



Assessment of Chlorine Detections method using Leucocrystal Violet in Post-Slow Sand Filtered Water

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Physics 201

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I have a BS in Environmental Geology, which initially got me interested in water remediation and clean up.

As a Masters student in Environmental and Ecological Engineering, I could pursue this interest and gain a better understanding of the work necessary to make clean, potable water more accessible to people in various regions of the world.

Slow sand filters (SSF) are reliable tools when it comes to reducing turbidity and removing select contaminants commonly found in drinking water. SSF are easy to construct, operate and maintain at a low cost, making them highly valuable resources in rural regions of developing countries where access to treated water may not be available. Over the past several years, a Global Engineering Design team at Purdue University; focused on water treatment, has worked on building, improving, and scaling up a SSF for use in several schools in Kenya, Columbia, and Tanzania. While a SSF utilizes biological processes to reduce turbidity and metabolize organic solids, post-treatment disinfection is still required prior to consumption with the addition of chlorine. The DPD (N,N Diethyl-1,4 Phenylenediamine Sulfate) colorimetric method is the most commonly used chlorine detection chemical, used mostly for swimming pools in the United States. While the most reliable standard available for chlorine detection, DPD does not have a long self-life or reasonable cost for the intended purposes in rural schools. My research objective was to assess an alternative to DPD for use in point-of-use water treatment systems, specifically slow sand filters deployed internationally.

Leucocrystal violet (LCV) was used for chlorine detection in the early-mid 20th century but fell out of use due to requiring HgCl_2 . With some amendments made to the original experimental procedure, LCV was combined with HCl or Acetic Acid at various concentrations to predict known chlorine levels in water samples. It was found that these amendments worked, with LCV producing a visible color reaction when combined with each acid and chlorine. Between HCl and Acetic Acid, HCl was the more reliable of the two, supporting the literature. Once the HCl was selected, all further tests used various percent concentrations of HCl. When the solution is at a $\text{pH} > 2$, the signature blue-violet color appears when LCV is oxidized, displaying a peak absorbance of $\sim 592\text{nm}$ on the spectrophotometer. Through additional experimentation, it was found that acidity does play a part in the color presented by LCV, which ranges from yellow to blue-violet as acidity decreases from almost 0 to above 2, with each color resulting in its own absorbance curves. Samples tested in the lab supported the information found in literature. When tested against DPD, LCV has shown a higher level of absorbance in the spectrophotometer than that of DPD, which is currently under additional assessment. While further testing under different conditions and with different water sources is required; as well as gaining a better idea of how LCV compares to DPD, it was found that LCV is a successful alternative to the standard DPD colorimetric method. Due to the positive outcome of this assessment, LCV should be considered for use as a post-SSF treated water chlorine indicator in these targeted communities.

