Scaling of Sewer Pipes: Causes and Remedies

David Jenkins
Professor Emeritus of Environmental Engineering,
University of California at Berkeley

National Clay Pipe Institute Seminar
September 18, 2012

A piping system can be penetrated in 3 ways

Leaching
Permeation
Leaking

Leaching

Substances present in the piping itself are dissolved into the liquid flowing in the pipe

Example:

Vinyl chloride monomer from PVC pipe

Permeation

Passage of substances from the outside of the pipe, through the piping structure then into the liquid flowing in the pipe

Example:

Petroleum components from contaminated soil passing through plastic water pipes

Leaking

Passage of substances through a physical opening from outside of the pipe to inside the pipe

Example:

Groundwater infiltration into sewer systems

The scaling problem is associated with leaking

Scaling of VCP Sewer Pipes

- **VCP sewers clogged with “whitish scale” especially close to manholes**
- **Scale occurs only above the highest sewage level (the “spring line”)**
- **Scale made up of two types of material in layers**

Scale in Sewer

From PBSJ, Encinitas CA, Jan 2004

Layered Scale

Layered Scale

Layered Scale

Layered Scale

Investigation

Composition determined by:

- **Chemical analysis**
- **XRD - X ray diffraction analysis**
- **SEM/EDS – scanning electron microscope/energy dispersive spectroscopy**

Composition of Scale

- **Whitish layer:**

  Largely $CaCO_3$ (Aragonite)

- **Darker layer:**

  Largely MnO_2-containing mineral (Buserite)

How do these Minerals Form?

- **Sewer above groundwater table in dry season; no groundwater infiltration**
- **Sewer below groundwater table in wet season; groundwater infiltrates**
- **Groundwater has high CO_2 content, low pH, high Ca and is anaerobic so Mn is in reduced, soluble, manganous form**
- **Sewer atmosphere has lower CO_2 content and is aerobic**

High Groundwater

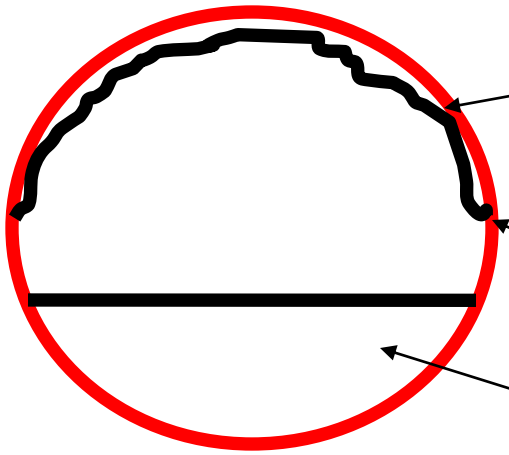
- **Groundwater enters sewer and is exposed to sewer low CO_2 atmosphere**
- **CO_2 outgases, pH increases, $CaCO_3$ precipitates (white layer)**
- **When groundwater drains to sewage surface it is diluted to a point where $CaCO_3$ does not precipitate**

Low Groundwater

- **Groundwater infiltration stops**
- **Surface of white scale surface becomes aerobic**
- **Manganous ion is oxidized by O_2 in sewer atmosphere to manganic ion**
- **Manganic ion precipitates as Buserite (black layer)**

Dry Season Situation

Ground surface



Scale from previous year

Sewer

Spring line

Sewage

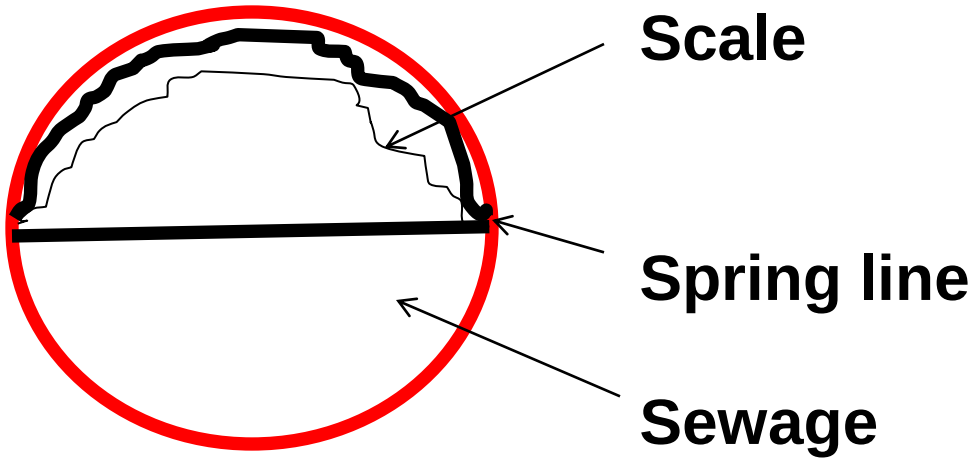
Water table

Wet Season Situation

Ground surface

Water table

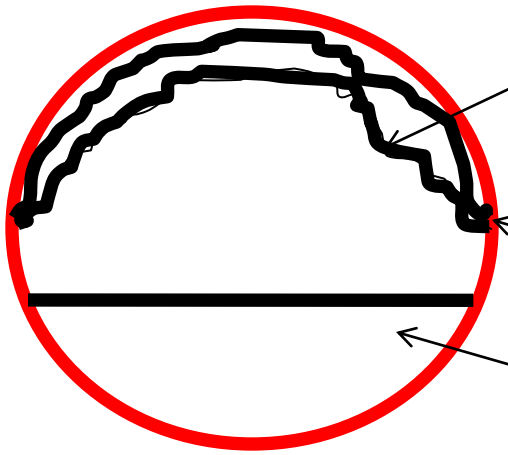
Sewer



Next Dry Season Situation

Ground surface

Sewer



Scale

Spring line

Sewage

Water table

Desert Varnish

Questions?