# Anaerobic Digester Effluent as a Pretreatment for Waste Paper

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# Anaerobic Digestion

- Microbial degradation of organic material in absence of oxygen
- Produces biogas (mostly carbon dioxide and methane) that can be used for energy
- Requires pre-treatment of solid feedstock to achieve particle size reduction
- Left over is digestate (solid portion) and effluent (liquid portion)

# Proposal

- Use effluent from digester to breakdown paper and feed paper into digester
- Closed loop
- Effluent contains microorganisms from the digester that excrete hydrolytic enzymes
- No harsh chemicals, no expensive equipment

# Small Scale Digester Simulation

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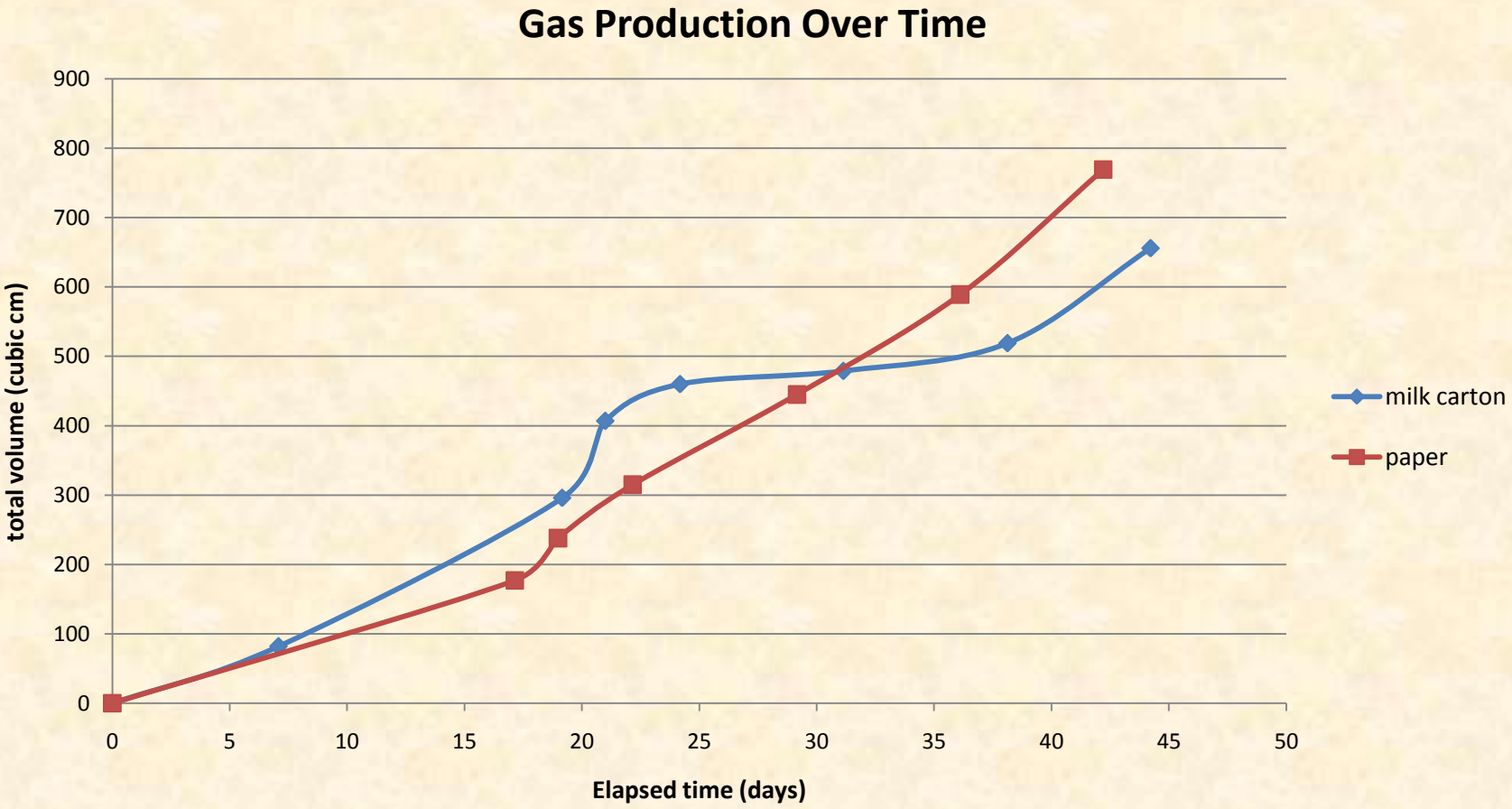


