Hardness removal from LRGV tap water using Graphite-Concrete Electrodes

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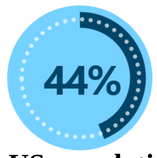
INTRODUCTION

- Water exceeding 100 mg/l as $CaCO_3$ is unpleasant to drink.
- Scaling in industrial and domestic water pipes.
- Novel Electrochemical process to remove (Ca^{+2}) and (Mg^{+2}) from extremely hard water like (LRGV) tap water.

WATER HARDNESS PROBLEM in LRGV

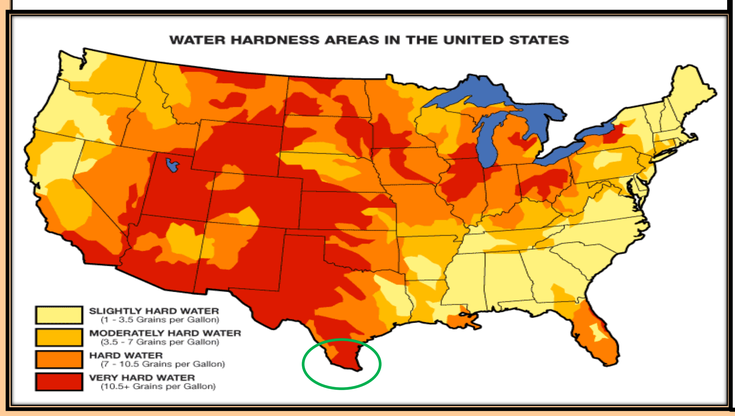


US population dependent on Ground water

20% of total withdrawal nationwide, is

85% boilers have hardwater supply

Existing Methods	Cons
• Chemical • Ion Exchange • Reverse Osmosis • Electrodialysis • Nano filtration • Crystallization • Distillation • Evaporation	**Costly** **Heavy Chemical Usage** **Post Processing** **Sludge**



ELECTROCHEMICAL PRECIPITATION

• Cathodic Reactions:

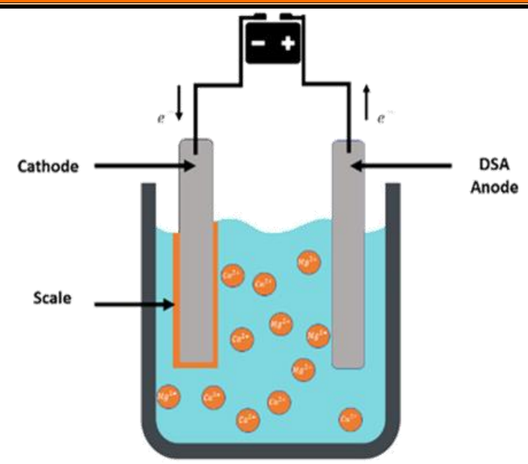
$O_2 + 2H_2O + 4e^- \rightarrow 4OH$

$2H_2O + 2e^- \rightarrow H_2\uparrow + 2OH^-$

• Scaling reactions

$Ca^{2+} + HCO_3^- + 2OH^- \rightarrow CaCO_3\downarrow + H_2O$

$Mg^{2+} + 2OH^- \rightarrow Mg(OH)_2$



METHODOLOGY

Casting Specimen

5,7.5, 10% graphite content by volume

Property Testing

- Resistance
- Saturation
- Materials preparation

Experiment

- Applying Optimal Condition
- DC power supply
- Stock water

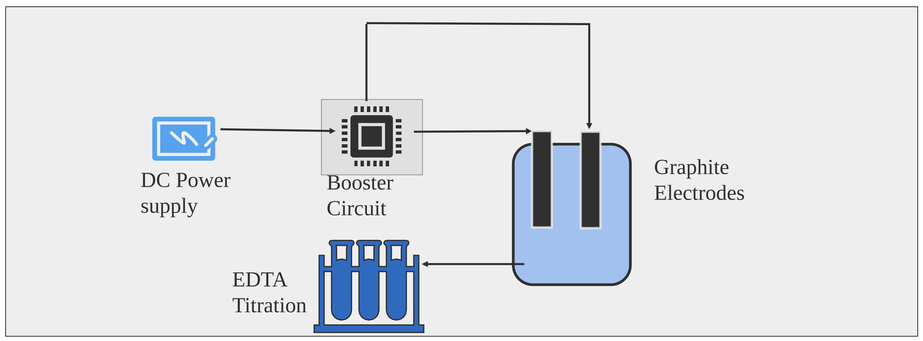
EXPERIMENTAL SETUP

Power Supply:
- 5 W,19V, 2.35 A
- Output- 19 V, .67A (open Circuit)

Water sample
- 330 mg/L as calcium carbonate
- EPA Standard, SOP: MB-30-00

Booster Circuit
- Input- 6-36V
- Output- .6-36V, 5A, Constant Current Function

Hardness measurement
- Ammonia Buffer
- Eriochrome black T
- EDTA



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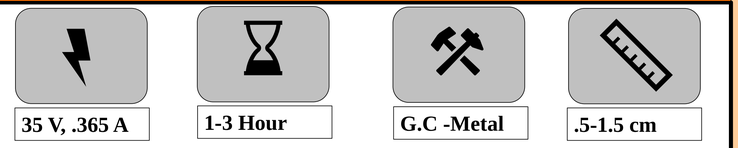

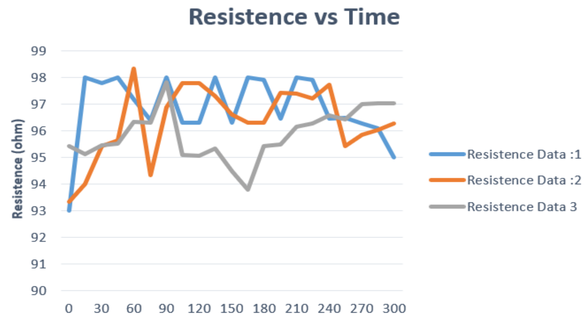

Figure: Residence of specimen over time

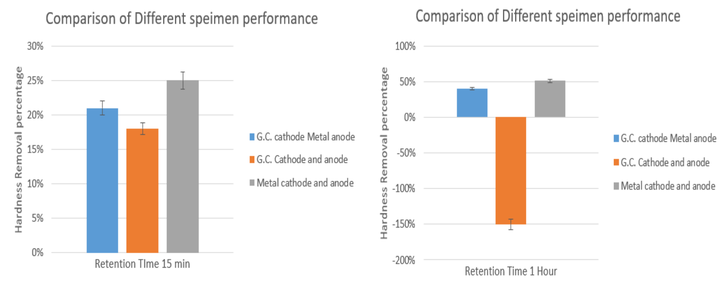

Figure: Comparison of different specimen performance in 15 mins and 1 hour (S.D. 10)

CONCLUSIONS

- Overall, Electrochemical precipitation using graphite concrete specimen to remove hardness from tap water, focuses on the necessity of people of LRGV. Further research can help the community get affordable and dependable hard water treatment system.
- Treatment efficiency of E.P. reactor depends highly on power supply, balance of power to efficiency is very important.
- Structural integrity of Graphite concrete is yet to be tested.

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