

# The effect of plant derived polymers in the removal of microorganisms, nutrients, and dissolved solids from water collected at Timberlake Ranch

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## Objectives

The objectives of this study are to test the efficiency of plant derived polymers in live water samples, and to compare the efficiency of the plant derived polymers with a commercially available treatment agent.

## Introduction

Increasingly, available water sources are becoming polluted with domestic, industrial, and agricultural waste. Pollution of surface waters often leads to an increase in nutrients and dissolved solids, as well as potentially harmful microorganisms such as *Escherichia coli* (E. coli). The United States Environmental Protection Agency (EPA) has set water quality standards in an attempt to prevent degradation of aquatic ecosystems and to help provide safe drinking water.<sup>1</sup>

Water treatment facilities aim to remove suspended solids, dissolved solids, and microorganisms before releasing the water to prevent degradation of ecosystems and to lower human health risks. Treatment facilities often use flocculation followed by sedimentation or filtration to treat the water. Currently this is achieved by coagulating agents, such as synthetic polymers, which are slow to biodegrade and may have associated human health hazards. Water treatment facilities are looking for ways to lower their operational costs and environmental impact.<sup>2</sup> Based on previous research, plant derived polymers may be as or more effective at removing nutrients and microorganisms than commercially available treatment agents. These polymers may serve as an environmentally friendly and economical alternative to current treatment agents.



Picture 1: Collecting Samples at Timberlake Biological Field Station

## Methods

Water samples were collected from the Timberlake Biological Field Station in Mills County, Texas, Stephenville City Park, and from wells in Lubbock. A standard Jar test was performed in conjunction with ion chromatography (IC) and the modified mTEC method<sup>3</sup> to test the removal of E. Coli.

Set Up: Control: 500ml water sample

Treatment: 400ml water sample + 100ml polymer solution

Agitation: Agitate with a Jartester at 100 rpm for 1 min, then 50 rpm for 5 min

Collection: Immediately after polymer was added, as well as 5, 15, 30, and 60 min after agitation.

### Nutrient Removal

Collection: 20 ml collected for Total Solids (TS), 40ml collected for Total Dissolved Solids (TDS) / Suspended Solids (SS).

Filtration: 40 ml filtered using glass microfiber filters and vacuum filtration. 20 ml of filtrate collected for TDS, the remainder collected in Polyvials for IC analysis

### Microorganism removal

Filtration: Sample was filtered through sterile modified mTEC filter papers using vacuum filtration

Incubation: Filter papers were transferred to modified mTEC agar plates, placed into the incubator at 35.0°C for 2 hrs, then placed into a water bath at 44.5°C for 22 hrs.

