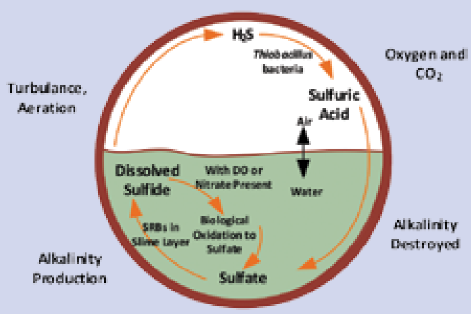
What every operator needs to know about collection system odor and corrosion control

Jorj Long

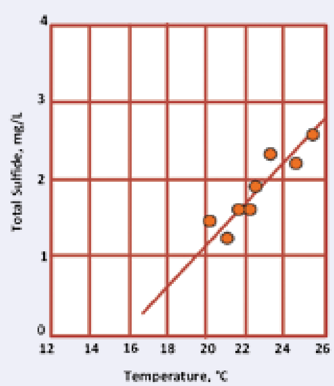
<table>
<tr><th>Knowledge</th><th>Principle</th><th>Practical considerations</th></tr>
<tr><td>Anaerobic conditions</td><td>When oxygen transfer is limited, as in wastewater force mains, sulfate-loving bacteria thrive.</td><td>Bacteria use the sulfate ion (SO_4^-), which is naturally abundant in most source waters, as an oxygen source for respiration. This results in hydrogen sulfide (H_2S).</td></tr>
<tr><td>Corrosion</td><td>Hydrogen sulfide directly attacks such metals as iron, steel, and copper as well as concrete.</td><td>Corrosion occurs on the concrete pipe crown, on the wall of manholes, within junction structures, and inside wet wells that remain moist but are not submerged continuously.</td></tr>
<tr><td>The sewer sulfide cycle</td><td>
</td><td>In the slime layer, sulfate is reduced to sulfide and some alkalinity.

Thiobacillus bacteria living above the water on the sewer walls oxidize hydrogen sulfide gas to sulfuric acid.

Turbulance releases hydrogen sulfide into the air.

The acid runs down the walls into the wastewater. Acid erodes the concrete along the way.

When the acid reaches the wastewater, it destroys the alkalinity prevously generated and becomes sulfate again.

The cycle begins anew.</td></tr>
<tr><td>Temperature effects</td><td>
</td><td>Warmer wastewater contains more sulfide; more sulfide leads to more hydrogen sulfide; more hydrogen sulfide leads to more sulfuric acid.

More sulfuric acid leads to more corrosion and more sulfate in the wastewater.

The cycle (see above) continues.</td></tr>
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Knowledge	Principle	Practical considerations
Ideal conditions for odor and corrosion	Certain conditions lead to the most odors and corrosion.	These conditions include ■ long force mains and flat sewers with debris, ■ warm wastewater temperatures, ■ high ratio of biochemical oxygen demand (BOD) to soluble BOD, and ■ high sulfate levels.
Odor of compounds	Hydrogen sulfide Ammonia Methylamine Acetone Butyric acid Mercaptans	Rotten eggs Dirty diapers Fishy, rotten Fruity, sweet Rancid Skunk, putrid to strong garlic
Actions in collections system to reduce odors that affect downstream treatment	Adding chemicals such as ozone, sodium hypochlorite, or hydrogen peroxide oxidizes hydrogen sulfide, ammonia, and volatile fatty acids (VFAs).	Odor mitigating chemicals are not sulfide-specific and will react with other constituents in wastewater. They react readily with oxidizable material, including BOD, in the sewer. VFAs are a subset of BOD and are oxidized easily. However, biological phosphorous removal requires VFAs in influent or a sufficient amount of rapidly biodegradable chemical oxygen demand (COD) that can be fermented to form VFA to trigger phosphorus release.
	Adding nitrate creates anoxic conditions and prevents fermentation, so hydrogen sulfide does not form.	Nitrate serves as an electron acceptor for biological actions, very similar to aeration, in the collection system. Under anoxic conditions, readily oxidizable VFA is consumed by the bacteria, so nitrate addition not only prevents VFA formation but can destroy VFA that already exists.
	Adding iron salts precipitates sulfide without significantly altering wastewater chemistry.	VFAs are not destroyed or affected.
	pH control can be effective. Hydrogen sulfide is a weak acid; it dissociates into HS^- and S^{-2} ions. Maintaining a pH above 9 keeps most of it in its ionized form and prevents its release to the headspace.	A pH between 9 and 10 will not adversely affect VFA formation, but pH above 11 will slow or stop the rate of fermentation.
	Vapor phase odor control – such as wet scrubbers – can control odors and corrosion.	Sidestreams can create problems. Chemical blowdown can contain high chlorine concentrations. Whether routed to the treatment facility headworks or discharged to the collections system, the chlorine oxidizes VFA.

Jorj Long *is the deputy director of operation technology for Black & Veatch (Overland Park, Kan.) and is a certified operator.*