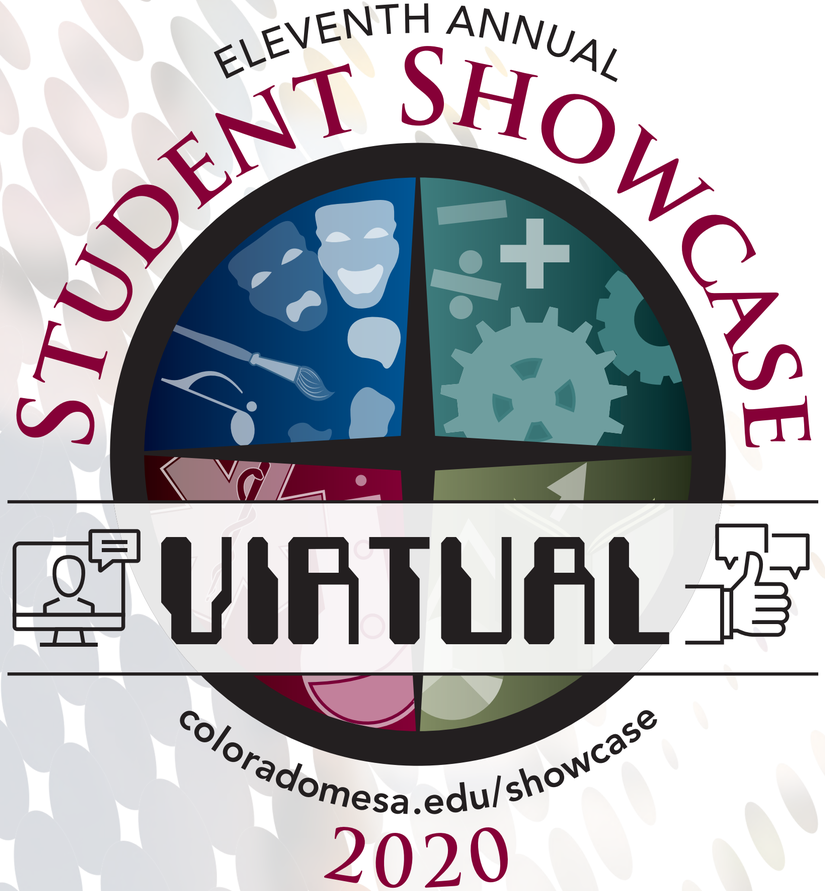

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PROJECT TITLE:

Mycoremediation of Phenol in Mesa County Landfill Leachate

Mycoremediation of Phenol from Mesa County Landfill Leachate

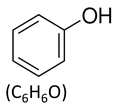
Ana Hinojosa, Jacob Park, Matt Rutkowski, Trevor Smith
CMU, Dept. of Physical and Environmental Sciences

Background

Landfill Leachate

- Precipitation and liquids discarded and percolating through waste, dissolving and mobilizing contaminants.
- Contains high concentrations of heavy metals and organic pollutants.
- Difficult to treat.

Phenol



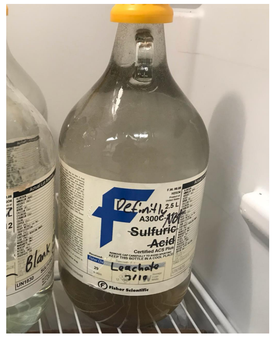
(C_6H_6O)

- Chemical used in production of plastics, resins, and paper.
- Often a contaminate in leachate.
- Hazardous and difficult to remove.
- Most wastewater treatment plants unable to treat or remove it.
- Several methods used to remove phenol from leachate.
  - Require extensive energy and/or hazardous chemicals.

Mycoremediation

- Emerging field, fungi to break down molecules for remediation.
- Mycelium absorbs nutrients and breaks down organic matter.
  - Appears as white, thread-like network under a microscope.
- Oyster mushrooms have demonstrated ability to remove phenol.
- Has not been tested to remove phenol in leachate.


Mycelium-straw mixture used in expiriment



Collection jug with raw leachate

Acknowledgements

- Leachate collected courtesy of Ryan Kyle.
- Mycelium donated by David Glenn from South River Aquaponics.
- CMU professors Dr. Witarsa, Scott Kalbach, and Dr. Becktell made this experiment possible.

Goal

To determine the ability of mycelium to remediate phenol from landfill leachate.

Objectives

1) Determine the chemical composition of the Mesa County landfill leachate and identify any present contaminants.
2) Assess the ability of oyster mushroom mycelium to remove phenol.
3) Effectively resolve if the leachate hinders mycelium growth.
4) Develop plans for field applications using mycoremediation as a basis for phenol removal.
5) Determine the implications of our study for the Mesa County landfill.

