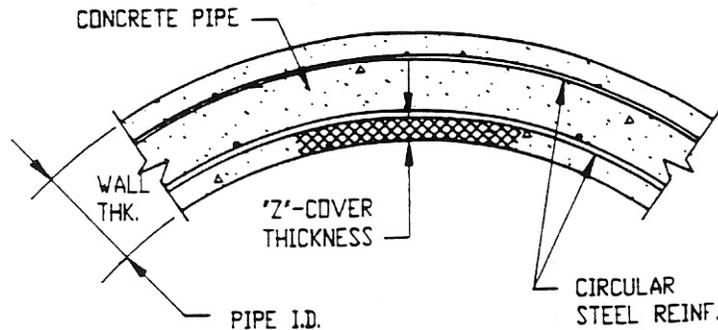


## Az LIFE FACTOR DESIGN FOR REINFORCED CONCRETE SEWER PIPE

The life of reinforced concrete pipe can be greatly extended by the use of the Az Life Factor Design procedure. Simply by knowing the characteristics of the sewage (BOD, pH, sulfides, etc.), concrete pipe can be designed to meet a longer service life. With this data, the alkalinity and thickness can be adjusted to meet those needs.



Under certain biological conditions in sanitary sewers, concrete pipe may experience some corrosion due to sulfide-induced acid generation. This paper is to point-out that the design engineer has measures available to him, such as: adjusting the concrete alkalinity by using greater amounts of limestone aggregates and/or increasing the concrete thickness over the steel to address such a condition (Az Design).

The Az Life Factor Design has been used successfully in providing the design life for concrete pipe. The "A" in the Az equation is the alkalinity of the cement bonded material, expressed as  $\text{CaCO}_3$  equivalent. This can be specified in the design of the pipe and verified by performing a Calcium Carbonate Equivalent test on the finished pipe. The "z" in the equation is the depth of concrete cover over the inner reinforcing steel cage. With Life Factor Design, the engineer needs only to specify the **corrosion protection** desired, which is the product of the two factors "A" times "z".

## **CORROSION PREDICTION**

The Environmental Protection Agency (EPA) Design Manual of "Sulfide Control in Sanitary Sewerage Systems" includes design aids that will assist in predicting corrosion rates for concrete pipes. The design service life is established and the pipe is designed for the combination of A and z to result in the specified service life. To assist in the amount of service life requirements, Rinker Materials has available, upon request, a computer design program for sanitary sewer conditions that predicts sulfide build-up and determines the Az protection for the wastewater collection systems being evaluated. The factor of safety included in the program provides for 1/3 of the thickness of the initial concrete cover over the steel be maintained at the design service life.

The American Society of Civil Engineers' (ASCE) Manual of Practice No. 69, "Sulfide in Wastewater Collection and Treatment Systems", discusses the Az concept and design procedure in detail and is recommended as a reference to help engineers understand sulfide problems, methods of quantifying, and controlling sulfides in wastewater facilities.

Also, the American Concrete Pipe Association's (ACPA) "Design Manual - Sulfide and Corrosion Prediction and Control" discusses the problems and solutions of sulfide corrosion in wastewater collection systems.

## **CONCLUSIONS AND RECOMMENDATIONS**

When hydrogen sulfide generation is of concern, the engineer should seek out the most efficient and economical solution available. For low levels of sulfide build-up, the alkalinity and thickness of standard pipe typically provides the design life; when moderate levels are predicted, then the Az Life Factor Design is recommended. In the event severe sulfide conditions are encountered that exceed the practical combination of Az, mechanically locked plastic liners in reinforced concrete pipe should be considered.