# Nine Types of Paper

#1-soft white napkin

#2-tough white napkin

#3-tough school toilet paper

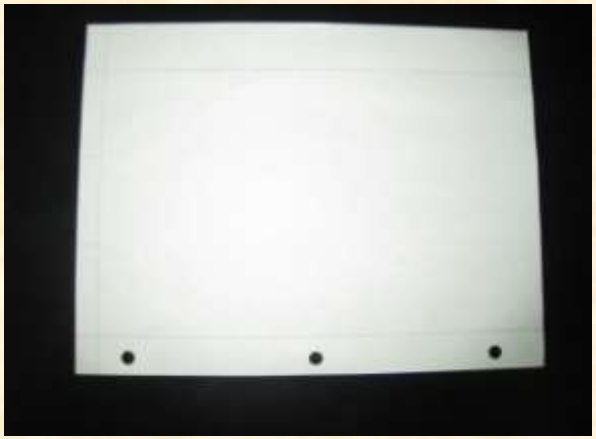
#4-soft home toilet paper

#5-brown lab paper towel

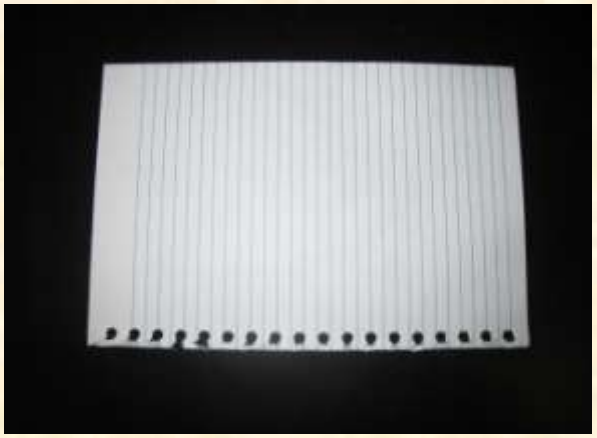
#6-soft home paper towel

# Nine Types of Paper

#7-office paper



#8-green engineering paper



#9-30% recycled notebook paper

# Chemical Oxygen Demand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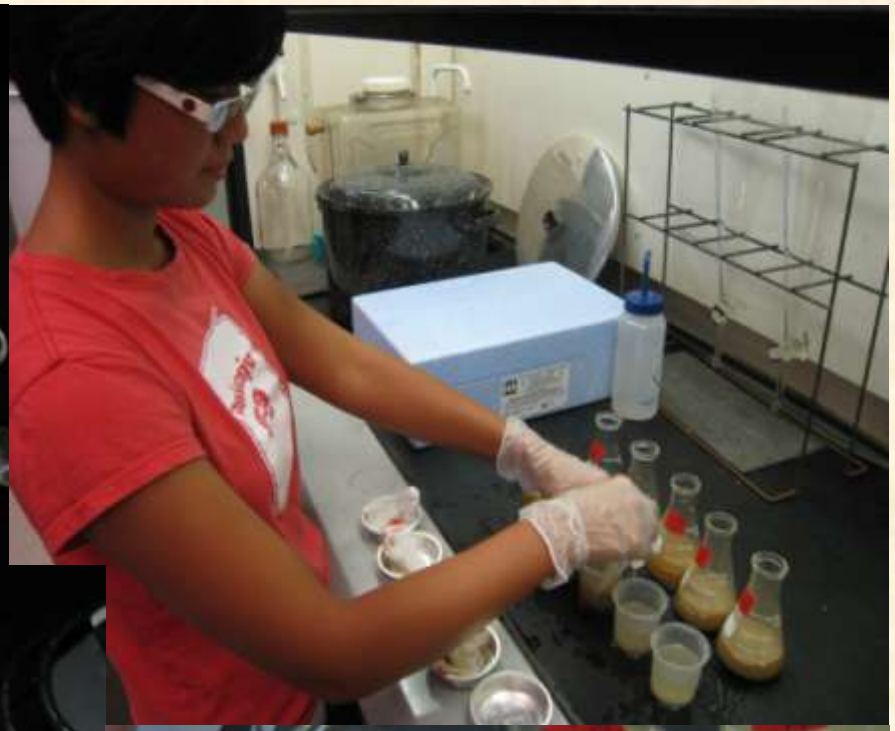
| paper # | COD/paper (g/g) | methane/paper (L/g) |
|---|---|---|
| 1 | 1.400 | 0.490 |
| 2 | 1.276 | 0.446 |
| 3 | 1.160 | 0.406 |
| 4 | 1.138 | 0.398 |
| 5 | 1.360 | 0.476 |
| 6 | 1.142 | 0.400 |
| 7 | 1.125 | 0.394 |
| 8 | 0.968 | 0.339 |
| 9 | 1.013 | 0.355 |

