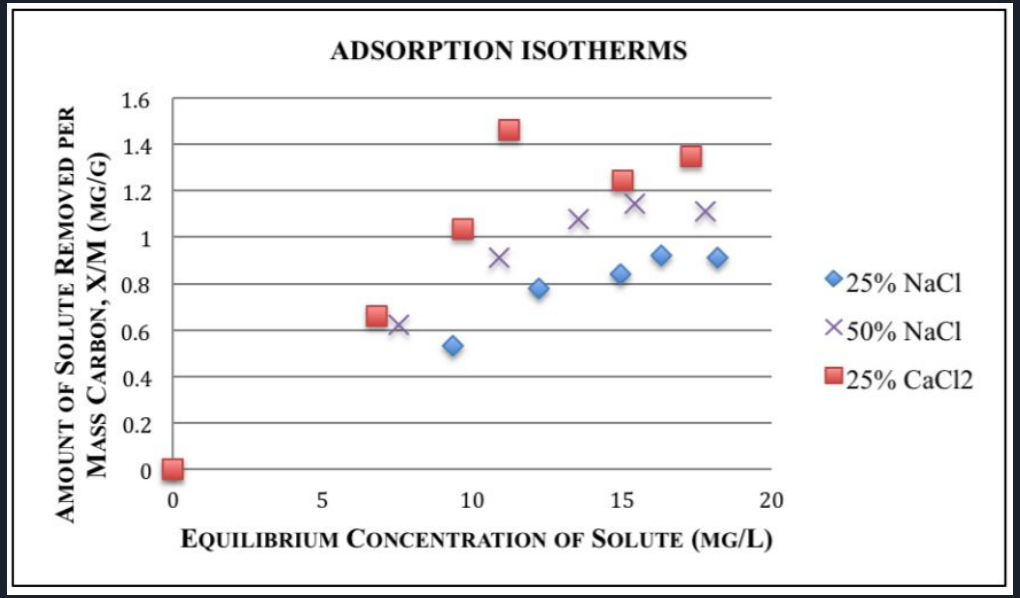
Salinization of Charcoal for Water Filtration

A research project by Daniel Pyrek and Jessie Powell

Background

- Low-Tech Coconut Shell Activated Charcoal Production Paper from Santa Clara University
  - Compared salt treated charcoal
- No data comparing effects to activated charcoal
- Sources with little credibility vouched for this method



Social Relevance

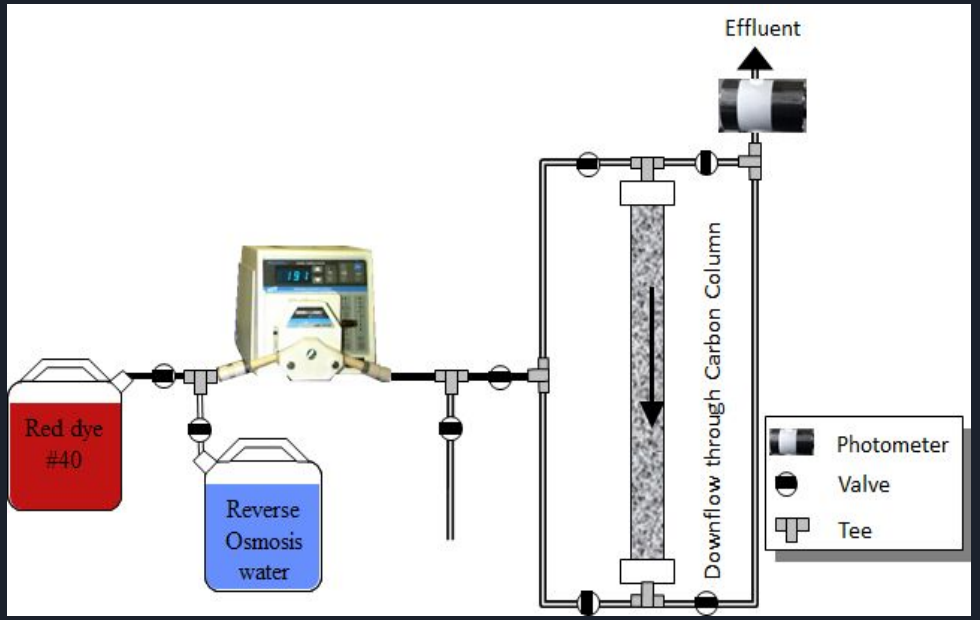
- Developing countries do not have access to centralized wastewater treatment
- Could use agricultural waste byproducts as a carbon source
- Commercial activated carbon can be expensive
- Activated carbon requires pyrolysis of 800 to 1000 Celcius

Objectives and Hypothesis

We expected that the effectiveness of adsorbent (from highest to lowest) would be 1.) activated carbon, 2.) charcoal activated with sodium chloride, 3.) plain charcoal, then 4.) sand.

