## Process Resource Requirements

| | Labor (labor hours/hr) | Water (lb/month) |
|---|---|---|
| Batch Cooker | 1 | 215311 |
| Evaporator | 1 | 20039 |
| Spray Drier | 0.5 | 0 |
| Agglomerator | 0.5 | 135000 |
| Process Total | 3 | 370350 |

| | Heating load (btu/month) | Temperature (Celsius) |
|---|---|---|
| Batch Cooker | 1.16347E+08 | 24 - 82.22 |
| Evaporator | 7.70809E+09 | 57.6 - 82.22 |
| Spray Drier | 4.30700E+08 | 24 - 100 |
| Agglomerator | 0.00000E+00 | 24-24 |
| Process Total | 8.25514E+09 | 24 - 100 |



## Economic Analysis

| | Labor Cost ($/month) | Water Cost ($/month) | Heating cost ($/month) |
|---|---|---|---|
| Batch Cooker | 3200 | 52.47344381 | 5.81734E+04 |
| Evaporator | 3200 | 4.88370469 | 3.85405E+06 |
| Spray Drier | 1600 | 0 | 2.15350E+05 |
| Agglomerator | 1600 | 32.90085 | 0.00000E+00 |
| Process Total | 9600 | 90.2579985 | 4.12757E+06 |

- Total monthly operating cost is $4,140,000
- Start up cost for the plant is $4,300,000
- Anticipated yearly profit is $48 million

- Energy conversation is necessary to reduce monthly operating cost for a profitable process

## Rehydration Experiments

- Objective: Measure the rheological properties of rehydrated tomato sauce

- Tomato powder was produced by freeze drying tomato sauce purchased at the store.

- Viscosity measurements were made using a Brookfield viscometer with number six spindle.

- Flow curves were fit using the Bingham plastic model, and yield stress was extrapolated at zero sheer rate.

- A 5:1 reconstitution ratio has a similar flow curve to the original sample, but a 4:1 reconstitution has similar characteristics when modeled.



Flow Curves for Rehydrated Tomato Sauce
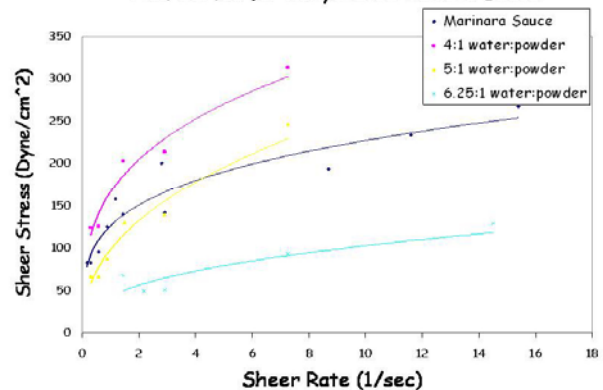
| Sample | $\tau_0$ (dyn/cm^2) | k (dyn*sec/cm^2)^(-n) | n |
|---|---|---|---|
| Original Sauce | 55 | 126.4 | 0.25 |
| 4:1 water(mL):powder(g) | 55 | 166.8 | 0.30 |
| 5:1 water(mL):powder(g) | 30 | 98.7 | 0.42 |
| 6.25:1 water(mL):powder(g) | 15 | 43.6 | 0.37 |
| 10:1 water(mL):powder(g) | viscosity too | low for reliable data | |