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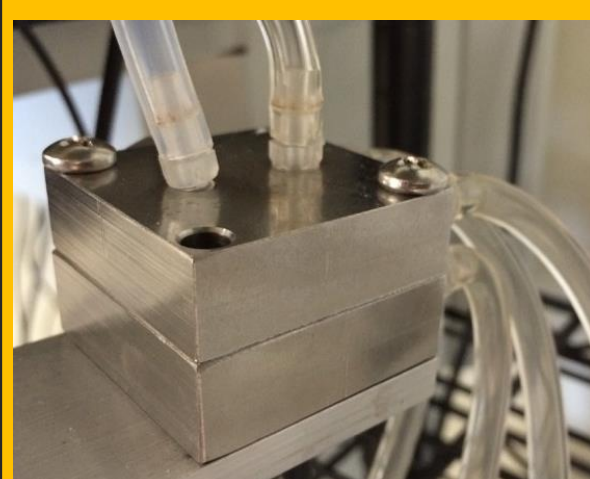
Polyisobutylene prior to preparation



Coating solution of 15% polyisobutylene and chloroform



A 5mhz quartz crystal is coated with PIB



Coated Crystal is placed inside this temperature controlled cell.

## Abstract

Sorption of benzene and toluene by polyisobutylene (PIB) was measured using a Quartz Crystal Microbalance. In order to check for proper functioning of the apparatus our data using benzene and toluene with PIB was compared to existing literature. When our