Impact of Various Artificial Substrata on Filamentous Algae Entrapment and Growth

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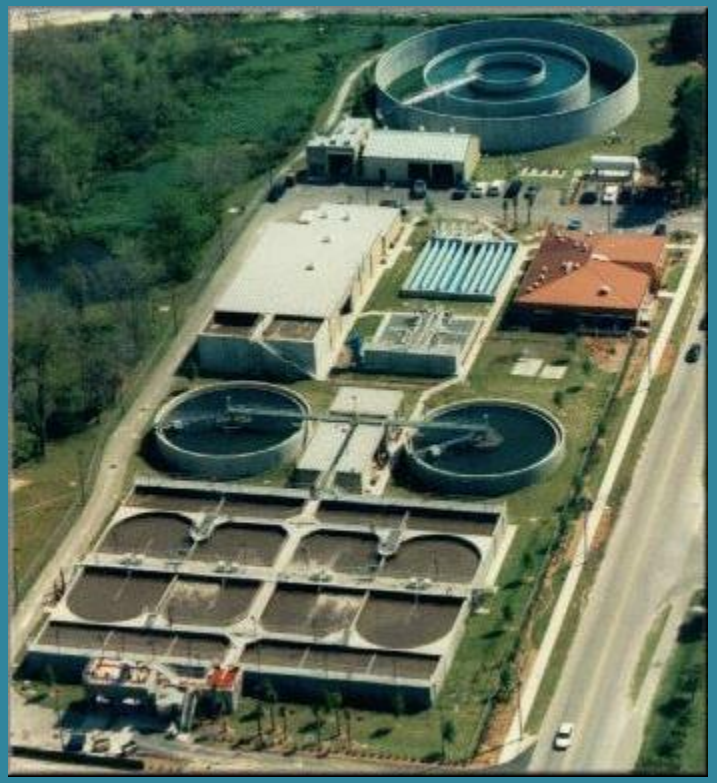
2012 BioEnergy and Sustainability School

August 7, 2012

Introduction

- What is our current wastewater treatment method?
- Benefits of using algae for bioremediation.
- Benefits of using filamentous algae over microalgae.



The University of Florida Water Reclamation Facility (retrieved from http://www.ufwrf.com/)

Hypothesis

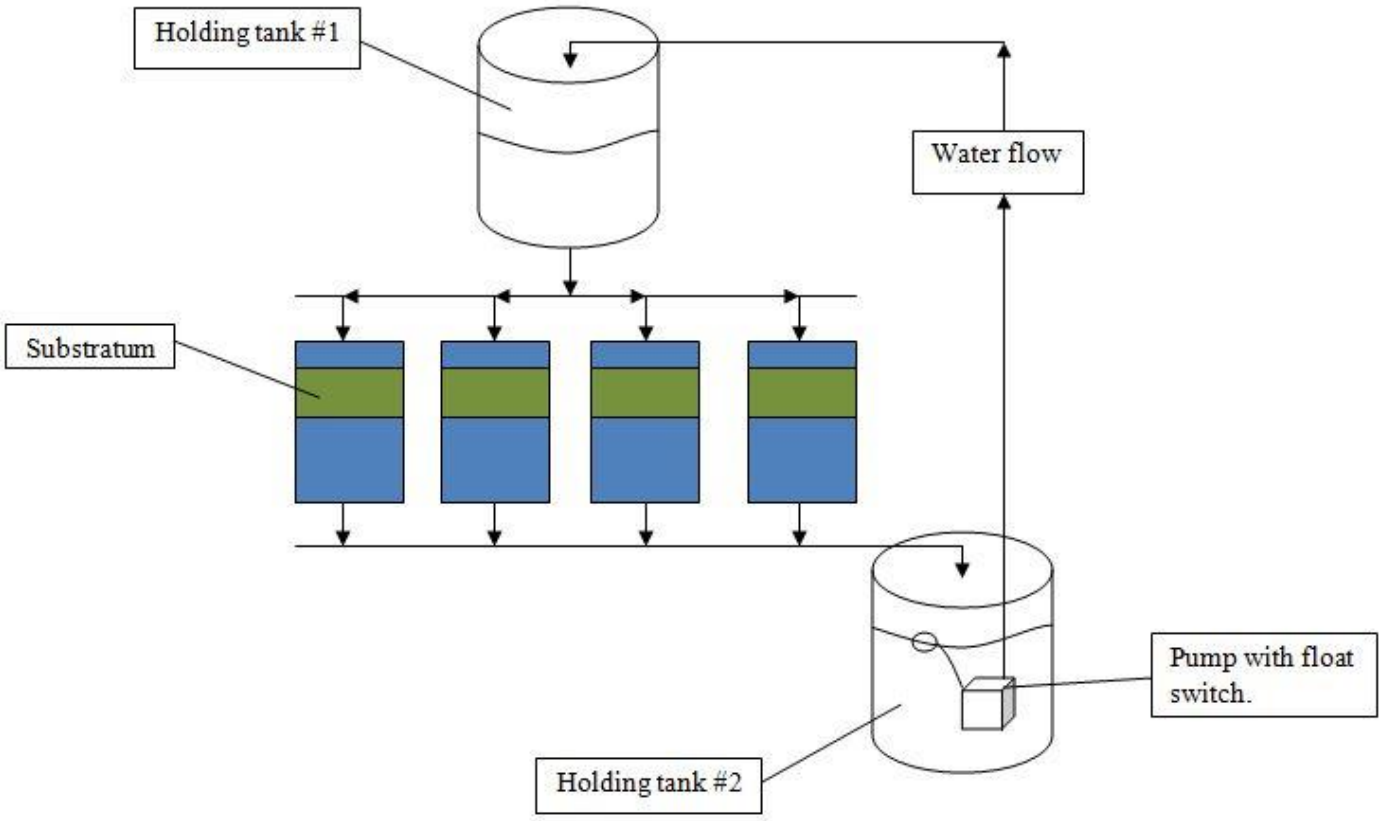
If filamentous algae can utilize a substratum to subsist and grow, then different types of substrata will foster varying amounts of algae entrapment and growth.

