


# Pollution Prevention Project: Water Waste Reduction
# Pasta Montana LLC


Intern: Edwin Allan

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# Edwin Allan

I was born in Accra, the capital of Ghana

- **Academic Background**
  - Bsc. Nutrition and Food Science, University of Ghana
  - Msc. Sustainable Food Systems, Montana State University

- **Career Goal**

Food scientist dedicated to improving the food security and nutrition of indigenous communities

# Pasta Montana LLC: Great Falls, Montana


Figure 1: Pasta Montana Compound

Figure 2: Semolina Flour


Figure 3: Pasta Montana Brands

- Produces pasta by extruding semolina flour.
- Pasta (long and short) is produced under 3 main brands
- Uses Kaizen principles in manufacturing and is currently operating and selling at max. capacity

# Pasta Montana

Figure 4: Pasta produced by Pasta Montana

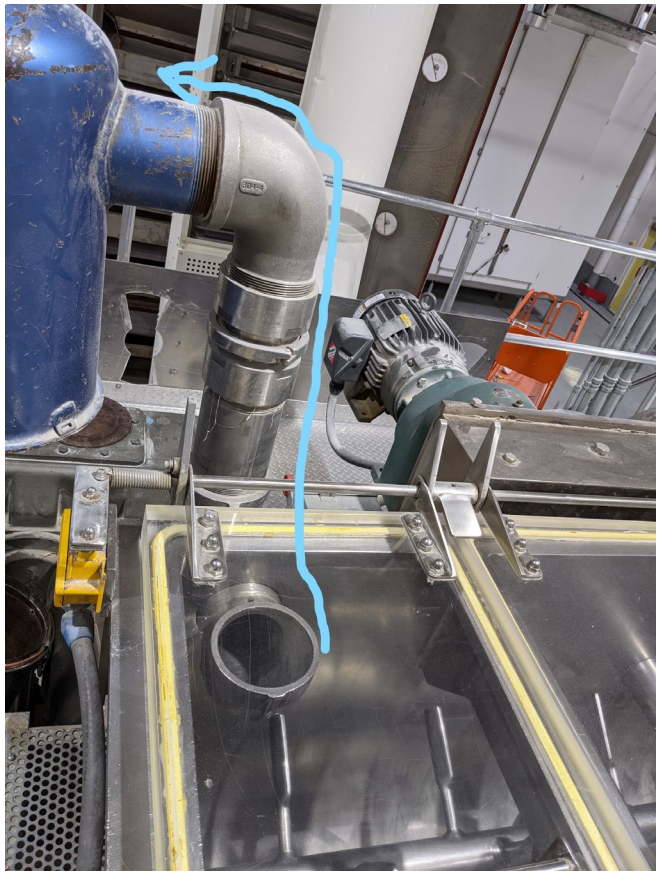


Figure 5: Vacuum supplied during Mixing

- With four pasta lines, Pasta Montana produces over 70 different dry pasta shapes
- The vibrant golden yellow color seen, is maintained by supplying a vacuum during mixing