results were consistent we added runs using chloroform and PIB. We also investigated the influence of temperature on the results.

## Background

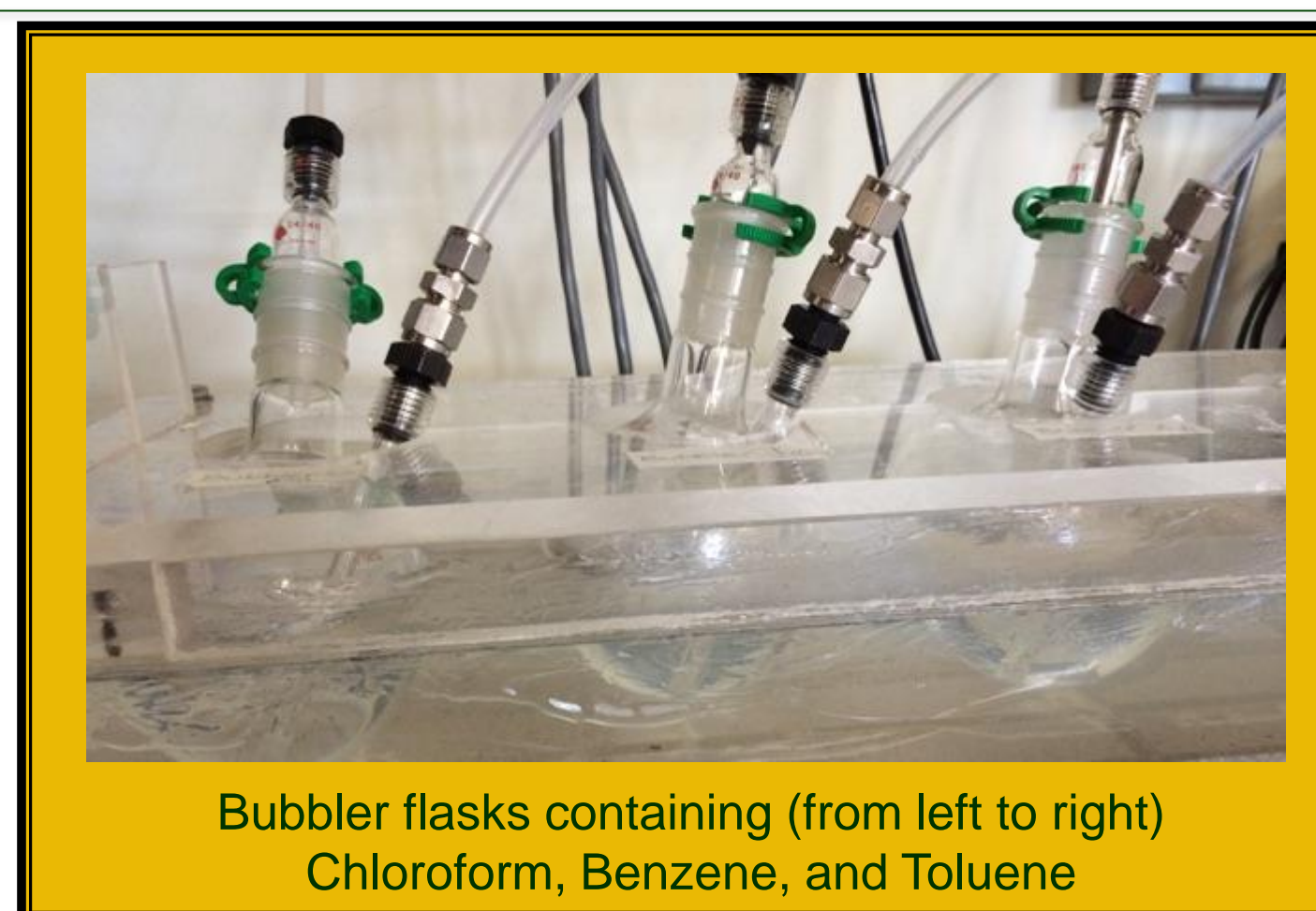
Measuring the solubility of organic compounds in polymers is difficult because diffusion of molecules through polymers can be a time consuming process. A reduction in the thickness of the polymer yields faster results but makes measuring of the smaller mass more difficult. The use of a quartz crystal microbalance has proven helpful due to its sensitivity and quickness in measuring.