Objectives

1. Construct a algae cultivation apparatus in which to entrap and grow filamentous algae, and to facilitate various algae cultivation experiments.
2. Test a wide array of possible substratum types.
3. Assess which substrata exhibit the greatest amount of algae entrapment and growth.

Materials/Methods

Algae growing apparatus



Materials/Methods

- 125 liter system, flow rate of 0.65 liters/sec
- Lights operate on a 12 hour cycle, 7:00-19:00
- Trials run on 5 day intervals
- Algae dried till constant mass.

Materials/Methods

- Initial polyculture inoculum:
  - 30g *Cladophora sp.*, blended (from Northside park in Gainesville, FL)
  - 30g *Pithophora sp.*, blended (from Northside park in Gainesville, FL)
  - 30g *Rhizoclonium sp.*, blended (from the University of Florida Water Reclamation Facility)

Materials/Methods

- 50% N-8 medium

Macronutrient	**Needed**	**Used**	**Substitute**
KNO_3	500 (mg/L)	62.5g	
KH_2PO_4	370 (mg/L)	46.25g	
$Na_2HPO_4 \cdot 2H_2O$	130 (mg/L)	16.25g	
$CaCl_2 \cdot 2H_2O$	6.5 (mg/L)	0.8125g	
Fe EDTA	5 (mg/L)	0.625g	Na EDTA
$MgSO_4 \cdot 7H_2O$	25 (mg/L)	3.125g	
Micronutrients	0.5 (mL/L)	62.5mL	
Micronutrients			
$Al_2(SO_4)_3 \cdot 18H_2O$	1.79 (g/L)	0.111g	
$MnCl_2 \cdot 4H_2O$	6.49 (g/L)	0.406g	
$CuSO_4 \cdot 5H_2O$	0.915 (g/L)	0.0572g	
$ZnSO_4 \cdot 7H_2O$	1.6 (g/L)	0.1g	

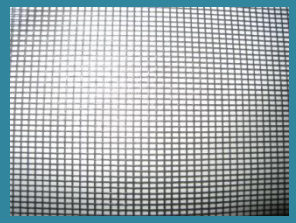
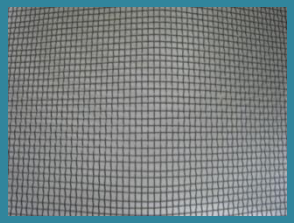
Materials/Methods

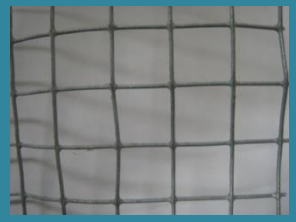
System parameters:

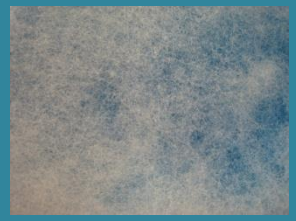
- pH: 6.41 - 6.70
- Conductivity: 3.92 - 4.19 mS/cm
- Irradiance: 58 - 71 µmol photons • m^{-2} • s^{-1}

Materials/Methods: Substrata

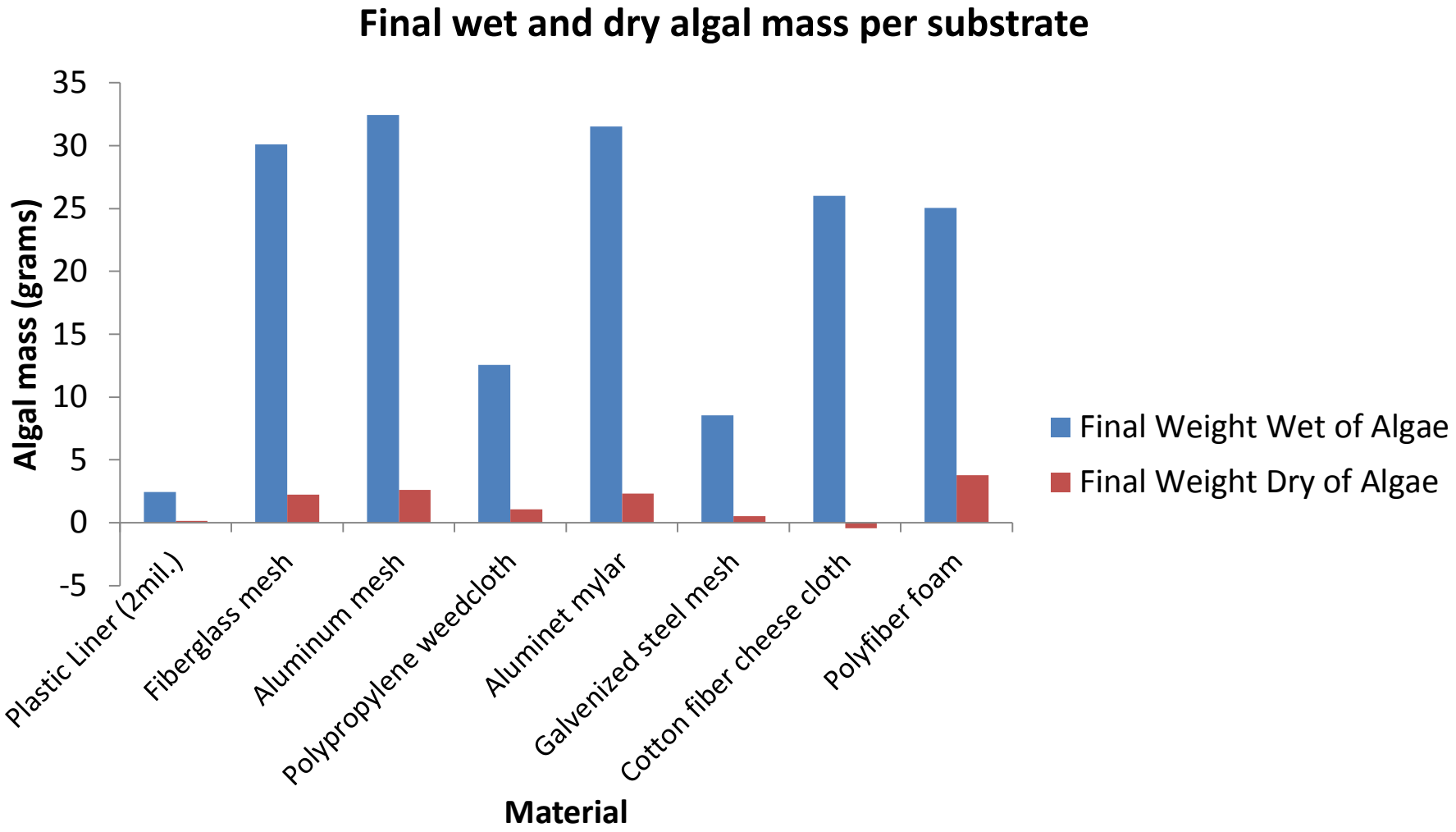
- Plastic Liner (2mil.)
- Fiberglass mesh (1mm×1mm)
- Aluminum mesh (1mm×1mm)
- Polypropylene weed cloth
- ‘Aluminet’ Mylar
- Galvanized steel mesh (1.5cm ×1.5cm)
- Cotton fiber cheesecloth
- Polyfiber foam (3.81 cm depth)

