Absorption rates of rye grass with lead using titration techniques, FTIR data, and MP-AES

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ABSTRACT: The purpose of this research was to determine if rye grass seed is a good biosorbent using titration techniques, FTIR data, and MP-AES. The absorption was tested by subjecting the shoots of the rye grass samples to 10 ml of 300 ppm $Pb(NO_3)_2$. The trial was conducted to determine how much the rye grass could absorb and a second trial was run to replicate the data. Although the sample absorbed about 250 ppm of lead the volume and mass need to be considered using q values. The q values ended up being low compared to other biosorbents. This opens the path to determine what functional groups rye grass does not have that a good biosorbent such as cilantro has. With this information further research could be done to mutate rye grass to become a good biosorbent. With rye grass being inexpensive and efficient it could be the key to lowering the growing amounts of toxins in the environment and become a reliable way to collect pollutants.

INTRODUCTION

Environmental pollutants have become an increasing dilemma and can be considered as one of humanities greatest rising problems (Muralikrishna & Manickam, 2017). Pollution unfortunately is all around us and its tiny particles are contaminating the air to a point where "…7 million people die…" each year from its dangerous effects. These particles cause lung and cardiovascular issues that lead to "…stroke, heart disease, lung cancer, chronic obstructive pulmonary diseases and respiratory infections…" (World Health Organization, 2018).

Engineers and scientists have spent countless hours trying to invent something that would clean up toxins and pollutants. The globe spends about "$4.6 trillion" dollars annually trying to take care of pollutants (Cohen, 2017). Plants already do this to a certain extent, through phytoremediation. With the amount of toxins going into the environment increasing rapidly, there is a need for an inexpensive, efficient, and reliable way to collect pollutants. It is hypothesized that plants can be mutated by using radiation to collect these environmental hazards.

METHODS

After growing the grass, the shoots were cut and put into the freeze drier. Once dried the sample was grinded into two sizes 0.25 mm and 0.063 mm. 20 mg of each sample size was placed into a centrifuge tube with 10 mL of 300 ppm Pb. This was then centrifuged at 300 rpms for an hour to allow the grass to absorb the lead. After this the samples were centrifuged for 3 minutes at 3000 rpms. The solution was then filtered off leaving the solvent in the tubes. Once this was done the amount of lead in the solution was detected using 4200-microwave plasma-atomic emission spectroscopy (MP-AES) System to find how much the grass did not absorb.

After finding the absorption data the FTIR was used to determine functional groups. In order to get more specific functional groups titrations were used. Starting with 0.2 g of the sample in 200 mL of boiling water the first titration began with 0.1 M NaOH until the pH was 11.5. Then 0.1 M HCl was added until it reached a pH of 2.5. Lastly 0.1 M of NaOH was added to reach the 11.5 pH again. Then the sample was vacuum filtered and an IR was taken once it dried. The graph of the last titration can be used to determine specific functional groups.

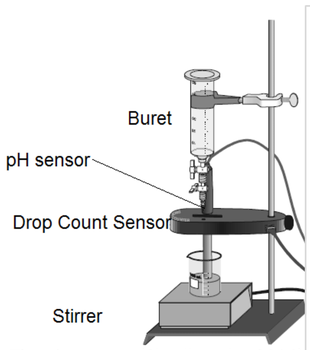

Rye grass before cutting shoots

RESULTS/DISCUSSION

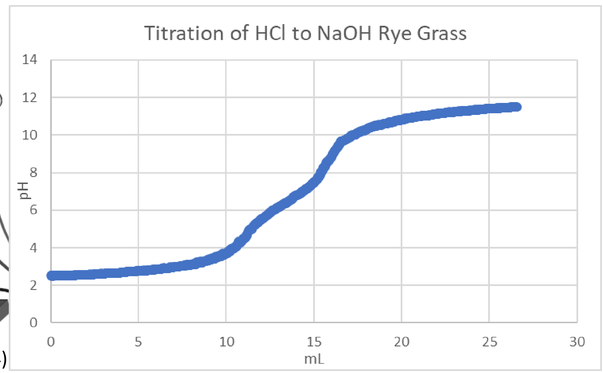
After determining how much lead was remaining in the tube the rye grass ended up absorbing about 250 ppm of lead. Although this seems good the volume of solution and weight of sample needs to be taken into consideration. That is where the q values in the table below come in. When analyzing the q values they are low compared to a good absorbent like cilantro which has a q value in closer to a hundred. This allows for further experimentation on comparing IR data to that of other biosorbents, this with the functional groups will determine what rye grass could be missing that would make absorb lead and other pollutants more reliably.