## Objectives

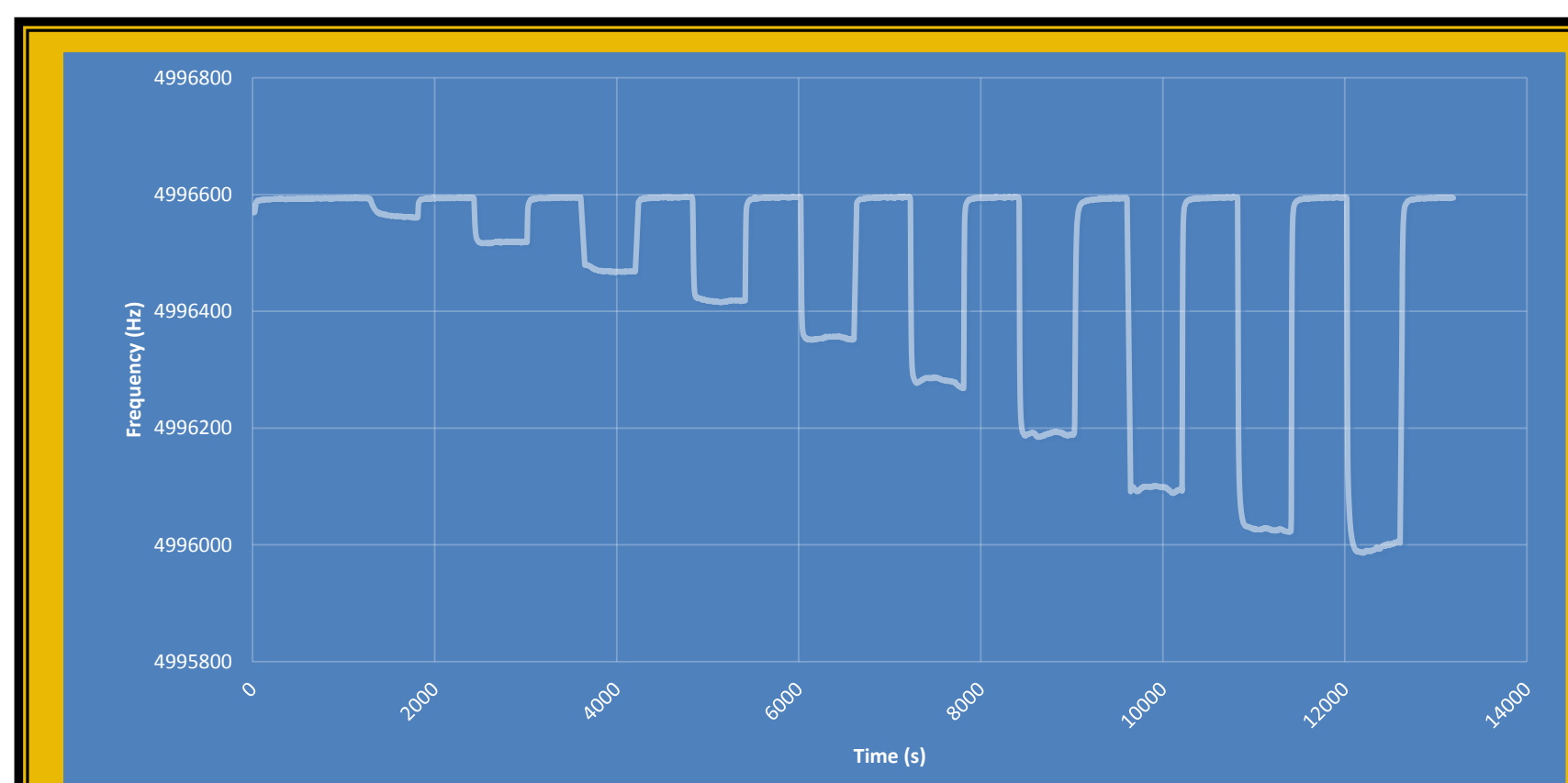
The first objective was to set up the apparatus to the established working parameters, Bhethanabotla (1). Next, in order to check the functionality of the apparatus we also compared our results to those of Wang (2), and Wibawa (3). Finally, we investigated the effects of temperature of the bubblers and cells and added a new solvent, chloroform.