# Water Usage: Vacuum Creation

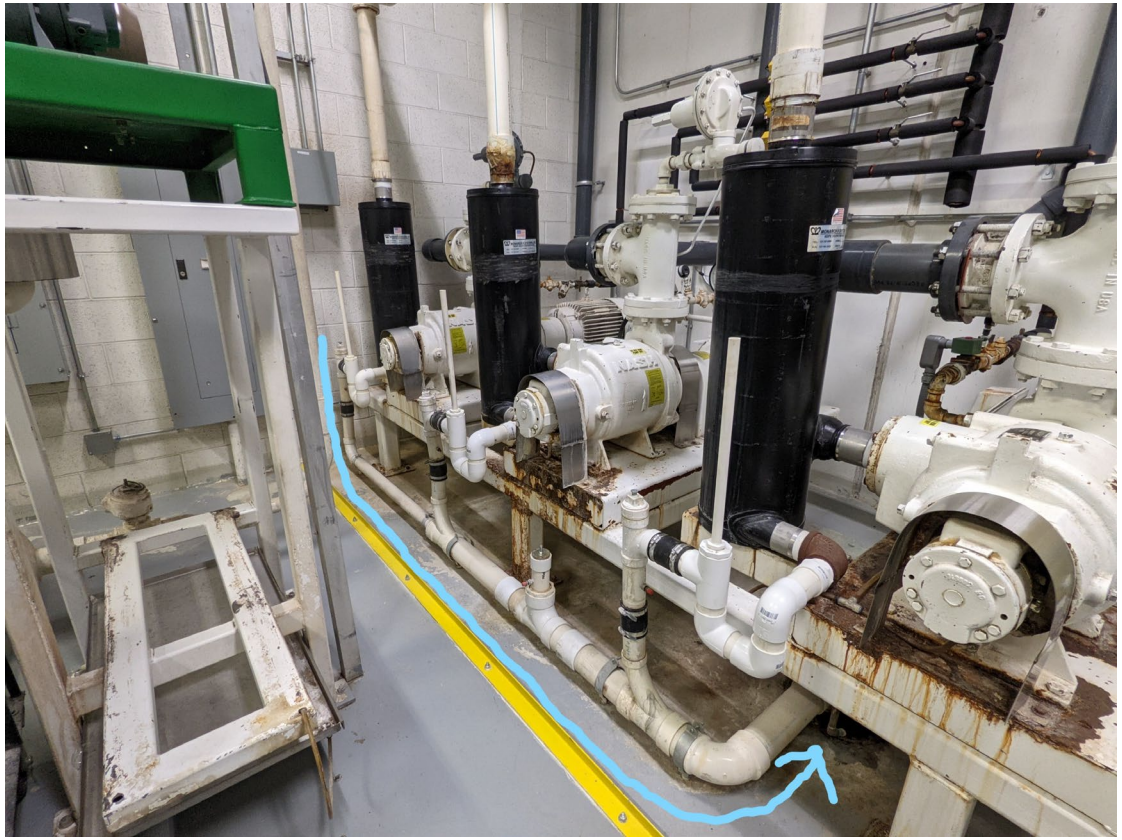
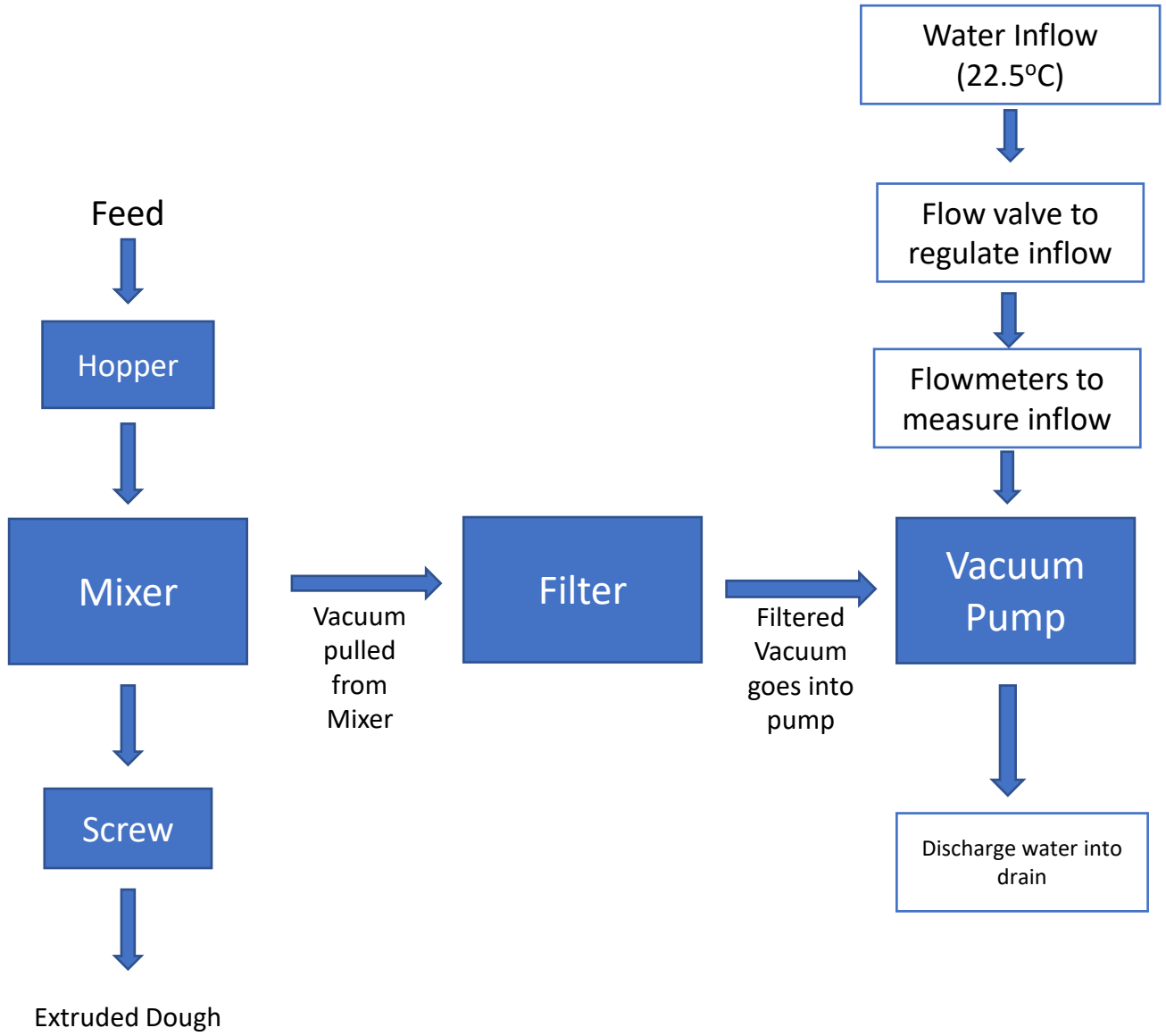


