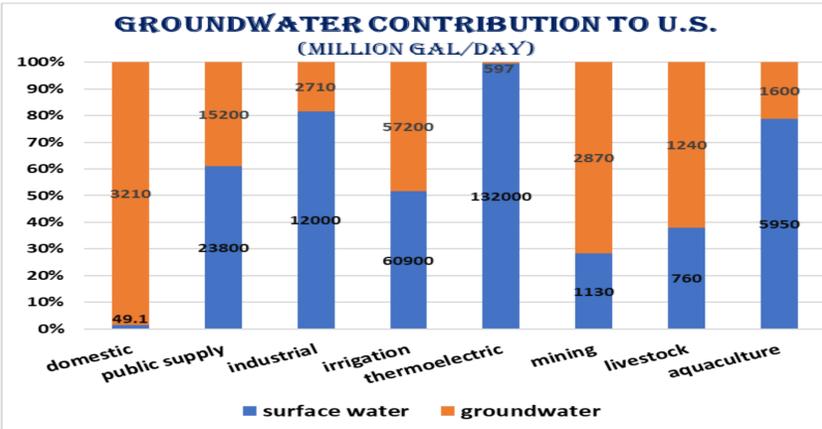


INTRODUCTION

Groundwater (GW) composes almost half of all drinking water worldwide and is crucial for the sustainability of ecosystems ¹



Aesthetic & Operational Concerns of Elevated Manganese Concentrations

- Manganese (Mn) naturally co exists with iron (Fe) in GW
- Presence of Mn in drinking water can stain laundry, cause scaling on plumbing, odor and makes water look, smell, or taste bad.

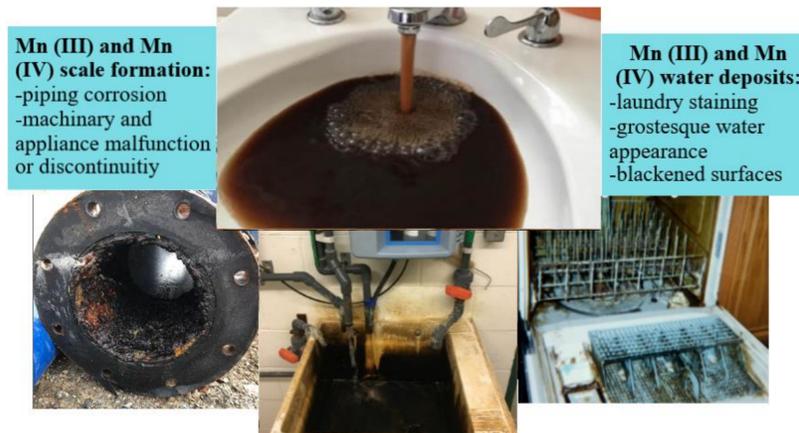


Figure 2. Aesthetic Mn in GW tribulations depiction.

Health Concerns of Elevated Manganese Concentrations

- Although Mn is an essential nutrient for human health, high concentrations can lead to neurotoxins
- Several epidemiological studies specifically addressed neurotoxic effects of Mn in young children

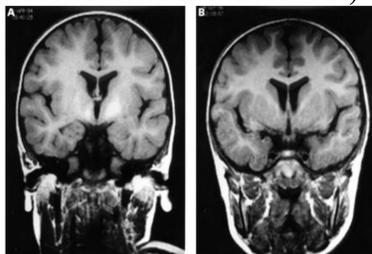
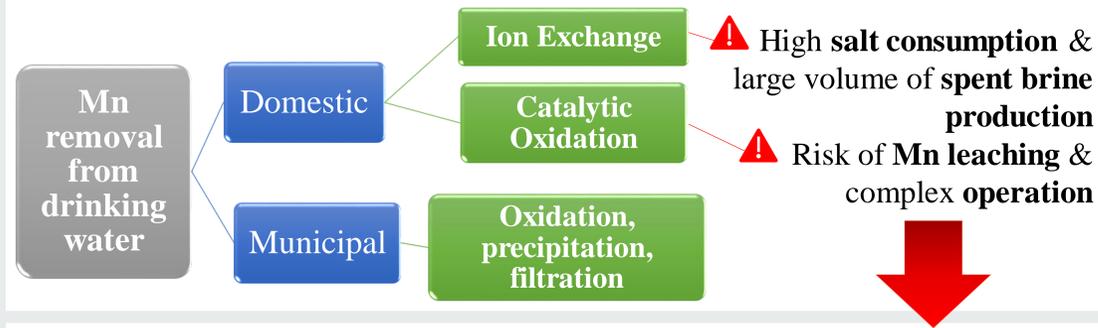