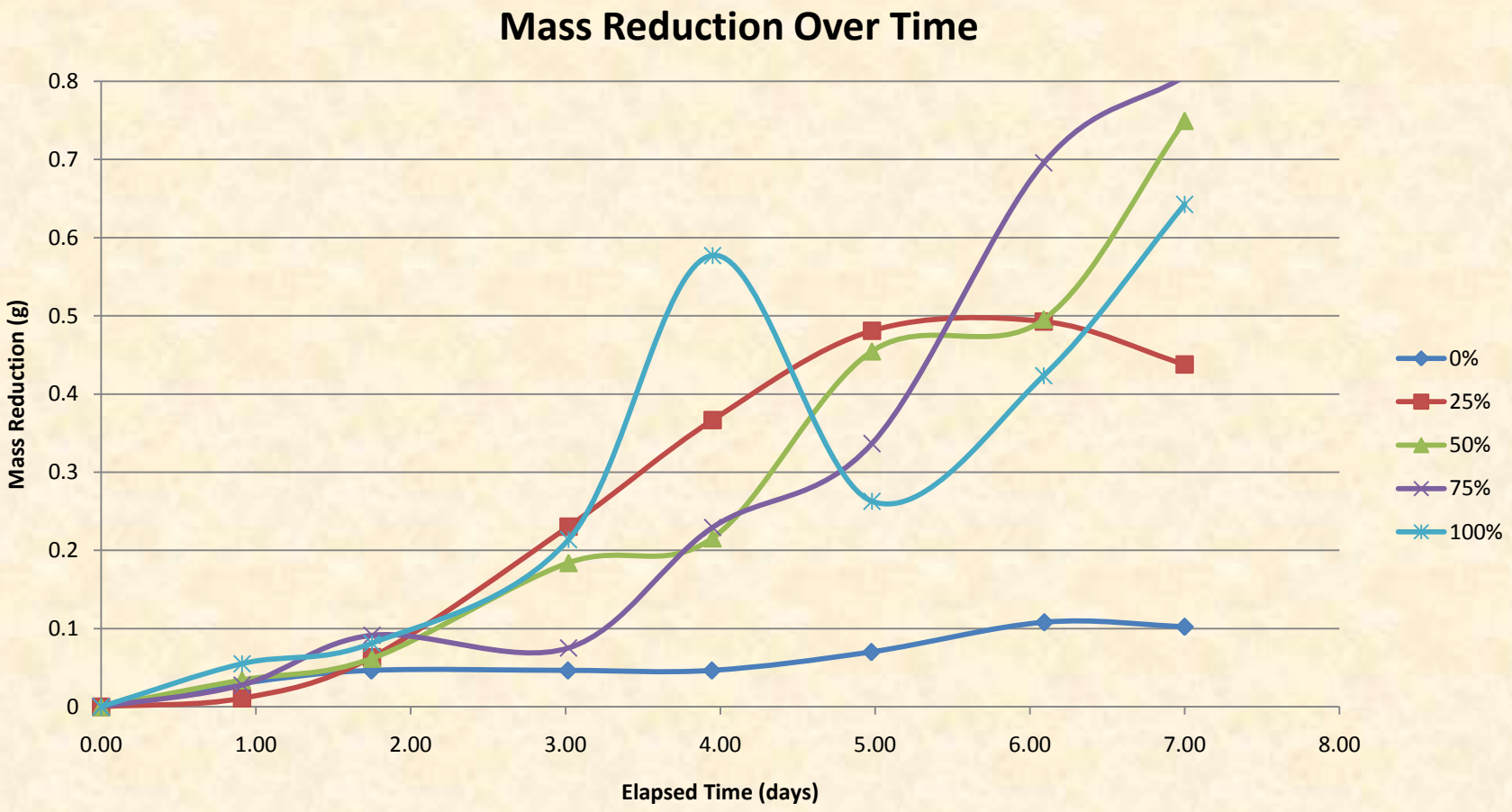
Average : 1.176 g COD/ g paper

**0.412 L methane/ g paper**

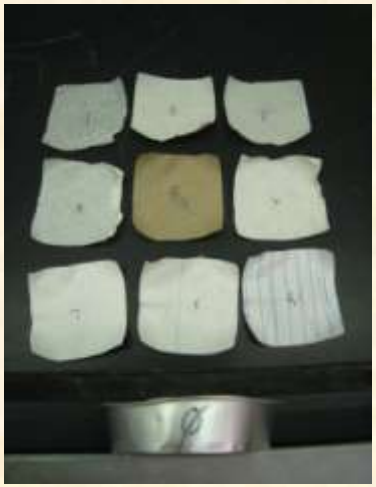
# Rate of Reduction Experiment



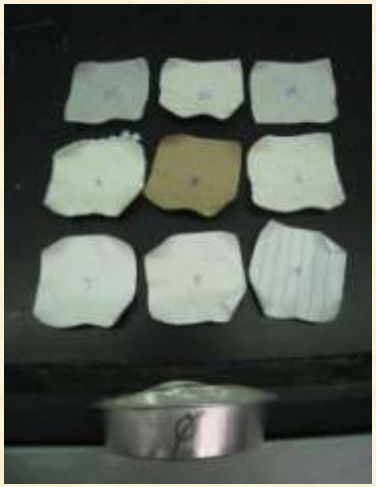
# Rate of Reduction Experiment



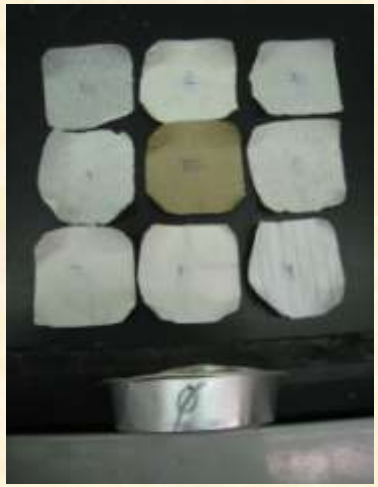
# 0%



Day 1



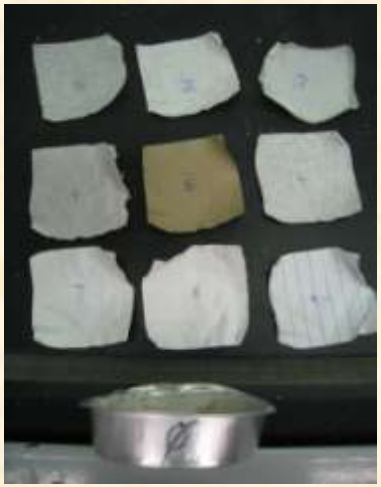
Day 2



Day 3

Day 4

Day 5



Day 6

Day 7

# 25%


Day 1


Day 2


Day 3

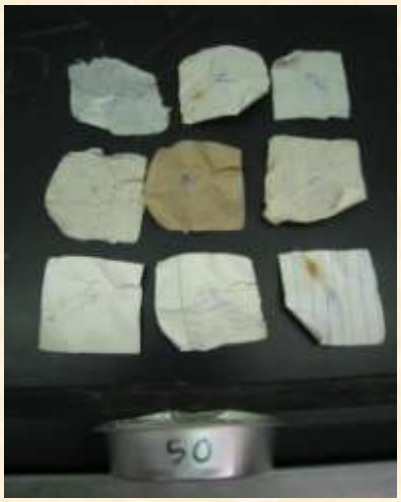
Day 4


Day 6


Day 5

Day 7

# 50%




Day 1


Day 2


Day3


Day 4


Day 5


Day 6


Day 7

# 75%


Day 1


Day 2


Day 3


Day 4