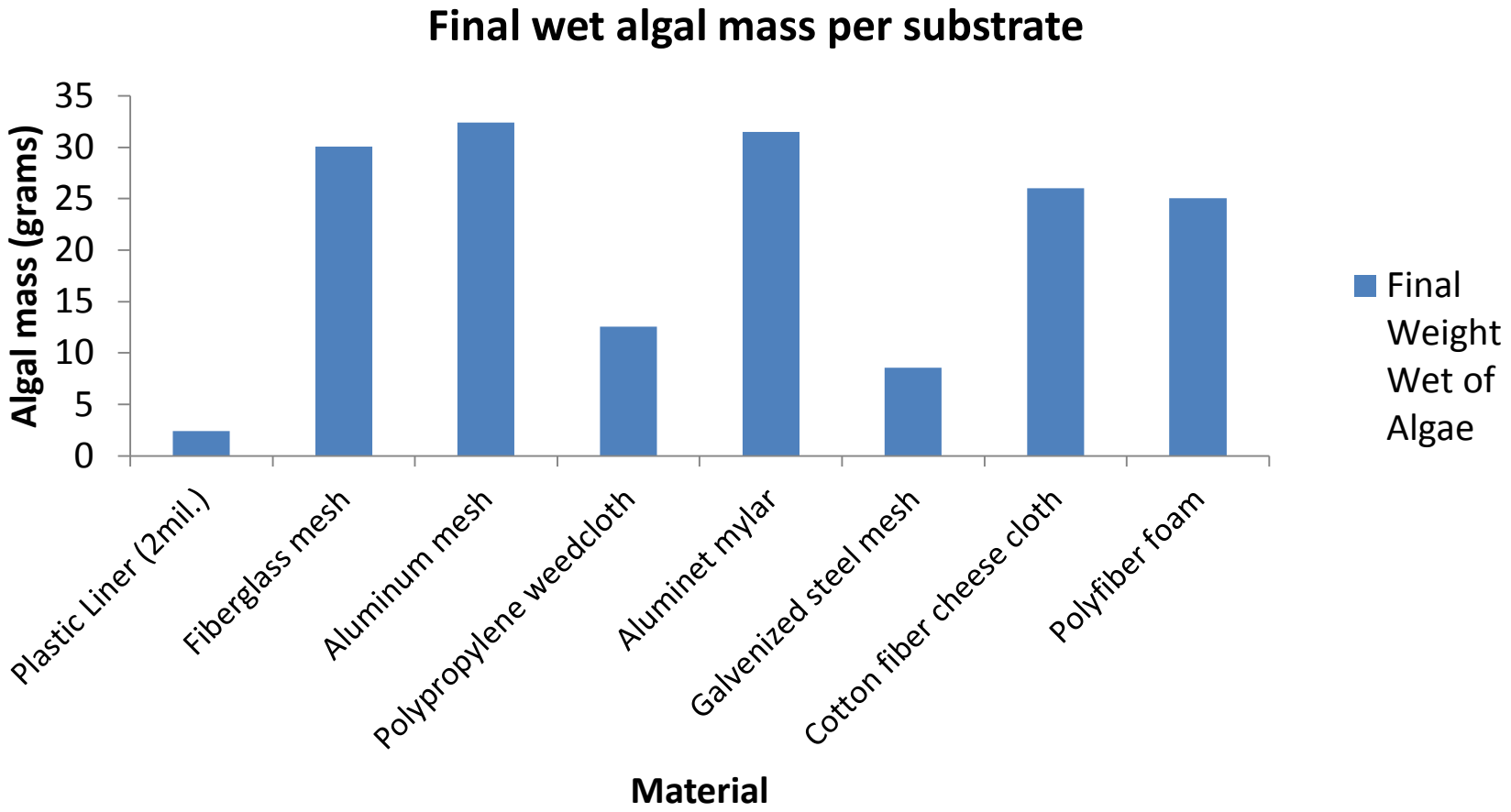





Results


Final wet and dry algal mass per substrate
Algal mass (grams)
35
30
25
20
15
10
5
0
-5
Plastic Liner (2mil.)
Fiberglass mesh
Aluminum mesh
Polypropylene weedcloth
Aluminet mylar
Galvenized steel mesh
Cotton fiber cheese cloth
Polyfiber foam
Material
Final Weight Wet of Algae
Final Weight Dry of Algae

