Field Trip # 3: To Greater Cincinnati Water Works – Miller Treatment Plant

Host: Mr. Jeff Vogt, Senior Chemist, Water Quality & Treatment Division
Date: July 13, 2010
Time: 2:00-5:00 PM
Venue: 5651 Kellogg Avenue, Cincinnati, Ohio 45230

Prepared by:
Ms. Sara Bagley, Erpenbeck Elementary School, Florence, KY
Mr. Scott Ketcham, Pre-Service Teacher Student, College of Education, Criminal Justice, and Human Services, University of Cincinnati, OH

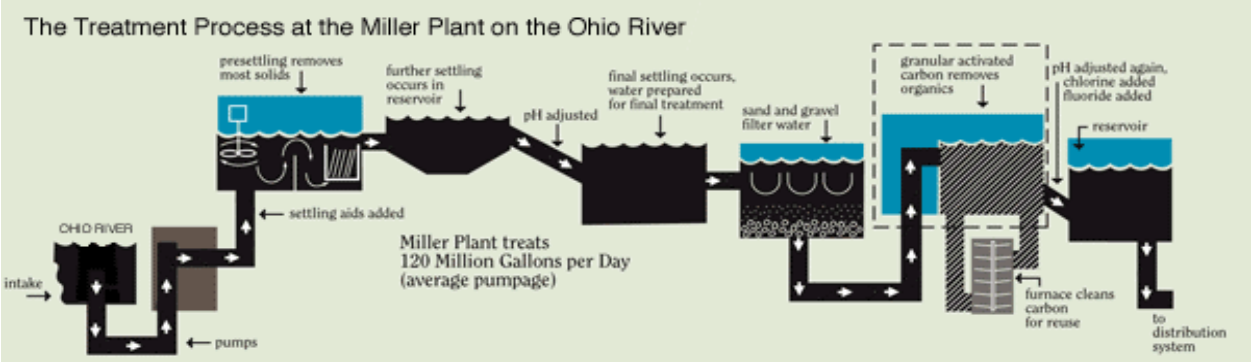
Mr. Jeff Vogt is a graduate from the University of Cincinnati with an Associates of Applied Science degree which was obtained in 1991. Mr. Vogt is currently enrolled at Northern Kentucky University in pursuit of a Bachelors degree in Environmental Studies. He has also worked two years at the Metropolitan Sewer District prior to transferring to the Greater Cincinnati Water Works, (GCWW). His responsibilities include: sampling, analysis, and reporting of water quality data. He has been employed at GCWW since 1992; started as a lab technician and currently his primary responsibilities include: Treatment Process Quality Control for both of Groundwater and Surface Water Treatment Plant, Supervision of four Chemist, OEPA Compliance sampling and reporting, full scale Treatment Process Improvements, Source Water Protection, and Public Education activities.

Greater Cincinnati Water Works supplies more than 48 billion gallons of water a year (220 million gallons per day) to nearly a quarter of a million residential and commercial customers. GCWW has been treating the Ohio River since its beginning using the Front Street Pumping Station in 1821, this pumping station uses 3,000 water mains to deliver drinkable water. Many of the pipes used to this day have been carrying water for over 100 years. On July 13th, the RET group, along with Mr. Hafiz Salih the graduate mentor for the RET water project, visited the Miller Treatment Plant component of GCWW. Mr. Jeff Vogt, Head Chemist, met the group and presented a history of the plant as well as a concise, informative overview of the nationally-recognized processes the state-of-the art facility conducts every day.

Mr. Vogt explained that in the 19th century, water quality, or lack there-of, was of high public significance because of the prevalence of typhoid, cholera, gastroenteritis, and other water-borne illnesses. In 1907, Louisville and Cincinnati were the first cities in the nation to utilize rapid sand filtration and alum coagulation as means of treating water. The California Waste Treatment Plant, as it used to be called, could pump 112 million gallons of water to the surrounding city nearly every day. In 1916, the plant began adding chlorine as a means of disinfecting the water. In the 1960's, a second pumping station was added to meet the growing population's need for water. Throughout the years, several reservoirs were built to store and protect water during times of emergency, such as in the case of an oil spill along the river. These reservoirs can hold 380 million gallons of water and supply the area with 2-4 days of water in times of need. These reservoirs are only cleaned every 12 years. The most important part of the facility was added in 1992 and provides Cincinnati with the best available treatment of water filtration, Granular Activated Carbon (GAC). GAC was originally used in columns at

the facility, before engineers developed the system of 12 contactors filled with GAC, which is still in use today. The GAC facility remains one of the largest of its type in the country.

Mr. Vogt introduced the process of water treatment before we toured the facility so that we could connect the equipment we would be viewing with the functions they perform. The diagram below shows the complete process.



In order to make the Ohio River water safe for human consumption, we must remove natural organic matter. To do so, GCWW moves the water through a series of four processes: Coagulation, Flocculation, Sedimentation, and Filtration. Coagulation has its basis in the electrical charges found in the very small particles of chemicals, alum at GCWW, that are added to raw water as it enters the treatment facility. The chemical charges cause the particles to aggregate, making them denser so that they separate out from the water and sink to the bottom. The coagulants are rapidly mixed with the water using a surface sweep, and the particles are collected on the bottom using devices called Lamella plates. These plates are slanted so that the particles do not have as far to travel through the water before they settle. This process results in a 23% reduction in TOC (Total Organic Carbon).

Water that has gone through coagulation, flocculation, and sedimentation must then be filtered to continue removing TOC. A total of 47 sand filters are utilized to trap particles. Each of these water filters can process 3 gallons per minute per square foot of surface, with a total of 1400 square feet per filter. When these filters fill up, GCWW uses a backwashing technique to break up the particles, expand the sand, and flush dirt and mud out. The solids from this backwashing are discharged daily so that the environment is not shocked.

After going through sand filtration, there is another 10% reduction in TOC level. A final measure of removing organics is conducting through adsorption by GAC as the water comes into contact 12 carbon contactors for 15 minutes. Each contactor contains 600,000 pounds of granular activated carbon. The organic matter left in the water is trapped in the small pores of the carbon, reducing the TOC level by another 50%. Mr. Vogt described the process for reactivating the carbon, which must occur when the pores are completely filled with particles. Using a large hearth furnace, the carbon is heated, which releases the organic matter as gas and leaves the carbon “clean” and ready to be used for adsorption again.

Mr. Vogt added that, as a final measurement of treatment, the GCWW adds a chlorine disinfectant and fluoride. On average, each filter must be backwashed after 30-35 hours of operation. Next, water is added to the bottom of the filter. This counter flow "raises" the bed (spreads the media particles) and flushes filter contaminants out of the top. This dirt and sediment then are collected and discharged to the Ohio River. The backflow then is sequentially reduced to allow the heavier media particles to settle first, re-layering the bed. The clean filter is then ready to be put back into service. The water is then pumped to clear wells and distribution stations which will serve the community.

After witnessing a complete backwash cycle, Mr. Vogt escorted the teachers to a hallway where they could see the structure where the filtered water collected prior to treatment with GAC. The facility has 12 GAC contactors, each with an average residence time of 15 minutes. Each contactor is underlain with stainless steel porous pipes through which the water is collected. The participants were asked not to take any pictures inside the treatment plant, due to the 911 incident. Few photographs in the presentation room are presented below.