Photodegradation of Rhodamine Dye in Water Under Solar Radiation

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Introduction

In June of 2021 Lake Jackson suddenly found its water draining through Porter Sink and into the aquifer that feeds all of the rivers and lakes in the area. When that happened however, there was a prevailing question: **Where did all of the water go?**

To determine this, a team of researchers from Florida Geological Survey introduced into the sinkhole Florescence dye, a soluble eco-friendly water marker. After processing through the water column and testing at several sites, the team was unable to find any trace of the dye within water samples. As a result, the team now questioned if there were any other outliers affecting the dye such as photodegradation when exposed to sunlight.

Rhodamine Dye is one of the common substances utilized for water tracing. Its emission spectrum makes it incredibly viable for use with a fluorometer as it can be evaluated into the parts per billion. However, there are studies that indicated that Rhodamine and Fluorescein dye will degrade at a higher rate when subject to lower concentrations (Cai 2020), as what is seen in this study.

Further, exposure to solar radiation will cause Rhodamine dye to experience photochemical decay (Water Tracing), which will further reduce the fluorescence of the dye within water.

Methods

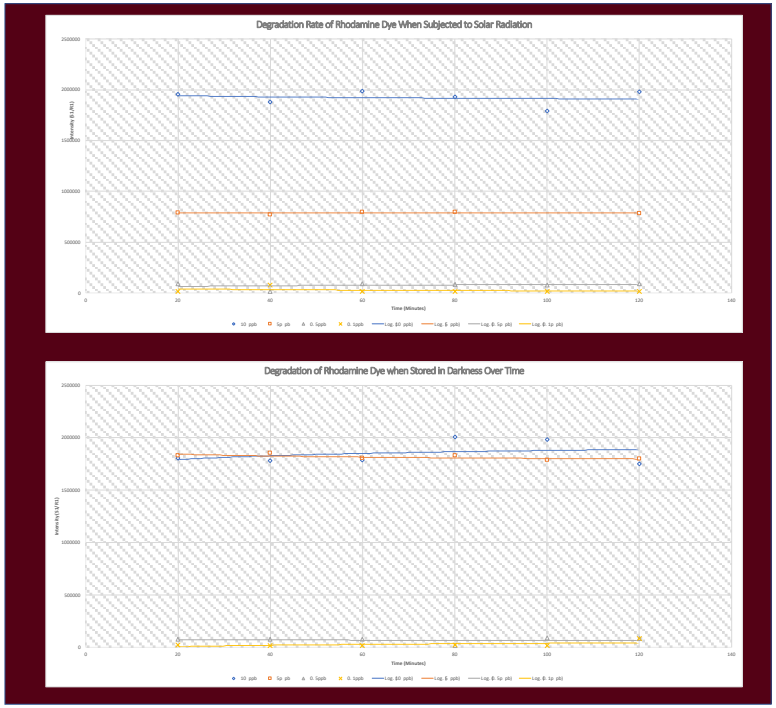
To conduct the experiment, the research team had to form initial calibration curves for testing. This required making 5 samples of 10 ppb, 5 ppb 0.5 ppb, and 0.1 ppb Rhodamine Dye solution.

With that completed, the team had to utilize the emission curve from that data to test different Cuvettes: Plastic, Glass, and Quartz. The same process was taken for the initial curve, and saw Quartz be the most effective.

Next, the team took the same samples, and set them in the sun for a 2 hour period, sampling from them every 20 minutes. Once those samples were collected, they were tested for emission in the Fluorometer.

Results

While the experiment has not been fully completed as it is ongoing, there are promising results. Over time, in a stable environment there has seen degradation of Rhodamine Dye in water. Further, the solar radiation has had negative effects on photochemical reactions in the past, indicating that the Rhodamine will degrade over time when exposed to solar radiation.



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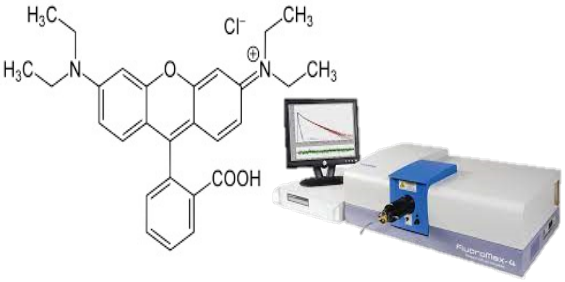
Water Tracing, in Situ Dye Fluorometry and YSI 6130 … https://www.ysi.com/file%20library/documents/white%20papers/e46-01 -rhodamine _paper.pdf.

Conclusion

As a tracer in water, Rhodamine Dye is one of the more effective photochemical pigments. At low Parts Per Billion, the dye is still strong enough to elicit readings on a fluorometer, and will give accurate measurements as to the source of the water it is in. However, the lower the concentration is, the more likely it will degrade at a faster rate The application of the knowledge found here is necessary for the utilization of the dye in the future. Understanding the degradation rates will allow researchers to estimate the flow of water from the source, and will give an idea of viability in the water



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