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## Results

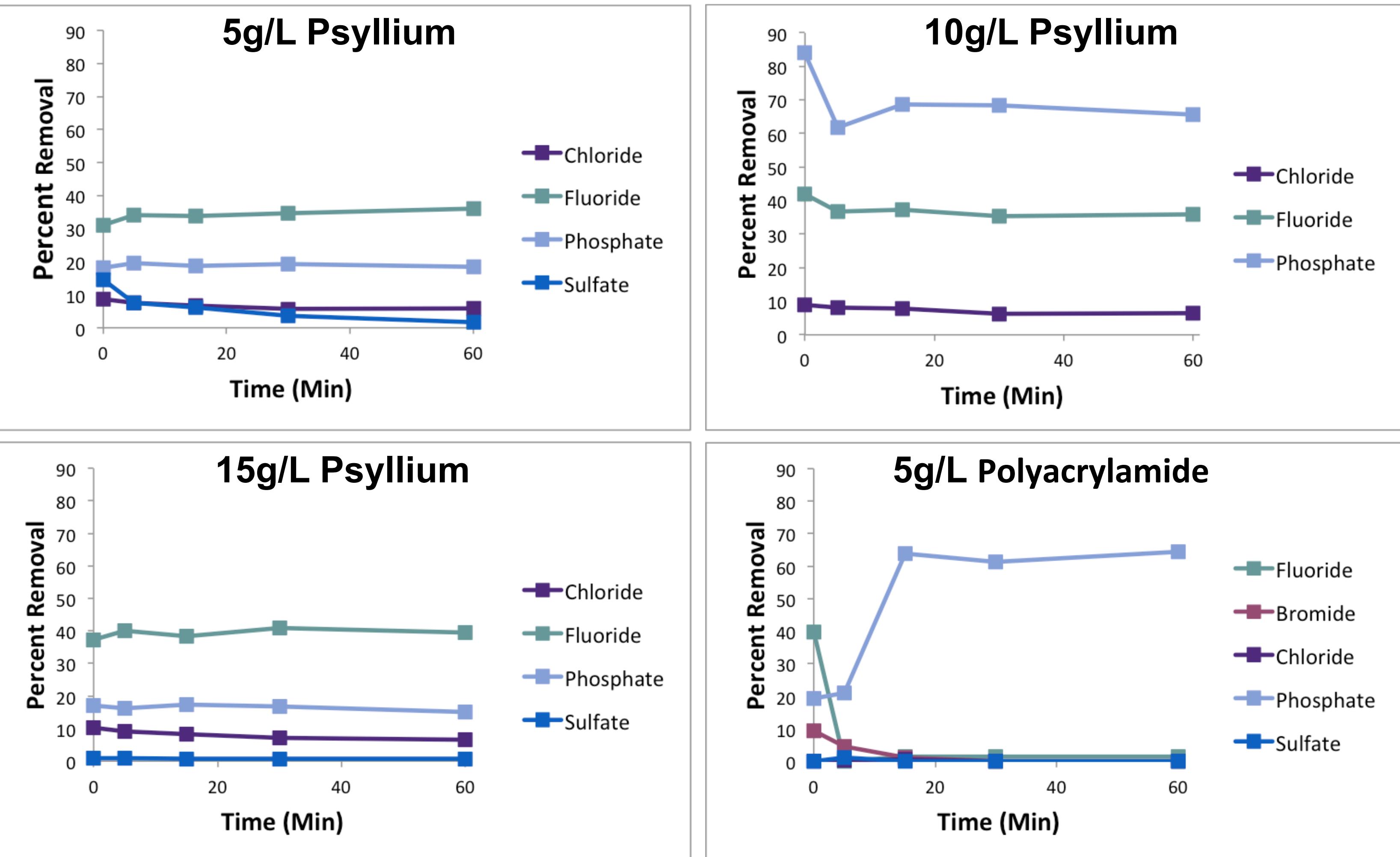


Figure 1. Comparison of percent removal from Timberlake water samples with differing doses of psyllium and polyacrylamide

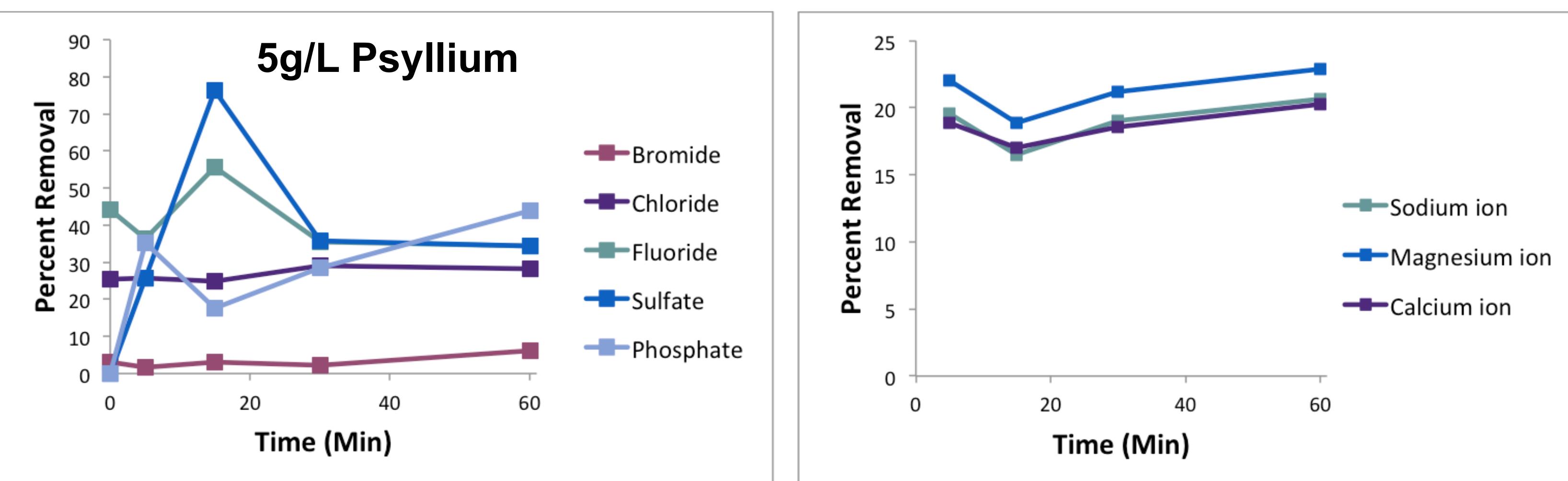


Figure 2. Anion percent removal from Lubbock Well Water samples with 5g/L psyllium