Apparatus

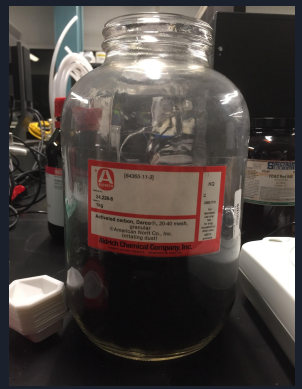
- Tube diameter: 1 in
- Red dye concentration: 0.05 g/L
- Mass of various adsorbent: 30 g
- Flow rate: 10 rpm

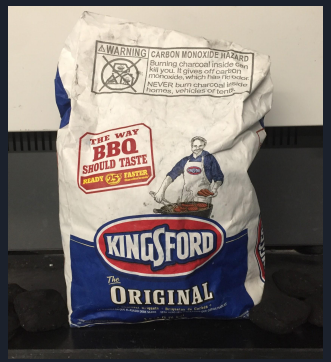


Parameters Tested

Four parameters were tested:

- Sand
- Activated carbon
- Charcoal
- Charcoal soaked in NaCl water for 24 hours





Procedure

To “activate” charcoal:

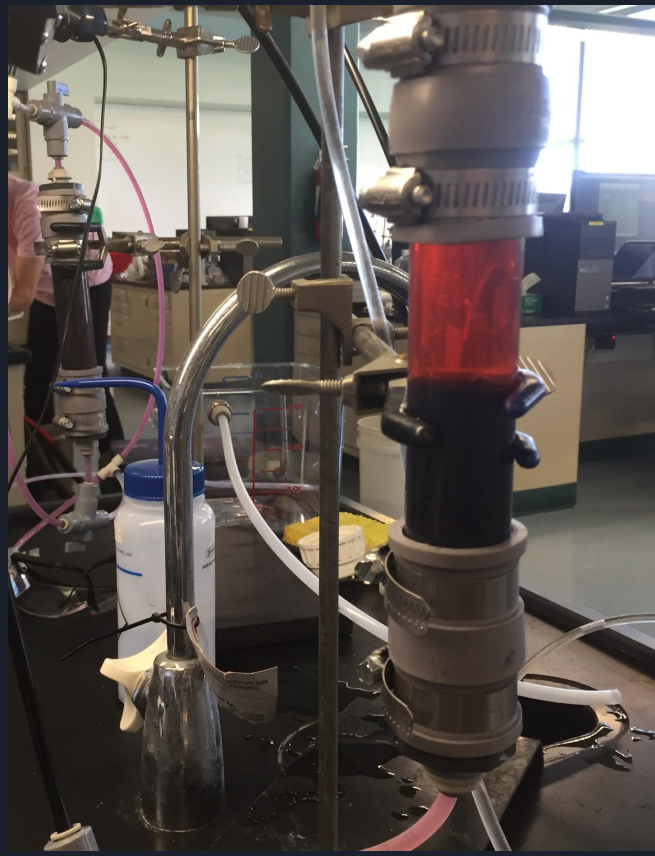
- Bought grilling charcoal briquettes and table salt (99% NaCl)
- Ground the briquettes into semi fine powder
- Soaked powder in a 25% m/v solution of salt water for approximately 24 hours
- Let water evaporate, then put leftovers in apparatus and flowed water through to dissolve remaining salt
- Allowed to dry

Charcoal after being soaked in salt water for 24 hours

Procedure cont'd

For all parameters:

- Measured out 30g of each substance and added to column
- For both charcoal tests, added coffee filter material to both ends of column
- Flowed water from bottom to top of column to remove air bubbles
- Flowed red dye from top to bottom at 10 rpm
- Waited for breakthrough time

