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Summer Research Report
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**PPCPs in Sewanee's Treated Wastewater**

My research this summer was in Sewanee's Chemistry Department under the direction of Dr. Emily White, the university's Environmental Chemist. Our focus was on the detection of trace organics in Sewanee's wastewater effluent. Primarily, we were interested in a class of emerging contaminants usually referred to as pharmaceuticals and personal care products, or PPCPs. These include chemicals in soap, toothpaste, medicines, and virtually anything that gets flush down our drains. PPCPs are considered to be "emerging contaminants" because they are becoming much more widespread and because little is known about their fate in the environment post water treatment.

Sewanee's wastewater treatment process is unique because of its size and location. Instead of a generic filtration and cleaning process, Sewanee Utility District (SUD) uses a series of three lagoons followed by a chlorination tank to clean waste sludge. This water is then sprayed out into the forest, rather than the more common system of dumping it into a lake or river.

The method I followed for analyzing the water samples was based on a modified version of EPA Method 1694. It involves a solid phase extraction of the sample, concentration of the extracted material, and then analysis using a High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS) instrument to separate and identify the specific compounds of interest. Before I could begin looking at wastewater effluent samples, I had to familiarize myself with solid phase

extraction and the use of highly sensitive instruments to quantitatively measure the amounts of particular chemicals in a sample. I started by looking at the amount of nitrate and phosphate in water samples using a spectrophotometer. I learned important lab techniques, like pipetting liquids, cleaning glassware, and formulating a calibration curve with good linearity. Next, I practiced solid phase extraction using Coke, Diet Coke, and Caffeine-free Coke, and looked at the respective amounts of caffeine, aspartame, and benzoic acid. The instruments that I used for this were the UV-Visible Spectrophotometer, as well as the HPLC/MS. I also expanded my analysis to other artificial sweeteners, looking additionally at sucralose and saccharin.

As I began to use the HPLC more, Dr. White and I discovered some contamination problems in our results. Apparently, these had been occurring for several months, and before continuing in our specific research, we tried to determine where the contamination was coming from and how it could be removed. Unfortunately, we could not pinpoint an exact location or completely eliminate the "background" that was showing up in our results, but we were able to clean out the instrument and modify our method to extract the data we needed.

Eventually, I got to the "exciting part" of looking at the treated wastewater. I took samples from the post-chlorination wastewater, and did the solid phase extraction and evaporated the samples by blowing them down with nitrogen gas. Then, I analyzed them with the HPLC/MS. Although I did not have time to run replicates or quantify any of my data, I was able to identify caffeine in the water samples, as well as what appeared to be two compounds called sulfamethoxazole and trimethoprim, both of which make up a fairly common antibiotic drug.

Amidst looking at wastewater with the HPLC/MS, I also helped monitor several nearby bodies of water, helping me learn more about water chemistry from an environmental prospective. I took samples from Harrison Spring off Hat Rock Road and various sites at the newly constructed Sewanee Golf Course. The spring site is of particular interest from an anthropogenic point of view, because many members of the Sewanee community use it as their primary source for drinking water, despite a posted sign advising against consumption. I tested it for coliform bacteria, and found that it does contain bacteria that often serve as markers for fecal contamination. However, whether this is from humans or other animals such as deer, cows, or dogs, could not be determined by our tests. The Golf Course has several new retention ponds and a new central pond that I tested for the presence of nitrates, phosphates, and ammonium, as well as checking the pH and conductivity. The fairways and greens had recently been sprayed with green turf paint, but fortunately our tests showed fairly low concentrations of the ions of interest.

Overall, my summer research experience was hugely instructive and interesting. I gained valuable lab experience, and in particular, learned how to analyze compounds with the HPLC/MS, an instrument that I knew very little about before this summer. There were some frustrating moments when we were working through the contamination problems and some less thrilling moments when doing literature searches or waiting to run yet another blank, but I learned that these are all part of lab work. I do not think that I will pursue a career in research, but I will definitely continue my studies in chemistry and the sciences, and hopefully continue working on this project in the future.