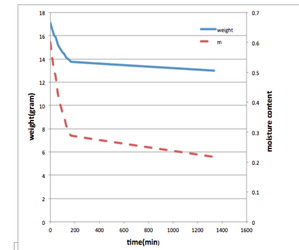
- Mixer: Make a continuous process, have 5 mixers, run for mixing time of 16 minutes
- Extruder: Have 2 extruder lines, run at medium production
- Dryer:

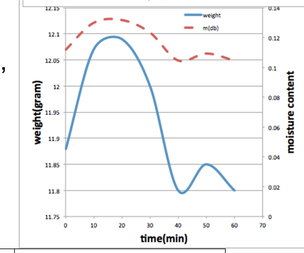
1.Paven dries pasta with a high initial temperature, following with a series stages of fast drying and stabilizing. The dryer is divided into several zones, which is controlled individually. The whole process takes about 3 hours.

2. Another company, Fava, initially has an intense predrying phase, then increase temperature to maximum and stays for 160 minutes, and followed by a last stage, which is a stabilizing zone. The whole process is controlled by PLC and takes about 6 hours (Field, Karen,2009).

Experiment:

- Flat sheet pasta was made in lab scale
- Cut into 6 pieces, randomly select piece #1, #2, &#4
- Dried at 40C, RH80%(top right), and then switch to 80C, RH80%(down right) after reach equilibrium.
- Waited until pasta reach new equilibrium





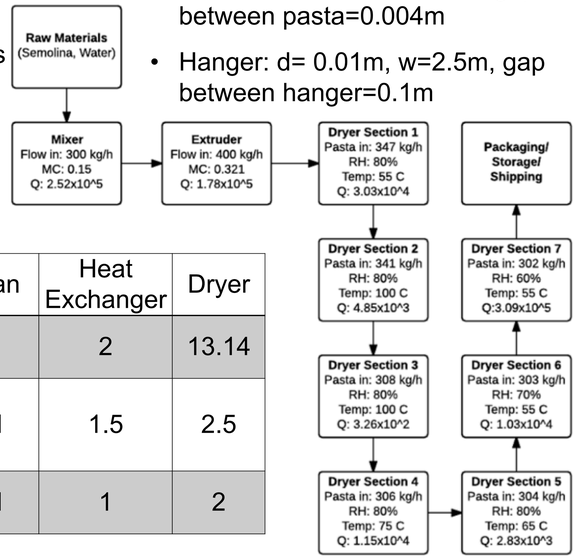
	fresh area(in^2)	after 40C,80% (in^2)	after 80C,80% (in^2)
#1	2.1	1.76	1.57
# 2	1.95	1.61	1.63
# 4	3.21	2.47	2.59

Market :

- became really big in the 19th century
- 82.47% of American households eats dry, prepackaged pasta (Statistica 2015)
- Pasta has become a big staple in America due to its convenience, low cost, and versatility
- people across all ages eat pasta with the highest rate of pasta consumption coming from people between the ages of 19-50 (Chung, Lee, Cho 2010).

Plant Design:

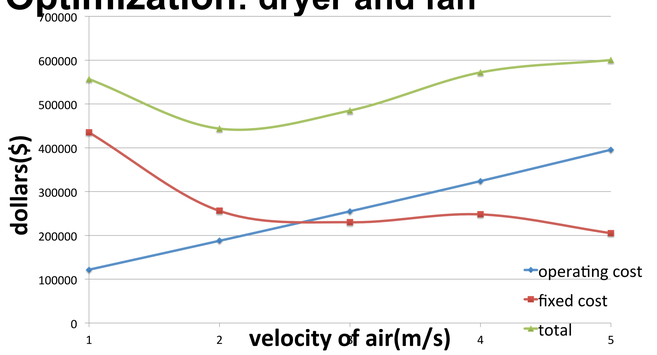
- Ship in semolina flour every two weeks
- Batch run mixer
- Continuous run extruder
- Continuous run conveyor dryer with 7 zones



- Pasta: d=0.018m, L= 1.5m, gap between pasta=0.004m
- Hanger: d= 0.01m, w=2.5m, gap between hanger=0.1m

	Storage tank	Mixer	Extruder	Fan	Heat Exchanger	Dryer
Length (m)		1.58	1.65		2	13.14
Width/ Diameter (m)	6	1.8	12.5	1	1.5	2.5
Height (m)	20	2.45	1.8	1	1	2

Optimization: dryer and fan



Background :

Extrusion.

- During this process, the dough is fed into one end. An auger forces the dough through the length of the extruder and forced through a die at the other end (Redazione 2013).
- The flow rate of the dough must be uniform during the extrusion, or causing the extruded noodles to not have uniform size.

Drying.

- Traditionally, low temperature (lower than 50), 20-30 hours
- Nowadays, higher temperatures, as fast as 3 hours.

Economics: purchased equipment

equipment & quantity	cost/unit($)	1 dryer	200000
1 tank	2000	7 heat exchanger	30000
3 mixer	4000	5 fans	56000
1 extruder	40000	1 packaging machine	1000

- Estimation of TCI is based on the total price of purchased equipment
- Estimation of TPC is based on the price of raw material
- Depreciation calculation was based on straight line estimation with 10 year life
- Assumed 35% tax rate

raw material($)	1264857.495
total equipment($)	744000
TCI($)	3474480
TPC($)	4216191.65
ROI	0.137719667

Technical Advisor:

Instructors:
Dr. Okos

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Think impact.