28. Hydrogen Sulfide (H_2S) Control.

a. General.

1) Consider the potential for hydrogen sulfide generation and release into proposed and existing sewers as result of the proposed design. Design the sewer systems to minimize the generation and release of hydrogen sulfide as indicated in this section.

2) Evaluate the following sewer pipelines for hydrogen sulfide generation and release:

   a) H_2S generation. All gravity sewers 27-inch and larger must be evaluated and designed to minimize hydrogen sulfide (H_2S) generation, see requirements in this section.

   b) H_2S release. The release of hydrogen sulfide which is most prevalent downstream of force mains and small diameter pressure sewers, occurs in all sizes of gravity sewers at transition manholes and in a portion of the piping and manholes downstream of the transition manhole. Therefore, hydrogen sulfide generation concentrations in small diameter pressure sewer systems and all force mains must be evaluated at the transition manhole as indicated below.

3) Perform analyses and prepare calculations according to the guidelines in this section and submit calculations and design to the WSSC.

b. Analysis for Hydrogen Sulfide Generation.

1) Criteria for H_2S generation forecasting in the design of gravity sewers 27-inch and larger.

   a) Chart "B", curves A/B provides approximate qualitative guidelines to indicate the likelihood of H_2S generation.

   b) If the design of the sanitary sewer falls in the field above curve A, it is unlikely that there will be any significant sulfide buildup.

   c) If the design falls below curve B, the development of sulfide is likely, see Selection of Pipe and Structure Material, in this section.

2) Grinder pump systems and force mains.

   a) Use Pomeroy's Equation for predicting hydrogen sulfide generation in 4-inch and smaller diameter pressure sewers (grinder pump systems) and all force mains.

   b) If hydrogen sulfide generation is predicted in these systems, include in the design the necessary provisions to either neutralize the H_2S or protect the downstream piping and structures from sulfide attack. Minimum sulfide concentrations (S_2) of 1 mg/l can cause problems in sewers.

3) After performing the analysis, request guidance from WSSC on the necessary provisions in the design to protect the sewer from H_2S attack, see Selection of Pipe and Structure Material, in this section.

POMEROY'S EQUATION

$$S_2 = S_1 + [M \times t \times EBOD \times ((4/d) + 1.57)]$$

Where:

S_2 = sulfide concentration at the transition manhole, mg/l

S_1 = sulfide concentration at the pump station wet well, mg/l; for pump station influent sewers 24" and smaller, $S_1 = 0$; for pump station influent sewers 27" and larger, consult with WSSC for determining S_1

M = empirical coefficient; for force mains larger than 6", M = 0.001; for pressure sewers and force mains 6" and smaller, M = 0.0003

t = detention time, hours

EBOD = $BOD_5 \times 1.07^{(T-20)}$, (assume EBOD = 300 mg/l maximum during summer months)

d = pipe diameter in meters

<u>NOTE:</u> The use of the A/B curves is restricted to sanitary sewers with flow depths not exceeding two-thirds of the pipe inside diameter. Use the initial six-hour average high flow, which occurs during the hottest three months of the year. Do not use the ultimate flow, when using the A/B curve to predict H_2S generation. (Assume the initial high flow equals 1.5 times the initial annual average daily flow)

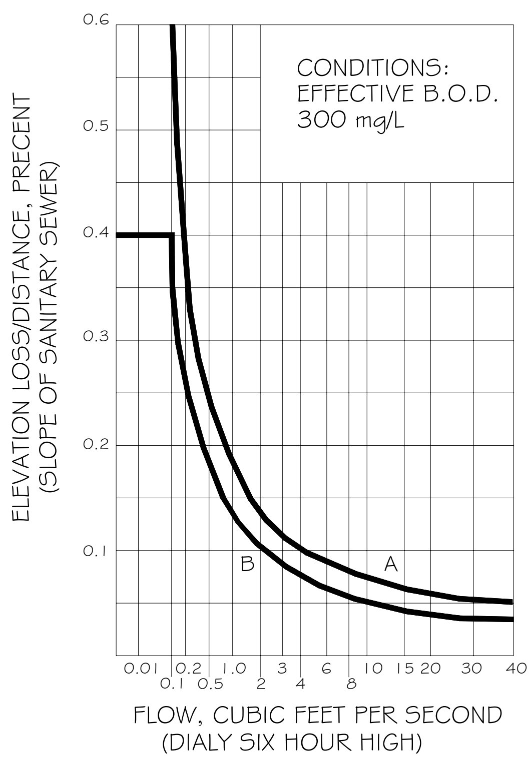

CHART "B"
Flow-Slope Relationship as a Guide to Sulfide Forecasting, Effective BOD of 300 mg/L

Chart "B" is a copied from Figure 4-5, Flow-slope relationship as a guide to sulfide forecasting, Effective BOD of 300 mg/L (From: the ASCE, Manual and Reports on Engineering Practice, No. 60, Gravity Sanitary Sewer Design and Construction, Chapter 4, Sulfide Generation, Corrosion, and Corrosion Protection in Sanitary Sewers.)

c. Selection of Pipe and Structure Material.

1) Give consideration to the selection of the sewer pipeline and structure materials when substantial hydrogen sulfide generation has been predicted and cannot be prevented through design changes in pipe size, pipe slope, etc. Design susceptible sewer pipelines and structures to resist attack from sulfuric acid, which is a product of hydrogen sulfide concentrations. Protect pipelines and structures from this condition, either by the use of H_2S corrosion resistant pipe materials such as PVC and/or linings/coatings for the sewer pipe and associated manholes/structures, manhole steps, etc.

d. Additional Design Considerations to Mitigate Hydrogen Sulfide Generation and Release.

1) For additional design considerations to mitigate H_2S generation and release, see the following sections in Part Two; Section 3 (Selection of Pipe Material - Gravity Sewer), Section 8 (Vertical Alignment - Profiles), Section 15 (Pipe Slope and Manhole Distance), Section 16 (Manhole Drop Connections), Section 24 (Force Main Design), Section 25 (Grinder Pump, Pressure Sewer System) and Appendix C.