Figure 6: Water moving into drain after vacuum seal creation

- 8 gallons of water per minute is supplied to liquid ring vacuum pumps to create at least 15 In.Hg vacuum
- All 8 gallons supplied is discharged into the drain after use
- Accounts for 50% of Pasta Montana's water usage (Very little water is needed for actual pasta production)

# Flow Diagram of Vacuum Creation




**Stages**

1. Water inflow
2. Vacuum pump
3. Vacuum
4. Vacuum from Mixer
5. Discharge into Drain

Figure 7: Flow Diagram of Vacuum Creation and Supply

# Water Usage: Why Use LRVPs?

Figure 8: Liquid Ring Vacuum Pumps for Lines 1, 2 and 3


Figure 9: Liquid Ring Vacuum Pumps for Line 4

- Liquid ring vacuum pumps seldomly require maintenance
- Expend and use less energy
- Eliminates the use and disposal of toxic chemicals when using water

# Water Reduction Process

What is the least amount of water needed for a 15 In.Hg vacuum?

Without causing:

- Vacuum Pump Cavitation
- Discoloration of Product
- Downtime

i. Calibration of flowmeters: “bucket and balance” method

ii. Read Installation manuals: Max inflow= 8 gpm, Min. inflow = 4 gpm (Gardner Denver, 2007)

iii. 4 gpm confirmed with manufacturers
Max Discharge water temperature = 71°C

iv. Inlet flow gradually reduced from 8 gpm to 4 gpm, in line with “bucket and balance” method

# Water Waste Reduction: Calibration of Flowmeters

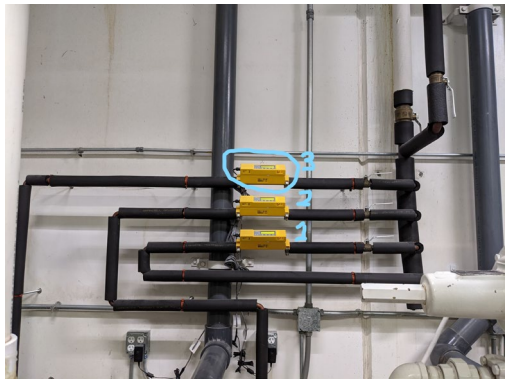


Figure 10: Flowmeters used to measure inlet flow

Figure 11: Filling bucket with discharge water in 10 seconds

Figure 12: Weighing Filled Bucket

- Flowmeters were suspected to be inaccurate
- Flow rate was remeasured by filling a bucket with drain water in 10 seconds.
- Water in the bucket was weighed and with a time of 10 seconds converted to gallons per minute

# Vacuum Pump Data Prior to Flowrate Reduction

Table 1: Vacuum Pump Responses at Initial Water Inflow Rate

| Production Line | Water flowrate (gpm) | Temp. of inflow water (°C) | Temp. of Discharge Water (°C) | Vacuum pressure measured from Pump (In.Hg) | Vacuum pressure measured from Mixer (In.Hg) |
|---|---|---|---|---|---|
| 1 | 8.72 | 22.5 | 27.9 | 20 | 15.7 |
| 2 | 8.56 | 22.5 | 27.9 | 26 | 16.5 |
| 3 | 7.98 | 22.5 | 27.9 | 16.5 | 16.5 |
| 4 | 13.9 | 22.5 | 26.4 | 21.8 | 18.9 |

