The problem of hydrogen sulphide in sewers

Foreword

It is a pleasure and privilege to write a Foreword to this Booklet by Dr. Pomeroy, both because he is an acknowledged authority on the subject that he discusses in these pages, and also because of the esteem in which these Technical Publications by the Clay Pipe Development Association are held in this country. They represent an example to other industries of what can and should be done to inform their users.

The subject of Dr. Pomeroy's Paper is one which has not until recently attracted the attention it deserves in the U.K. There have been a number of incidents of corrosion or problems of smell in this country over the years which usually derived from unusual effluent conditions or exceptionally long retention times in pumped schemes. In 1966 one of the Stevenage "Notes on Water Pollution" dealt with the subject and indicated that Water Pollution Research Laboratory workers had found good correlation with Dr. Pomeroy's formulae for the accumulation of sulphide in sewage rising mains. However, the areas of the world where the problem has occupied the attention of engineers have been those hotter countries which have established sewerage systems, such as the United States, Australia and Southern Africa. Most of the research and clarification of the problems has come from engineers in those countries although as early as 1906 C.C. James described the condition in a book dealing with sewerage work in Egypt, India and the Far East. The only recent work in this country was undertaken at the Water Research Centre and related to oxygen injection into rising mains. With the current great expansion of the provision of sewerage systems in the Middle East it behoves engineers concerned with overseas sewerage projects to be well informed on the matter and this publication will undoubtedly help to achieve that.

The Booklet sets out the subject very clearly, starting with the production and effects of hydrogen sulphide, and dealing with its occurrence in sewage in a way which will illuminate the conditions inside a sewer pipe for the designer. Predictive methods for forecasting sulphide conditions and the rates of build-up are very thoroughly dealt with. All the equations developed for this are discussed including those for the full and the part full situations, and for rates of resulting corrosion. Examples of the use of these equations make this section very useful for the designer.

Of course the Author recognises that accuracy in prediction of sulphide conditions in a sewer need not be relied upon if reliable materials capable of resisting corrosion are employed in the fabric of the sewer. In the section of his Paper dealing with this, the efficacy of vitrified clayware is rightly stressed. However, the means to prevent attack upon cementsitious materials must be perfected and the characteristics of other pipe materials must be exploited since the present size limitations of 750 mm bore on vitrified clay pipes with flexible joints means that they are not available to the engineer in all the sizes he needs.

In the nature of things of course the problems tend to be even more severe (and certainly more often noticed) in larger pipes. These are necessary in the larger sewerage systems as downstream trunk or outfall sewers and in existing systems large pipes may be essential as interceptors. In either case the retention time of the sewage is likely to be considerable before it reaches them and hence hydrogen sulphide production is very probable, particularly at high temperatures. Unfortunately, the newer materials which the engineer is forced to adopt for the larger sizes of pipe to counter likely corrosion, as a coating, a lining or the pipe body itself, do not have the track record extending over thousands of years that clay has! It is to be hoped that the engineering materials industry generally will continue to respond to the challenge of the hydrogen sulphide corrosion problem by development and improvement to provide the engineer with products whose long term dependability may be taken for granted.

There is no doubt that CPDA and Dr. Pomeroy have performed a very useful service at this particular juncture in publishing this booklet. It is to be hoped that all those concerned with sewerage will have the opportunity to read it.

Peter A. Banks  John Taylor & Sons  Westminster, SW1P 1RY  December 1976
I am pleased that CPDA are re-issuing this valuable booklet and that it has been updated by Arthur Boon. New generations of designers need reminding of the old lessons and to be given the means of assessing the risks posed by hydrogen sulphide and the ability of their current materials to mitigate them.

In this latter respect vitrified clayware still stands supreme in its size range, now up to 1,000 mm bore. Indeed the improvements both in pipe properties (notably strength) and adaptability of pipes to new user requirements have been substantial in the intervening years since the first edition. In the case of the other materials, necessary for the larger pipe sizes, coatings of cementitious pipes have been abandoned although linings continue to be reasonably effective. Plastics have made strides and experience has added much to the engineer's ability to specify the necessary characteristics.

However, in choosing materials, longevity is still the most important objective; "lay and forget" is the aim. Knowing all about the problem helps to ensure the choice is a correct one. This booklet serves admirably to ensure the engineer has that knowledge.

Peter A. Banks Acer John Taylor Westminster, SW1H 0EX June 1990

Dr. R. D. Pomeroy

Dr. Richard D. Pomeroy founded the firm of Pomeroy, Johnston and Bailey of California, U.S.A., specialists in water and waste technology.

Dr. Pomeroy is renowned throughout the world for his work in the field of hydrogen sulphide production and corrosion, and means for dealing with the problem. He has had numerous papers published over a thirty year period, culminating in writing the United States Environmental Protection Agency's "Process Design Manual for Sulfide Control in Sanitary Sewerage Systems", published in October, 1974. In the United States this document is recognised as the designers' guide for hydrogen sulphide problems.

In this booklet, written for the Clay Pipe Development Association, Dr. Pomeroy has further developed this subject and included published work from world-wide sources.

A. G. Boon

During the 32 years that Arthur Boon worked for WRc, he gained an international reputation for his research into, and knowledge of, waste water treatment processes and for the work he pioneered in the UK into the causes, consequences, and containment of sulphide corrosion of sewers. He cooperated with Dr. Richard Pomeroy and many other well-known experts to take part in the very successful IWPC seminar on "Septic Sewage: Problems and Solutions" held in 1979.

In September 1989, he joined Acer Consultants as a Director and has selected a team of experts to staff a new Process Design and Environmental Sciences office in Stevenage, which is part of Acer Environmental. His expertise in these fields, together with the environmental aspects of water supply and sewage treatment, will continue to be of service to a wide range of national and international clients.

In editing this 2nd edition of Dr. Pomeroy's booklet, Arthur Boon has incorporated the results of research carried out since its first publication and brought in some additional detail.
FIGURE 3

100 mm diameter cast iron pumping main after being in service for 25 years. The corrosion is due to graphitization.

FIGURE 4

Unequal distribution of corrosion in a concrete sewer.

Reproduced from “Sulfide Control in Sanitary Sewage Systems”, by permission of United States Environmental Protection Agency.

FIGURE 5

235mm diameter asbestos cement pipe which was bitumen lined, showing the effects of 14 years of acid attack.

FIGURE 6

Remainder of bottom third of 225mm O-G jointed concrete pipe from a sewer downstream of a pumping main discharge which had failed after less than 10 years service. The aggregate exposed after the cement had been attacked by sulfuric acid oxidised from atmospheric hydrogen sulfide in the presence of moisture is clearly visible.
FIGURE 7

Exposed aggregate and reinforcement in a concrete pipe. The concrete was attacked by sulfuric acid oxidised from atmospheric hydrogen sulfide in the presence of moisture and the reinforcement attacked directly by atmospheric hydrogen sulfide.

FIGURE 8

Attack by sulfuric acid oxidised from atmospheric hydrogen sulfide in the presence of moisture at a pressure main outfall. Most of the mortar between the clay bricks has disappeared and the concrete benching has been severely attacked.

FIGURE 9

Corrosion of 200mm concrete pipe, benching and manhole walls by sulfuric acid oxidised from atmospheric hydrogen sulfide in the presence of moisture, evident only 5 years after construction.

FIGURE 10

Corrosion of a wet well where septic sewage was continually present, 5 years after construction. The rendering had been renewed and coated with a coal-tar paint only 2 years before this photograph was taken.