Results


Final wet algal mass per substrate
Algal mass (grams)
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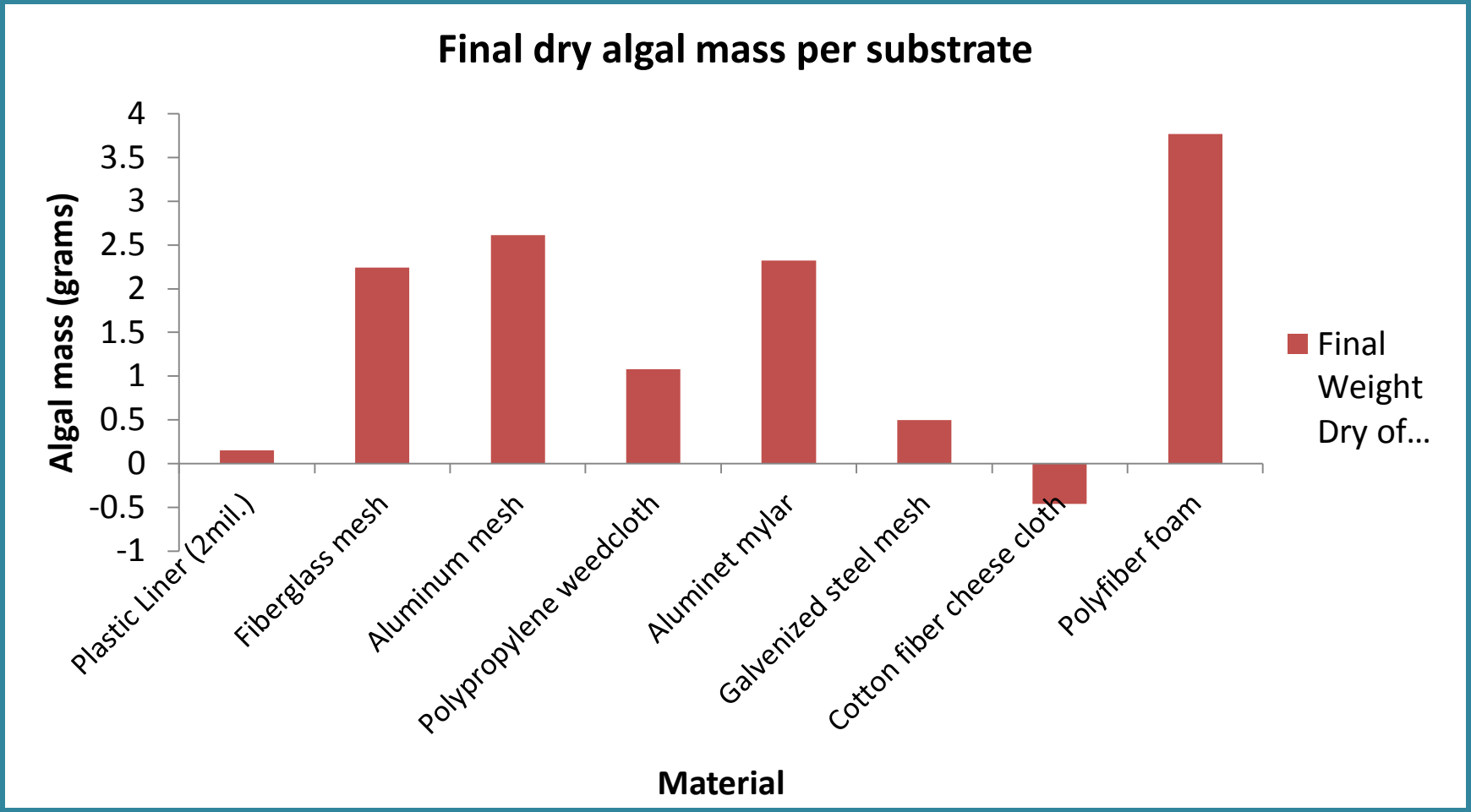
Plastic Liner (2mil.)
Fiberglass mesh
Aluminum mesh
Polypropylene weedcloth
Aluminet mylar
Galvenized steel mesh
Cotton fiber cheese cloth
Polyfiber foam
Material
Final Weight Wet of Algae

Results


Final dry algal mass per substrate
Algal mass (grams)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
Plastic Liner (2mil.)
Fiberglass mesh
Aluminum mesh
Polypropylene weedcloth
Aluminet mylar
Galvenized steel mesh
Cotton fiber cheese cloth
Polyfiber foam
Material
Final Weight Dry of…

Results: Substrata

Plastic Liner (2 mil.)