Day 5


Day 6


Day 7

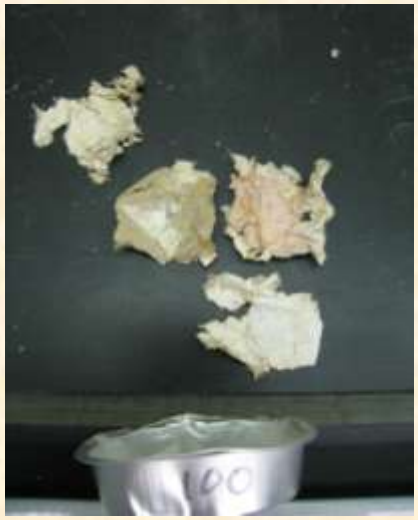
# 100%


Day 1


Day 2


Day 3


Day 4




Day 5


Day 6


Day 7

# Summary

- Waxy milk cartons and mixed papers are digestible
- Average of 0.412 L methane/ g  mixed paper
- 0.0137g/day reduction by water only; 0.0806g/day by 25% effluent
- Effluent pretreatment is more effective at mass reduction than hydropulping
- Mixing is necessary

# Future Studies

- Gas Analysis on small scale digester over time
- Repeat Rate of Reduction Experiment with constant mixing
- Pilot scale pretreatment demonstrations

# Questions/Comments

Thank you