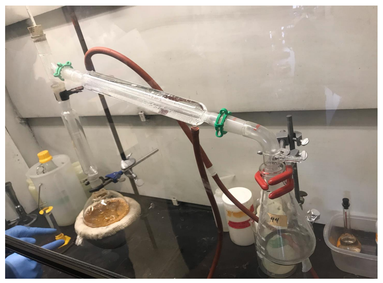
Methods

Experimental Design

Table 1: Composition of experiment trials.

Treatment	Mycelium (g)	Solution	Phenol (ppm)	Glucose (g)
Mycelium (aq)	1.5	Water	0	0.4
Mycelium + phenol	1.5	Water	40	0.4
Mycelium+ Leachate	1.5	Leachate	~32	0.4
Leachate	0	Leachate	~32	0.4

- Three replicates per treatment.
- Stored in 250mL flask.
- Sealed with parafilm
- Incubated at ~27 °C for 30 days.
- Monitored and agitated via swirling once every 48 – 72 hours.
- Preserved at pH < 2.0 with sulfuric acid.


Distillation glassware in chemistry hood


Mycelium and leachate samples in incubator

Leachate Distillation

- 500 mL of leachate distilled to isolate phenol
  - Heating mantle and Graham condenser
- Color indicator added
- Dilution of distillate within calibration curve.
- Absorbance measured and compared to calibration curve.

Phenol Calibration Curve

- Determine background concentrations of leachate with
  - Known concentrations of phenol
  - Color indicator
  - Spectrophotometer

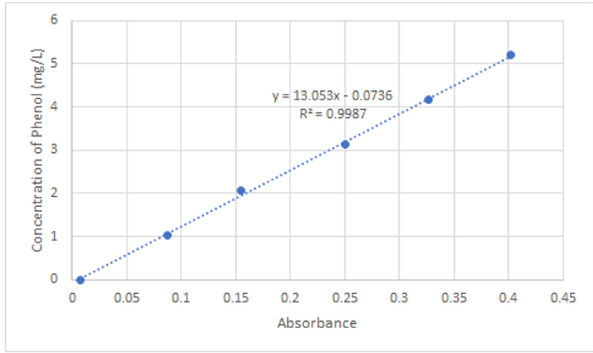
Future Steps

1) Perform distillations of the trials
2) Determine phenol concentrations using previous methods
3) Statistically analyze the data (ANOVA)
4) Determine if results support that mycoremediation of phenol was successful
5) Develop plans for field applications and possible further research
6) Discuss the implications of our study in reference to the Mesa County landfill

Preliminary Results

Phenol Concentration

- Calibration curve is highly significant (R^2 > .99).
- Total concentration of phenol present in the leachate was determined to be 32 mg/L.



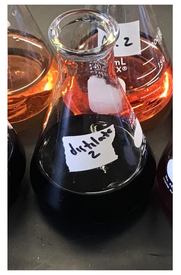
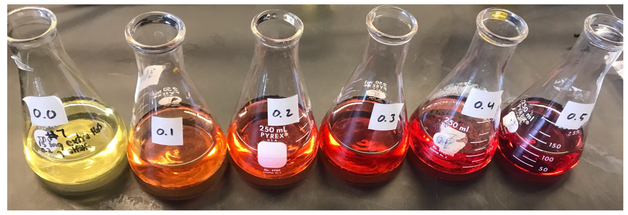

Distilled leachate with phenol color indicator

Figure 1. The standard curve for phenol absorbance at 500 nm.



Known concentrations of phenol with color indicator used to create the calibration curve

pH and Biomass

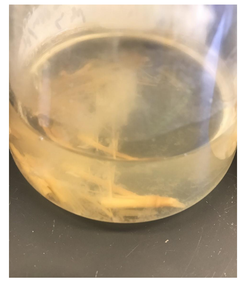
- Drop in pH across all samples, due to organic acid production
- Mycelium and Mycelium/phenol samples: approximately pH 3 – 4
- Leachate and Mycelium/leachate samples: approximately. pH 5
- Total mycelium biomass was relatively higher without the additions of leachate or phenol
- Biomass is notably not a viable indicator for mycoremediation

Table 2: Measured pH and qualitative biomass per treatment type following 30 day incubation with mycelium.

Treatment	pH (± std. error)	Biomass (% total)
Mycelium (aq)	3.80 ± 0.84	25%
Mycelium + phenol	3.46 ± 0.19	15%
Mycelium + Leachate	5.18 ±0.58	5%
Leachate	5.29 ± 0.25	n/a

Table 3: Independent samples T-test results for pH of samples following 30 day incubation time with mycelium.

Treatment	Statistic	df	p
Mycelium (aq) & Mycelium + phenol	0.685	4.00	0.531
Mycelium (aq) & Mycelium + Leachate	-2.35	4.00	0.078
Leachate & Mycelium + Leachate	0.283	4.00	0.791


Mycelium biomass and leachate after incubation.