Fiberglass mesh (1mm×1mm)

Results: Substrata

Aluminum mesh (1mm×1mm)

Polypropylene weedcloth

Results: Substrata

Aluminet Mylar

Galvanized steel mesh (1.5cm×1.5cm)

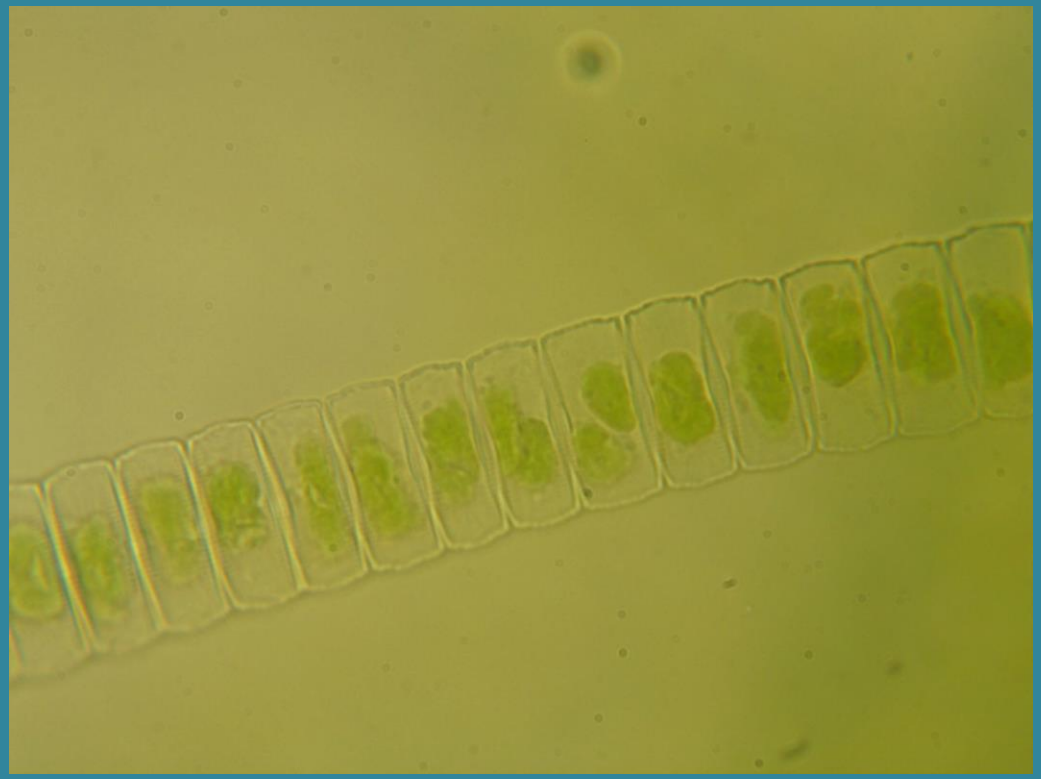
Results: Substrata

Cotton fiber cheesecloth

Polyfiber foam

Rhizoclonium sp. growth after 5 days
300X magnification

Cladophora sp. and *Fragilaria sp.*
300X magnification



Fragilaria sp.
1250X magnification

Conclusion

Unsuccessful substratum:

- Plastic Liner
- Polypropylene weed cloth
- Cotton fiber cheesecloth*
- Galvanized steel mesh

Conclusion

Successful substratum:

- Fiberglass mesh
- Aluminum mesh
- Aluminet Mylar
- Cotton fiber cheesecloth*
  - Possible cellulose degradation
  - Possible advantages in application
- Polyfiber foam
  - Possible harvesting disadvantages

Further Research

- Methods and apparatus shown to be successful.
- Using the same procedures:
  - Further idealize substratum based on surface area and specific material type.

Further Research

- Long-term bioremedial study:
  - Month long time period
  - Using the same system and same N-8 medium.
  - Track long-term algae growth over time.
  - Track nutrient reduction in the water over time.