## Approach

Using the quartz crystal microbalance allowed the solubility in a thin layer of polymer to be tested by measuring the shift  $\Delta f_0$  between the crystal and the crystal coated with polymer. The solvent was carried through the system by nitrogen and was exposed to the polymer-coated quartz crystal that was contained within the temperature controlled cell. When equilibrium in the polymer and gas stream was reached, the additional



Bubbler flasks containing (from left to right) Chloroform, Benzene, and Toluene



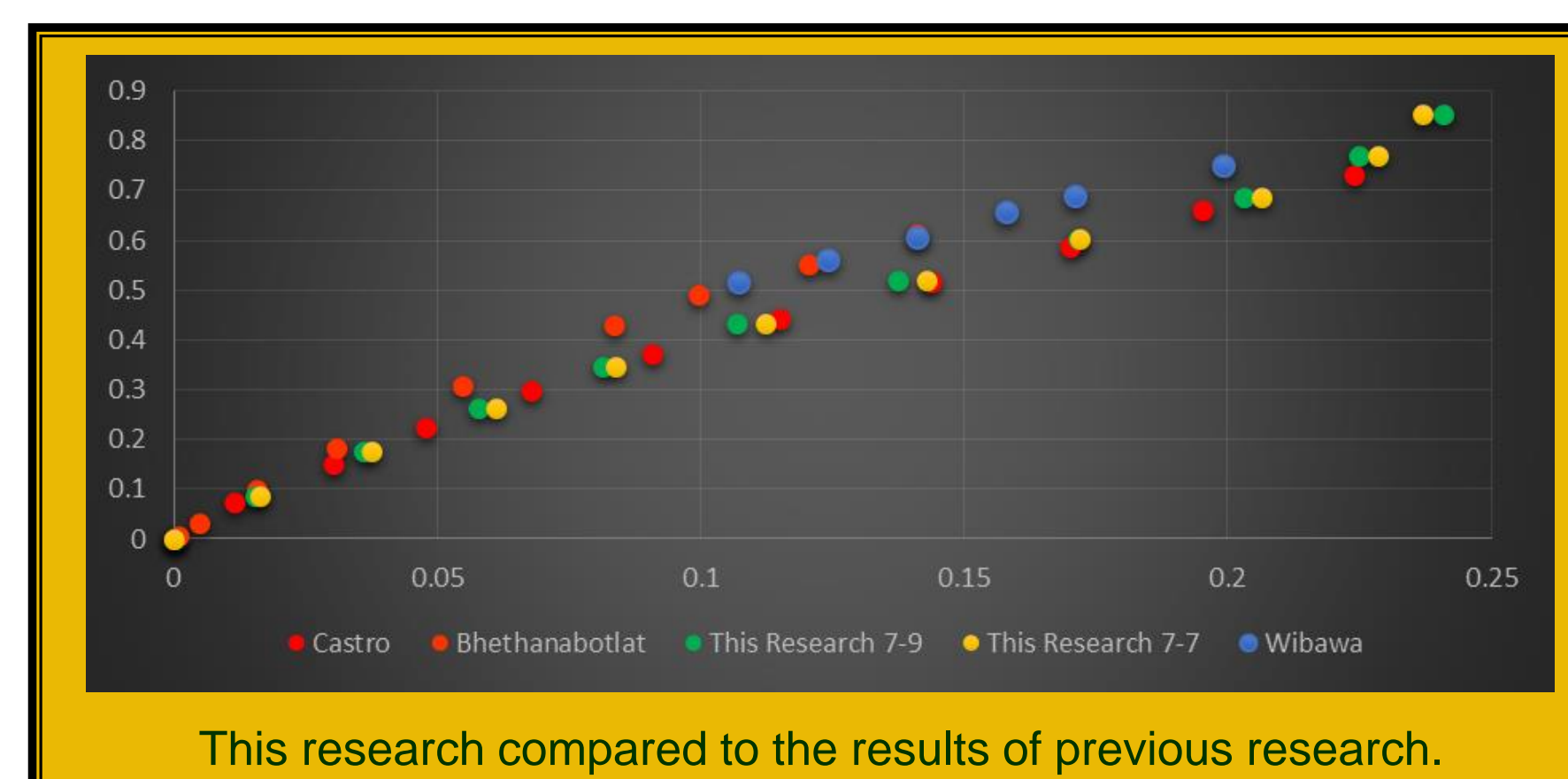
Baseline and exposure periods for Toluene and PIB

frequency shift  $\Delta f$  was noted.