Figure 3. Average cation percent removal from Timberlake water samples with 5g/L psyllium

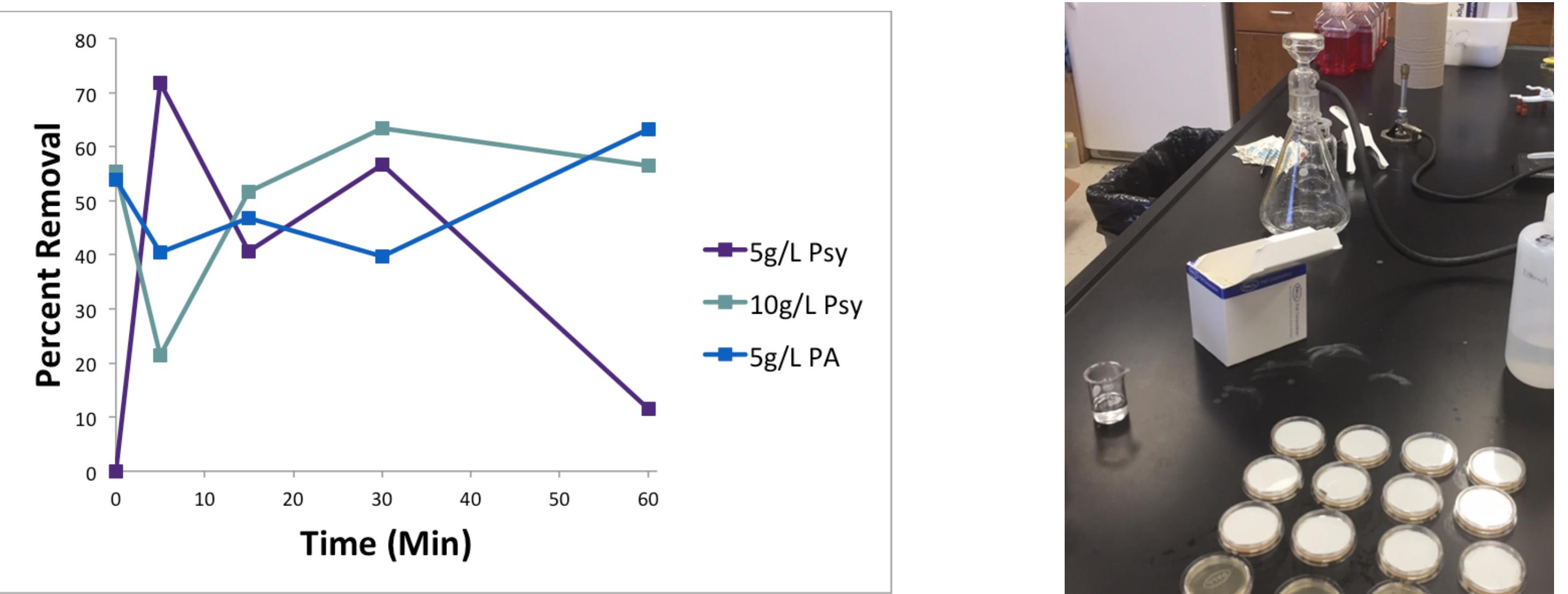


Figure 4. Bacteria percent removal with 5g/L psyllium, 10g/L psyllium, and 5g/L polyacrylamide