- Lines 1, 2 and 4 were found to be operating above 8 gpm
- Flowmeters on each line were adjusted to 8 gpm and gradually reduced to 4 gpm

# Vacuum Pump Data after Flowrate Reduction

Table 2: Vacuum Pump Responses at Adjusted Water Inflow Rate

| Production Line | Water flowrate (gpm) | Temp. of inflow water (°C) | Temp. of Discharge Water (°C) | Vacuum pressure measured from Pump (In.Hg) | Vacuum pressure measured from Mixer (In.Hg) |
|---|---|---|---|---|---|
| 1 | 4 | 22.5 | 32.6 | 20 | 16 |
| 2 | 4 | 22.5 | 32.6 | 26 | 16 |
| 3 | 4 | 22.5 | 32.6 | 16.5 | 16.2 |
| 4 | 4 | 22.5 | 29.6 | 21.5 | *18.9 |

Flow rate on Line 4 was higher than the recommended 8 gpm but did not provide a noticeably higher vacuum pressure after flow rate reduction to 4 gpm

# Water Reduction Process: Water Quality Test

Table 3: Water Quality of Discharge Water from Liquid Ring Vacuum Pumps

| Source | Total Coliform | E. Coli | Turbidity (NTU) |
|---|---|---|---|
| Inflow (City water) | Absent | Absent | < 0.3 |
| Line 1,2,3 | Present | Absent | 0.287 |
| Line 4 | Absent | Absent | 0.157 |

- Coliform contamination comes from the environment (*Water Quality-Consumer Confidence Reports*, 2020)
- Line 1,2,3 likely to be contaminated during testing
- Water with turbidity less than 1 NTU is safe for drinking (WHO, 2017)
- Water can be stored and reused for gardening and housekeeping activities

# Did we really have to Reduce Water Waste?

- Pasta Montana's Yearly Water + Sewage Bill = $138,420
- Global water footprint: The US has the highest water footprint per capita of 6.8 tons per day

Table 4: Savings made per year after water reduction

| Lines | Initial Flowrate | Gallons per year | Adjusted Flowrate | Gallons Saved per year | New Gallons per year | Savings per year ($) |
|---|---|---|---|---|---|---|
| 1 | 8.72 | 4,219,085 | 4 | 2,283,725 | 1,935,360 | 14,212.31 |
| 2 | 8.56 | 4,141,670 | 4 | 2,206,310 | 1,935,360 | 13,730.54 |
| 3 | 7.98 | 3,861,043 | 4 | 962,842 | 1,935,360 | 5,992.06 |
| 4 | 13.91 | 6,730,214 | 4 | 4,794,854 | 1,935,360 | 29,839.84 |
| Total | 39.17 | 18,952,012 | 16 | 10,247,731 | 7,741,440 | 63,774.75 |

Pasta Montana LLC has reduced overall water usage by 41% and saved $63,774.75

Old yearly water bill = $138,420
New yearly water bill = $74,645

# Conclusion

- Water use and sewage was reduced by 10.2 million gallons a year
- Potential to further reduce discharge water
- Potential to recirculate discharge water
- Potential to store and reuse discharge water
- Pasta Montana reduced water usage by 41% by being committed to pollution prevention and waste reduction

# Next Steps

- Heavy metal testing of discharge water
- Installation of partial recirculation configuration to potentially drop inlet flow to 2 gpm
- Monitoring device for vacuum supplied to mixer and temperature of discharge water
- Storage of discharge water for gardening and housekeeping
- Explore durum wheat varieties with low lipoxygenase activity

# Personal Benefits

- Better understanding of food extrusion
- Learnt how to make pasta and different shapes
- Learnt how to work as a professional
- BRC food safety standards, implementation and internal audits

# Acknowledgements


- Pasta Montana LLC, Montana Manufacturing Extension Center and MSU Food Product Development lab
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- David Oien, Timeless Seeds
- Wan-Yuan Kuo and Food Product Development Lab


# References


- City of  Great Falls, W. S. (2020). *Water Quality-Consumer Confidence Reports*. https://greatfallsmt.net/ccr2020.
- Gardner Denver. (2007). *CLASSIC LIQUID RING PUMPS & COMPRESSORS*.
- World Health Organization. (2017). *WATER QUALITY AND HEALTH-REVIEW OF TURBIDITY: Information for regulators and water suppliers*.

# Thank you