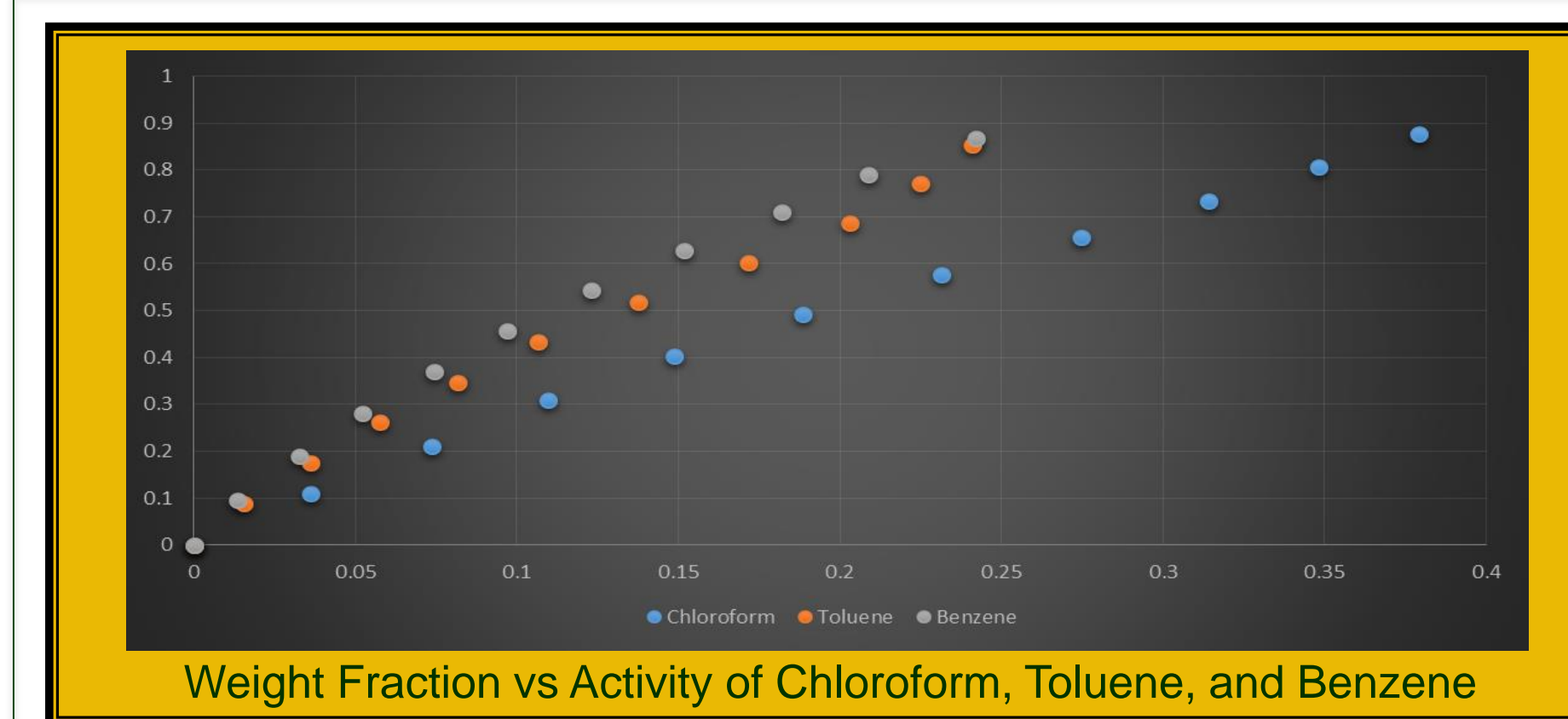
The weight fraction ( $W_1$ ) of the organic species in the polymer film was calculated from  $W_1 = \Delta f / (\Delta f + \Delta f_0)$

After setting up the apparatus our next goal was to run it using an established set of parameters to be sure that it was accurate.

Our data, shown in the graph to the right in green and yellow, clearly demonstrates a correlation to the results from previous research.



This research compared to the results of previous research.



Weight Fraction vs Activity of Chloroform, Toluene, and Benzene

New tests were run to explore the solubility in a PIB layer when exposed to chloroform. We also looked at temperature as a variable. Future studies will examine combinations of various polymers, organic vapors and mixtures of solvents.

## Conclusions

The data collected during this investigation can be used to strengthen the existing knowledge on solubility of solvents in polymers. Application in other fields could include filtration for environmental pollutants, identification of desired or undesired materials during fabrication, and precise sensors that could not only tell you if a substance is present but in what concentration. Further study is needed to determine the best process for coating the quartz crystals.

## Referenced Resources

Bhethanabotla, V. (2015, June 22). Personal Interview

Wang, Ning-He, Shigeki Takishima, and Hirokatsu Masuoka. "Solubility Measurements of Benzene and Cyclohexane in Molten Polyisobutylene by the Piezoelectric-quartz Sorption Method and Its Correlation by the Modified Dual-sorption Model." KAGAKU KOGAKU RONBUNSHU 15.2 (1989): 313-21. Web.

Wibawa, Gede, Masaki Takahashi, Yoshiyuki Sato, Shigeki Takishima, and Hirokatsu Masuoka. "Solubility of Seven Nonpolar Organic Solvents in Four Polymers Using the Piezoelectric-Quartz Sorption Method." Journal of Chemical & Engineering Data 47.3 (2002): 518-24. Web.