Picture 2: Filtering bacteria test samples

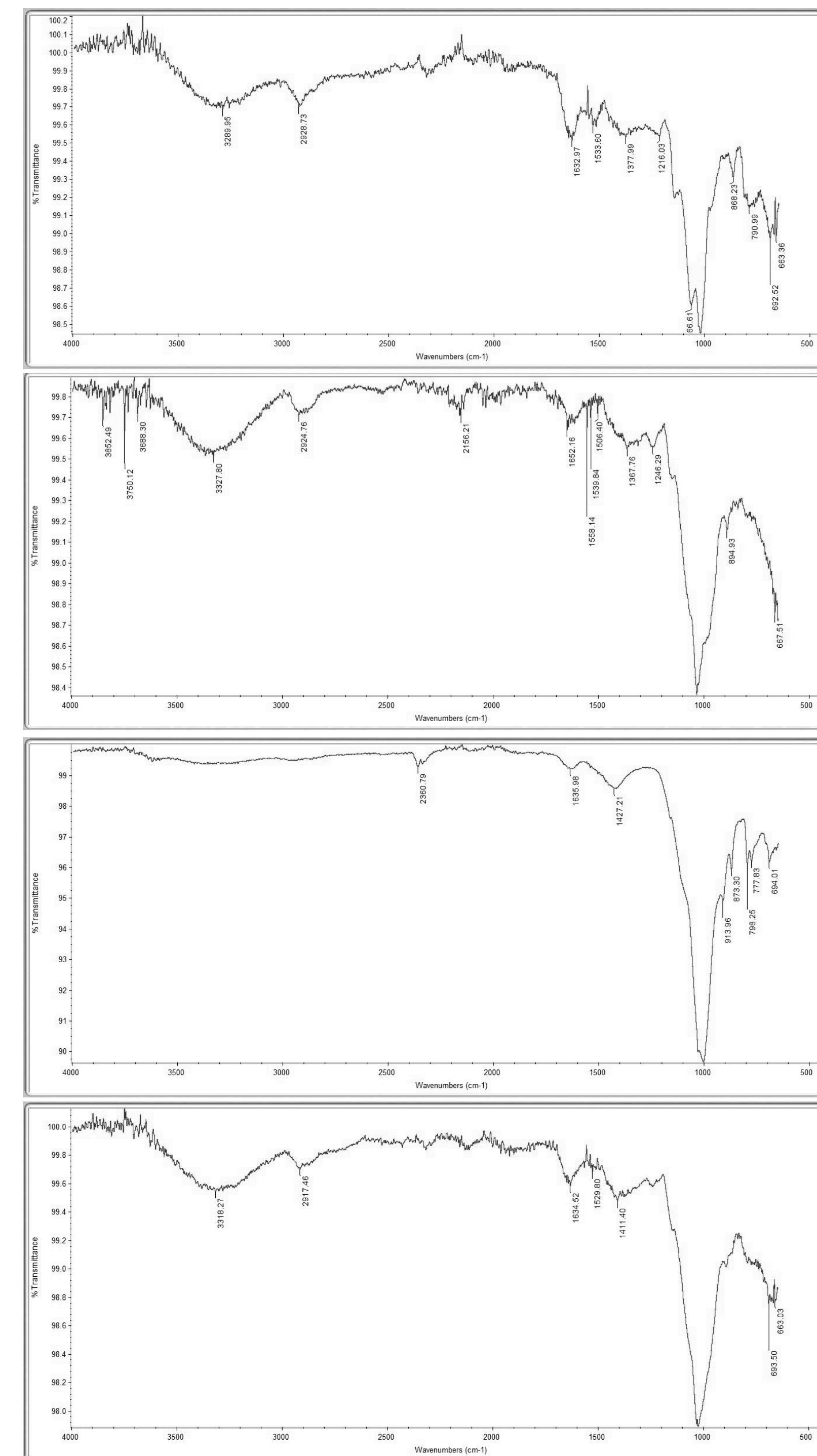


Figure 5. FTIR scans of the unused Fenugreek polymer, unused psyllium polymer, contaminants from the Colorado river, and a mixture of Fenugreek, psyllium, and the adsorbed contaminants.

## Summary of Results

The polymer was able to successfully decrease the concentration of particular anions and cations through using flocculation as a water treatment process. Preliminary experiments with 5g/L of psyllium showed that it was possible to remove 55.64% of fluoride ions from the water, 29.13% of chloride ions, 6.05% of bromide ions, 43.75% of phosphate ions, and 76.21% of sulfate ions. With the exception of phosphate ions, the plant derived polymer showed percent removals higher than the commercial polymer. The plant derived polymer was able to remove up to 71.87% of the E. coli with 5g/L of psyllium. Using FTIR it was possible to see that the polymers were adsorbing the contaminants.

## Conclusion

The preliminary results of this study were promising, in showing that the polymer has the ability to adsorb dissolved solids and E. coli. However, further studies are needed to optimize the results and to test different polymer doses and mixes.

## Acknowledgments

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## References

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