HYDROGEN SULFIDE CORROSION IN SANITARY SEWERS EFFECTED BY FLOW VELOCITIES

The reduction, elimination, or control of hydrogen sulfide (H_2S) should be the goal of all designers of sanitary sewer systems.

Hydrogen sulfide gases are generated within the anaerobic slime layer formed on the submerged pipe walls. Hydrogen sulfide gases released from the slime layer rise into the airway portion of the sewer pipe and react with the bacteria and moisture on the pipe walls to form sulfuric acid (H_2SO_4). It is the sulfuric acid that corrodes ferrous metals and concrete.

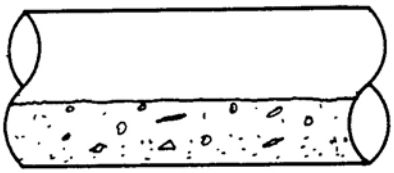
Within the last 30 years (approximately) a greater understanding of how hydrogen sulfide is generated and the corrective actions that are available to the engineer have been developed. Through correct design procedures, sanitary sewers currently need not experience the same corrosion problems as did older sewers.

One very simple procedure that the engineer should incorporate in the design of sanitary sewers is to establish a proper gradient and flow velocity. This will prevent grit accumulation and will either eliminate the development of anaerobic slime layer, or at least control such development.

The EPA Process Design Manual for Sulfide Control in Sanitary Sewerage Systems indicates that the effect of velocity on the transport of solids is a very important consideration. Quoting from pages 3-26: "*A small amount of gritty matter lying in the pipe does not have much effect on sulfide generation, but when the velocity is slower, organic solids may concentrate at the bottom, intermittently sliding and rolling along. Because of oxygen depletion in the loosely deposited solids, and the large interfacial area, sulfide generation is then markedly accelerated. If the velocity is slow enough so that a deep, stable deposit of sludge forms, it does not proportionally increase sulfide generation, because the sludge becomes starved for sulfate, but conditions do continue to become worse with decreasing velocity.*"

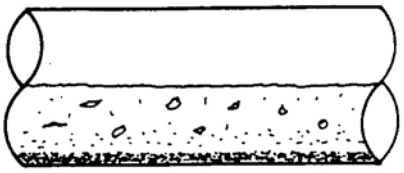
The following illustrations demonstrate the relationship between velocity, grit and organic solids accumulation, and sulfide problems:

A



Velocity 2 fps. Efficient solids transport no sulfide buildup in small flows, up to 2 cfs. Sulfide buildup often observed in larger flows, but only at a very slow rate.

B

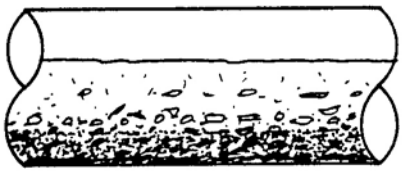


Velocity 1.5 to 2.0 fps. Inorganic grit accumulating in the bottom. More sulfide buildup as the velocity diminishes.

C

Velocity 1.0 to 1.4 fps. Inorganic grit in the bottom, organic solids slowly moving along the bottom. Strongly enhanced sulfide buildup; severe problems expected.

D



Velocity below 1.0 fps. Much organic and inorganic solid matter accumulating, overlain with slow-moving organic solids. Sulfide problems worse than in C.

CONCLUSION: Proper flow velocities in sanitary sewer collection systems should be one of the first considerations by the designer. Flows of 2.0 fps or greater will greatly minimize, or eliminate, hydrogen sulfide problems.