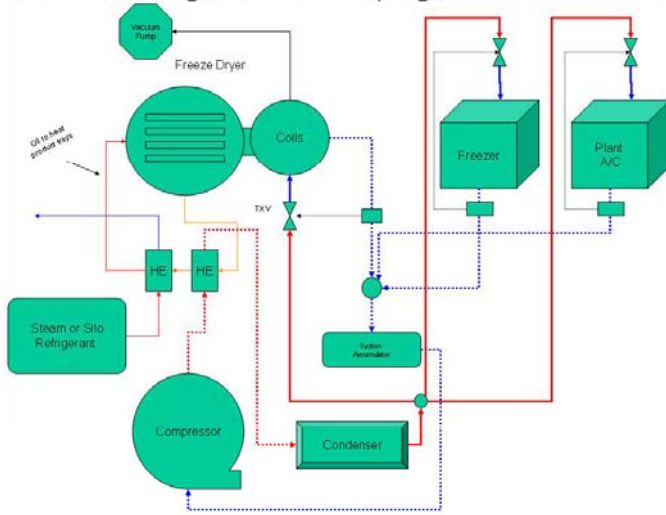


Example Refrigeration System for Freezing, Freeze Drying, and Plant A/C



Energy Requirements

Heat Required for Pasteurization:

- > Plate and Frame Heat Exchanger
- > 129.4 kJ/kg
- > 5726.94 GJ/yr

Steam Requirement

- > 2,650,000 kg/yr
- > Estimated cost of steam - \$4.40/1000kg
- > Steam Cost - \$11,675/yr

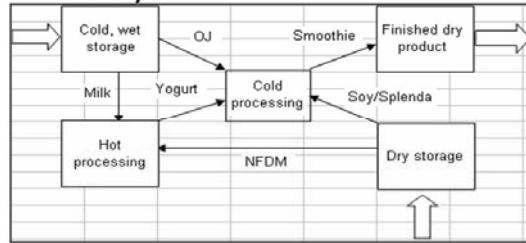
Savings from Preheating Step
\$14,102/yr

Economic Analysis

Purchase Equipment Cost Estimations

Equipment	Number	Cost	Process Cost	Running Cost
Skim Milk Storage Silo	1	70000	\$70,000	\$70,000.00
Dry Milk Silo	1	54427	\$54,427	\$124,427.00
Mix Tank	3	11000	\$33,000	\$157,427.00
Pre-heater	1	1000	\$1,000	\$158,427.00
Homogenizer	1	17553	\$17,553	\$175,980.00
Pasteurization	1	800	\$800	\$176,780.00
Hold Tube	1	511.6	\$512	\$177,291.60
Insulation	1	127.9	\$128	\$177,419.50
Fermentation Tanks	34	2600	\$88,400	\$265,819.50
Storage/Aging Tank	2	40000	\$80,000	\$345,819.50
Soy Powder Silo	1	54427	\$54,427	\$400,246.50
Splenda Silo	1	54427	\$54,427	\$454,673.50
Orange Juice Storage Silo	2	70000	\$140,000	\$594,673.50
High Pressure Past.	3	500000	\$1,500,000	\$2,094,673.50
Mix Tank	3	11000	\$33,000	\$2,127,673.50
Freeze Dryer	66	30000	\$1,980,000	\$4,107,673.50
Agglomeration	1	26137	\$26,137	\$4,133,810.50
		Total:	\$4,133,810.50	

Plant Layout



Freeze Dryer Product Chambers



Freeze Dryer Condensation Chambers



Freeze Dryer Trays in Freezer

Photos from Van Drunen Farms, Momence, IL

Economic Analysis

- > Total Start-Up Costs Estimation: \$21,000,000
- > Annual Costs (utilities, ingredients, labor, etc.) - \$362,000,000
- > Total Product Cost - \$4.92/lb
- > Product Selling Price - \$5.05/lb

Assuming tax rate of 35%, straight line depreciation, and all product sold, discounted rate of return over a ten year period is 24%

Future Work

- > Incorporate oat β -glucan as thickening agent
- > Final product formulation
- > Continued investigation into equipment and utility costs