Figure 3. (A) Abnormal high signal in globus pallidus.(B) Regression of abnormal signal after reduced manganese supplementation. Retrieved from Kafrista et al., (1998)

Maria Soto, Maryam Haddad PhD

Department of Chemical Engineering

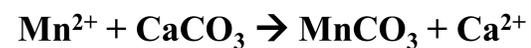
Current Water Treatment for Mn Removal



OBJECTIVE

To design a green and efficient layered calcium carbonate column as a simple and reliable treatment method for Manganese removal and remineralization of groundwater.

METHODS



Operation Conditions:

Room temperature



Up flow packed bed column

Feed: synthetic solutions with different Mn concentration and hardness levels

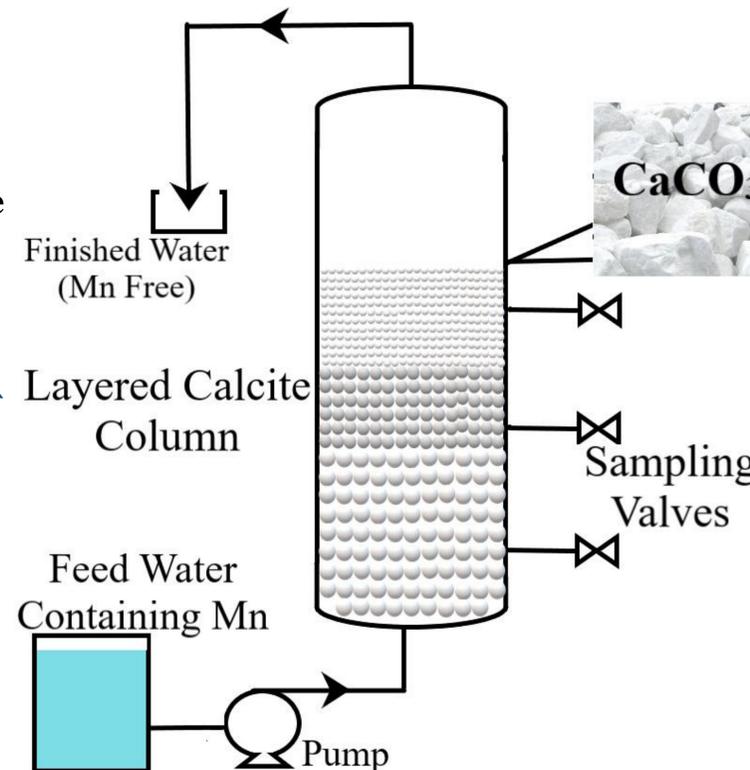


Figure 4. Schematic Design of Calcite Contactor Column

ANALYTICAL MEASUREMENTS

Frequent water sampling for analysis of:

- Mn by Hach test method
- Hardness by titration
- Alkalinity by measuring bicarbonate (HCO_3^-) content



OPTICAL MEASUREMENTS

Frequent Media sampling for examination of:

- Scanning Electron Microscope (SEM): study the structure of the coated Mn layer on calcite surface
- Energy Dispersive X-ray Analysis (EDX): determine Mn coating progression on calcite media with different particle size

FUTURE WORK

- Study impact of initial Mn concentration on performance of Mn removal via layered calcite column
- Investigate role of the calcite particle size on efficacy of Mn removal process
- Determine the effort of GW hardness level on Mn removal via layered calcite contactor
- Calculate the overall energy consumption of the Mn removal process

REFERENCES

- United States Geological Survey. (2017). Total Water Use in the United States.
- Agency for Toxic Substances and Disease Registry. (2019). Toxicological Profile for Manganese.
- Hamed Pourahmad, et al. (2019). Impact of media coating on simultaneous manganese removal and remineralization of soft water via calcite contactor. Water Research.
- John E. Tobiasson, et al. (2016). Manganese Removal from Drinking Water Sources. Water Pollution.

ACKNOWLEDGEMENTS

This research was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Numbers; UL1GM118979; TL4GM118980; RL5GM118978. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.