Electrocoagulation & Boron Removal

As a means of produced water treatment

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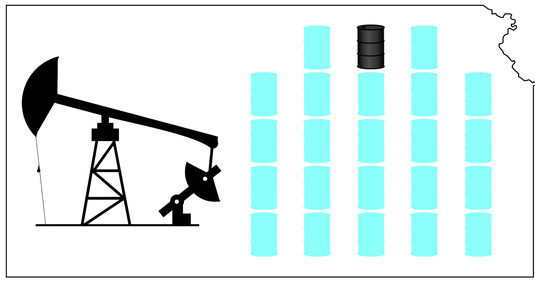
Abstract

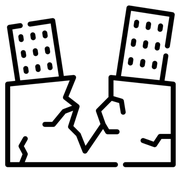
High boron levels in oil & gas produced waters prevent its beneficial reuse as irrigation water without additional selective treatment. Electrocoagulation (EC) has been shown as a promising technology for Boron removal. Synthetic solutions with Douglas County (DGC) produced water (TDS ~30,000 mg/L) is studied to understand mechanisms of EC.

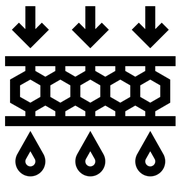
Introduction

In Kansas, one oil barrel generates 22 barrels of produced water (PW).



Conventional sub-surface disposal of PW is linked to increased seismic activity.

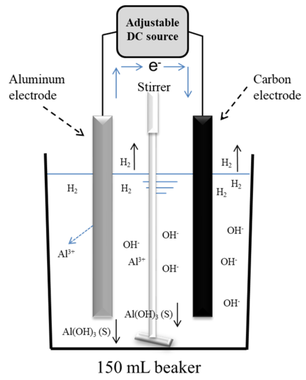




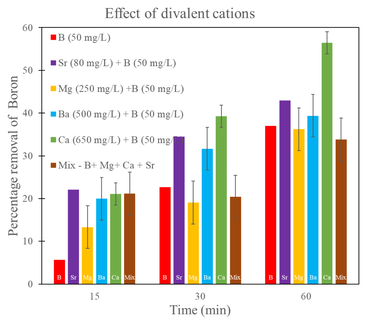
Single stage membrane treatment exhibits poor Boron rejection.

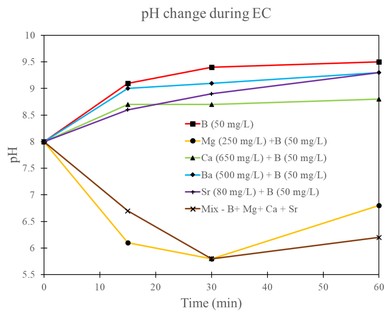
Experimental Setup

Electrocoagulation involves generation of insoluble Aluminum Hydroxide solids from a sacrificial anode on which adsorption of Boron takes place. For equivalent aluminum dosing, higher boron removal is achieved in EC than through conventional chemical coagulation.



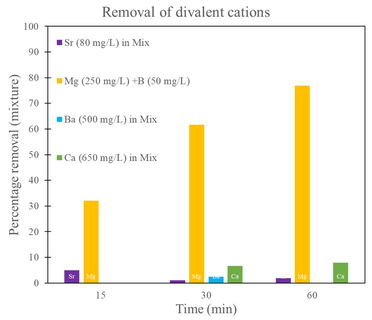
Results

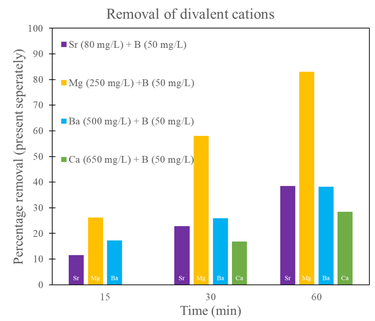


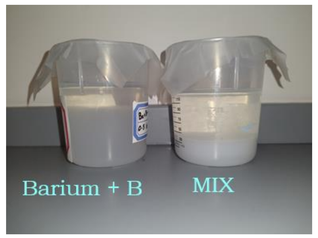


Enhanced boron removal is achieved with presence of calcium, while magnesium results in below par removal, a possibility explained by their solution's pH from the optimal of 8 for Boron removal.

pH drop in case of magnesium can be attributed to its preferential removal from liquid phase compared to other divalents.





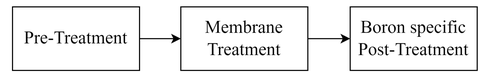


Solution chemistry also affected coagulant settling, and thereby Boron removals with individual cation solutions producing fluffy non–settling solids but the DGC composition had a powdery quick settling solid mass under same conditions.

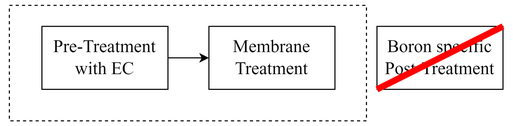
Conclusions

Experimental data indicates that Magnesium in produced water drives a reduction in Boron removal by depressing pH, while calcium enhances it. This means that different produced waters would behave differently during EC depending on their chemical profile. This variability should be factored into models of PW treatment effectiveness and cost..

Discussion



With integration of EC pretreatment for membrane treatment of produced water, a Boron specific post treatment step can be removed.



Future Directions

While presence of Magnesium & Calcium alters behavior during EC by manipulating pH. Upcoming work focuses on developing a life cycle comparison of EC and conventional chemical coagulation to look at these two technologies through a Life cycle standpoint.