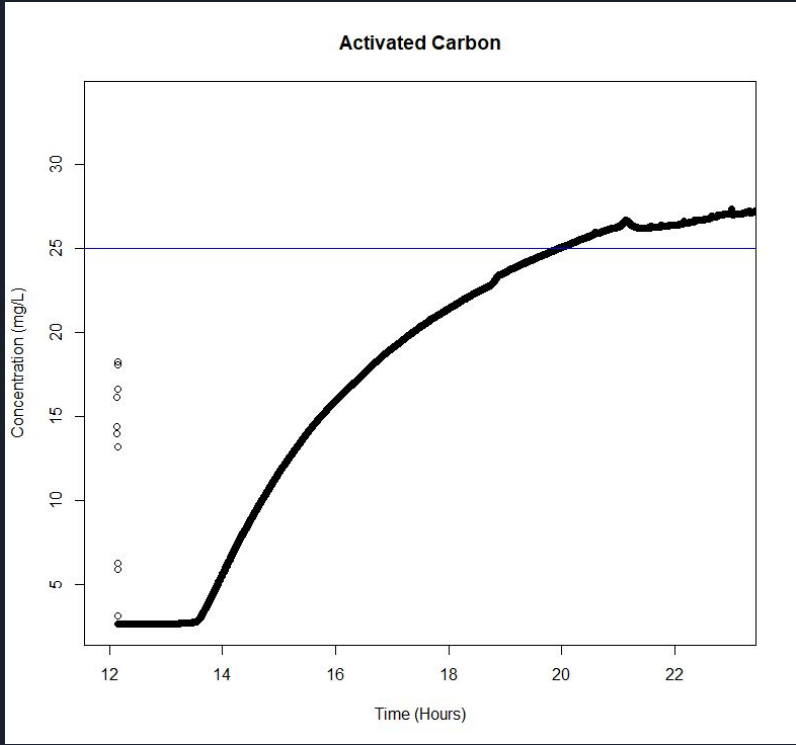


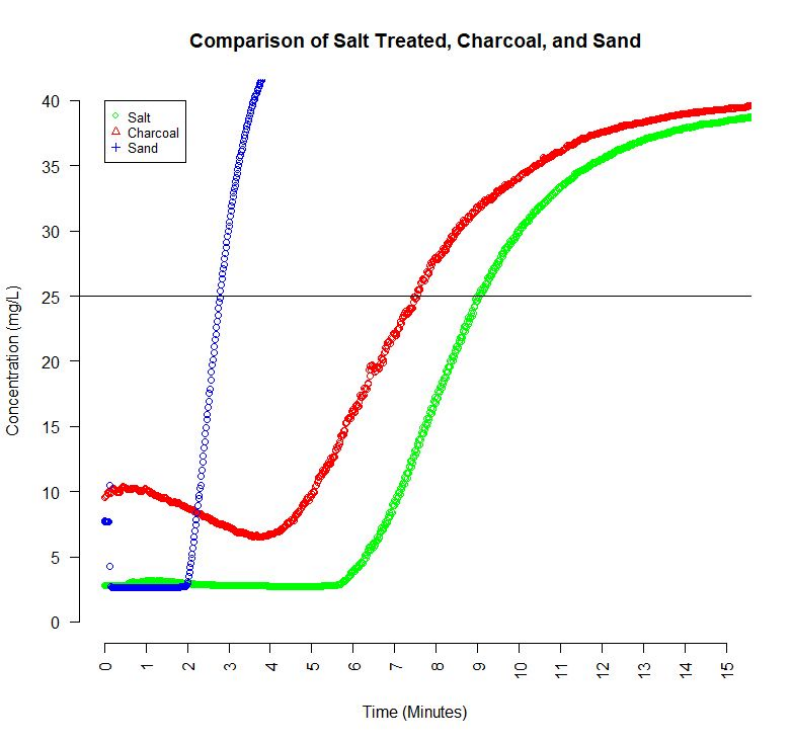
Charcoal filled column with dye

Results

Parameter:	Sand	Charcoal	Salt Treated Charcoal	Commercial Carbon
Breakthrough time:	2.67 min	7.29 min	9.01 min	~ 20 hours

Graphs


Activated Carbon
Concentration (mg/L)
5
10
15
20
25
30
12
14
16
18
20
22
Time (Hours)


Comparison of Salt Treated, Charcoal, and Sand
Salt
Charcoal
Sand
Concentration (mg/L)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Time (Minutes)

Conclusion

Based on the data collected from this experiment, charcoal soaked in NaCl solution, while minimally more absorbent than untreated charcoal, is not a viable option compared to activated carbon for filtering water and acting as a usable adsorbent for affordable and efficient water treatment.

Setbacks

- The charcoal was too fine for the standard column filter
- It was unknown whether the charcoal had to be soaked in 25% solution M/V or M/M
- There was a significant amount of salt left, and it was difficult to remove all of it

NaCl and charcoal after evaporation

Changes

- We added an extra filter, a coffee filter, to the column in order to prevent charcoal from leaving
- Out of convenience, we chose to do a M/V solution
- We ran the salt soaked charcoal through the column in order to remove the NaCl

Future Recommendations

For future replications of this experiment, we recommend:

- Test with different types of salts
- Bake or cook the charcoal after soaking it
- Due to high pressure in the column because of the filters, make sure clamps on ends are tight and secure
- Perform multiple tests on charcoal parameters to better discern differences between substances

Thank you