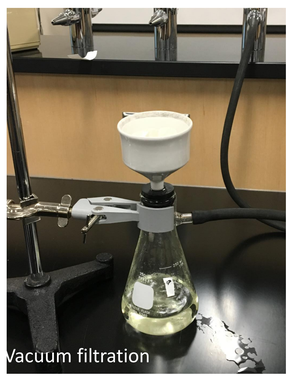
Data of Absorption Run One			
Sample (mm)	Lead (ppm)	Mass (g)	q (L*ppm/g)
1 0.063	56.7427	0.2053	11.8489
2 0.063	66.6077	0.2059	11.3352
3 0.063	52.508	0.2034	12.1677
1 0.25	51.0313	0.2024	12.3008
2 0.25	51.9011	0.2014	12.3187
3 0.25	51.5535	0.2062	12.0488

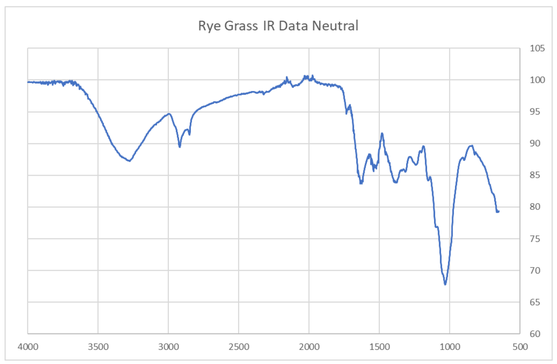
Data of Absorption Run Two			
Sample (mm)	Lead (ppm)	Mass (g)	q (L*ppm/g)
1 0.063	42.1681	0.2138	12.0595
2 0.063	40.7586	0.2156	12.0242
3 0.063	43.9532	0.2134	11.9984
1 0.25	38.4268	0.2244	11.6566
2 0.25	38.1335	0.2054	12.7491
3 0.25	36.8035	0.2158	12.1963

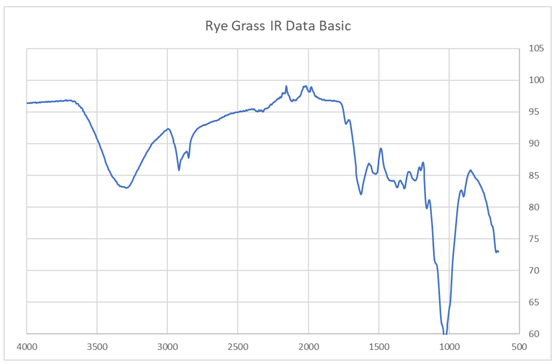


Titration setup (Shudhanshu,2014)




Vacuum filtration

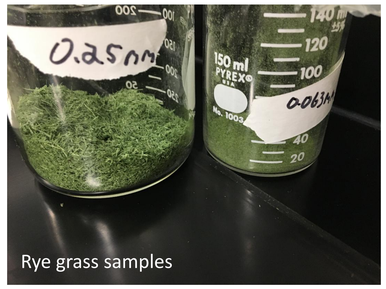




FURTHER RESEARCH

Future research would involve determining functional groups that a good biosorbent like cilantro has and seeing how it differs from rye grass. At this point tests could be developed to mutate the rye grass to contain these functional groups. Also the roots could be tested for absorbency since current experimentation was just done on the shoots.

Allowing samples to absorb for longer then a hour could also change how much the rye grass absorbs. Although this could increase the amount slightly it should not make a significant change. The small change could help but looking into the functional groups seems more promising.



Rye grass samples

CONCLUSIONS

Phytoremediation has the chance to make a prominent impact on discovering alternatives for cleaning up pollution. There is a need for an inexpensive, efficient, and reliable way to collect pollutants to start decreasing the toxins in the environment. The trials conducted provide an insight on how good of a bio-absorbent rye grass is. Although its absorption is low further research could develop rye grass into a solution to pollution.

The idea is that a super plant could be mutated to be used routinely, but for chemical spills and waste sites as well. With additional research this concept could turn into a quick, viable, reliable and environmentally friendly way to improve and save the environment.

REFERENCES

***Selected* references – the complete list in the accompanying report.**

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