# ODOR AVOIDANCE & CONTROL

A large number of wastewater treatment plants across the state and across the country experience problems with odors to one extent or another. The means and methods used to combat these problems are as varied as the treatment plants themselves. The purpose of this information sheet is to describe the particular odor problems encountered at the Niagara Falls Wastewater Treatment Facility on Buffalo Avenue and the steps that are taken to counteract them.

Most modern wastewater treatment plants employ some type of biological process for waste stabilization and pollutant reduction. The biological processes require aerobic conditions, where adequate levels of oxygen discourage odor formation. The high percentage of industrial wastes precluded the use of a biological-type process at the Niagara Falls plant. In its place, physical and chemical processes are used to remove and treat pollutants.

Physical-chemical treatment systems are typically more susceptible to odor problems due to the lack of wastestream aeration. This lack of aeration can permit the development of anaerobic conditions, under which anaerobic bacteria flourish and produce gas as a by-product. Hydrogen sulfide (H2S) is the most common and odorous gas produced, which possesses a rotten egg smell. The anaerobic conditions leading to the formation of H2S usually favor the generation of other malodorous chemicals such as mercaptans and skatoles. These gases are carried with the wastestream until they are released at an air-water interface or an air-solid interface.

In addition to anaerobic conditions, other factors can work to promote gas production. An elevated waste temperature, such as that present in summertime, will increase microbial activity which in turn increases gas production. Gas formation is sustained when a waste-containing stream is mixed with a bacterial colony and held under anaerobic conditions for an extended period of time; therefore, contact time is also important.

There are two basic approaches that may be taken to counteract odor problems. The first involves the active avoidance of conditions that promote odor production. The second involves the chemical treatment of odors that are unavoidable formed during the waste treatment process. Both approaches are followed at the Niagara Falls plant.

**Solids treatment**

As mentioned above, elevated temperature and long holding times both contribute to odor formation. There is not a practical method by which wastestream temperature can be lowered to achieve a measurable decrease in microbial activity. Other control methods, usually taking the form of chemical additions, must be adjusted to compensate

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for increased odor formation due to temperature. Sludge holding time, however, is an item over which the plant staff can exert control.

Solids which enter the plant are chemically treated and allowed to settle in the large sedimentation tanks just south of Buffalo Avenue. The settled material, now referred to as sludge, is pumped to gravity thickeners for concentrating followed by mechanical dewatering on belt filter presses. Lime is mixed into the resulting sludge cake to stabilize the sludge by elevating pH and inactivating pathogens. The stabilized sludge is loaded into hauling containers and trucked offsite for landfilling. The facility has four primary sedimentation basins, two gravity thickeners, three belt filter presses, and two lime blending mills. Solids must pass through this entire pathway before they can be removed from the facility.

The longer it takes for the solids to complete this pathway, the more likely it is to have anaerobic conditions develop. To avoid this situation, the plant staff strives to keep the sludge moving through the system as quickly as possible. If equipment problems develop with just one of the operations along the pathway, the entire pathway slows down and becomes susceptible to odor formation. Odors may be emitted from the sedimentation basins and thickeners by bubble formation and release, as well as having air in direct contact with solids in an offline or malfunctioning unit. Once equipment repair allows for improved processing time, a backlog of anaerobic sludge must be processed in addition to the normal quantity of incoming material.

A compounding problem involves a change in the nature of the sludge. The now anaerobic sludge is usually more difficult to gravity thicken and mechanically dewater. Both of these factors tend to prolong sludge holding time and maintain the anaerobic conditions. Staff attempts to break out of this vicious cycle by operating more belt presses on a longer schedule, adjusting chemical conditioning of the sludge for better dewatering performance, reactivating the offline thickener for parallel operations, or combinations of the above measures.

**Liquid Treatment**

As part of the treatment process, wastewater must pass through activated carbon filters. A minimum residence time in these filters is required to achieve the necessary level of pollutant removal. During this process, anaerobic biological attached growths reduce sulfate to H2S which is carried away in the filter effluent. The gas is released at the wet well air-water interface and at the outside chlorine contact tank, where the effluent flows over two sets of weirs. Gas may also be released in other plant areas where repumped carbon filter effluent, also known as plant water, is mixed in an open atmosphere.

One of the chemicals used in the liquid process to combat odors is hydrogen peroxide (H2O2). Peroxide is added to the filter effluent in order to chemically oxidize reduced compounds coming from the filters, including H2S. Usage varies, but typically averages about 650 gallons per day.

Peroxide alone is insufficient in controlling filter effluent odors. Sodium hypochlorite (NaOCl) is also added to the filter effluent, downstream from the peroxide addition. Effluent chlorination was converted from liquid chlorine to hypochlorite in 2002. Average daily usage of hypochlorite exceeds 8000 gallons. Working together, the peroxide and hypochlorite oxidize filter effluent chlorine demand, and allows for a residual concentration of chlorine to achieve final effluent disinfection.

Hypochlorite is also periodically added to carbon filter backwash supply water in an effort to stress the anaerobic bacteria and lessen H2S production.

The measures taken to counteract treatment plant odors would be greatly simplified if the factors promoting odor generation remained constant. This, however, is not the case. Raw sewage flow, wet weather events, individual equipment performance, operational flexibility, and treatment process constraints are all in a continual state of change. Raw sewage characteristics also impact odor generation, as the plant can receive slug loads of either odorous chemicals or precursors which are converted to odorous chemicals during the course of physical-chemical treatment. Although these changing factors combine to complicate effective odor control, the plant staff continually adjusts the control measures available to them to maximize the overall odor control effort.

**Sedimentation Basins**

**Carbon Filters**

**Hydrogen Peroxide Storage Tank**