Steel Mains

CALCIUM ALUMINATE CEMENT (CAC)
FOR GRAVITY SEWAGE AND PUMPED PRESSURE APPLICATIONS

SINTAKOTE® STEEL PIPELINE SYSTEM FOR AGGRESSIVE FLUIDS

Cement mortar linings have been successfully used in steel pipelines to convey sewage for many years, especially in pumped pressure pipeline systems (rising mains).

Typical sewerage environments are alkaline and non-aggressive to cement mortar linings. In these non-septic/ non-acidic situations commonly usd cements, such as AS 3972 Type SR cements, provide satisfactory long term service.

Septic/acidic conditions are routinely encoutered in non-pressure gravity sewerage pipelines, whilst in pressure pipelines such conditions occur infrequently. [1]

Septic sewage contains high levels of hydrogen sulfide (H_2S). H_2S will not damage a sewer pumped rising main which remains full, except perhaps at the high points, if they are exposed to air spaces. The H_2S remains in solution and is diluted by the sewage which results in no corrosion of the pipe. With the reduced pressure at the top end of a rising main, H_2S may come out of solution, if exposed to air spaces, and enter the air space in the gravity main. The H_2S will then dissolve and be oxidised by bacteria to form sulfuric acid which is very corrosive to the cement lining.

In septic/acidic aggressive sewer environments calcium aluminate cement provides a high level of resistance and is the most appropriate material for most of these applications.

PRODUCT SPECIFICATION

Calcium Aluminate Cement (CAC) mortar lining is a solid, durable material that is used to protect the internal walls of the pipeline from deterioration. CAC has properties which protect the pipeline from aggressive fluids with extreme pH values and/or abrasive solids.

CAC lining provides superior resistance to chemical attack and abrasion, preventing degeneration of pipe walls from sewage and industrial waste. It contains a rapid-hardening material which resists high temperatures and corrosive substances (monocalcium aluminate (CA)).

STANDARDS

Steel Mains manufacturing plants are accredited to ISO 9001 and Sintakote steel pipes are StandardsMark certified to AS 1579.

BACTERIOGENIC ACID ATTACK

Gravity sewers which run partially full

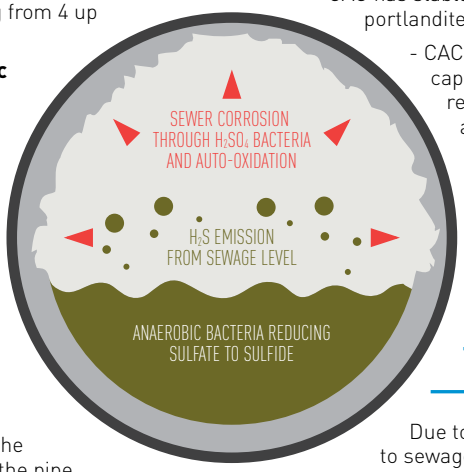
Bacteriogenic acid attack is a high-risk form of damage to cementitious materials and is common to gravity sewers which run partially full.

Under these conditions anaerobic bacteria reduce sulfates in the sewage effluent to sulfides, and lead to the formation of hydrogen sulfide (H_2S), which is then carried to the crown of the pipe by convection air currents. There it oxidises to sulfur or dissolves in moisture to form sulfuric acid (H_2SO_4), both of which are used as nutrients, for a second set of aerobic bacteria.

This type of damage occurs when the interior surface of the pipeline above the fluid level is exposed to sulfuric acid generated by bacterial action at the pipe wall as shown in the graphic below. This is known as biogenic sulfuric acid corrosion (BSAC).

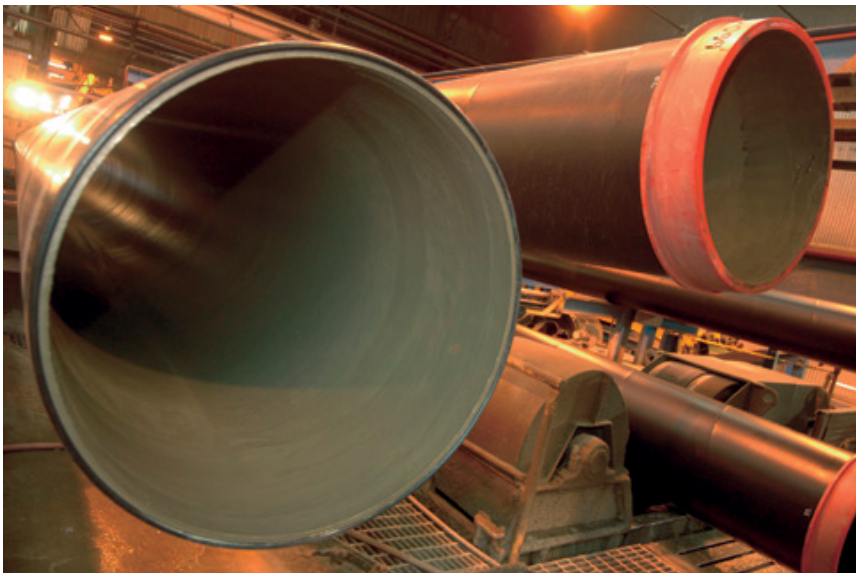
This acid destroys Portland cement mortar by reacting with portlandite and calcium silicate hydrate, dissolving the calcium and leaving the structureless silica gel.

Damage can range from superficial loss to complete breakdown of mortar and thus the structural integrity of the pipeline. Calcium Aluminate Cement is a more sophisticated form of cement than Portland cement, and is able to accommodate fluids with pH values ranging from 4 up to 12.



Bacteriogenic acid attack

- Sulfates produced by bacteria.
- Reduction of sulfates to sulfide by anaerobic bacteria living in the slime layer.
- Turbulence ejects H_2S dissolved in the effluent into the pipe atmosphere where it is carried by convection to the pipe crown.
- Oxidation of H_2S to sulfur.
- Transformation of sulfur to sulfuric acid by aerobic bacteria.
- Dissolution of the cement mortar.



CAC ACCOMMODATES EXTREME PH RANGES

PH 4 TO PH 12

Calcium Aluminate Cement (CAC) mortar linings also protect the internal steel surface from corrosion and tuberculation when conveying aggressive fluids common in sewage and wastewater pipelines.

CAC affords much greater resistance to these environments due to a combination of three main factors:

- CAC has stable hydrates containing no portlandite;
- CAC has higher neutralisation capacity than Portland cement requiring nearly twice the amount of acid to destroy the same mass of material;
- CAC has lower bacteriogenic acid production.

RESISTANCE TO CORROSION

Due to CAC's high resistance to sewage and wastewaters, in combination with extraordinary abrasion resistance and high resistance to biogenic sulfuric acid corrosion, CAC provides a cost-effective solution for sewerage systems and wastewater plants.

CAC linings conform to the requirements of AS 1579 and AS 1281.

FIELD CUTTING

When pipes are field cut the CAC cement mortar, at the field cut, may require reinstatement with a calcium aluminate premix such as Sewpercoat®.

Refer to the Sintakote Steel Pipeline Systems Handling and Installation Manual.

CML LIMITS

The following limits on the use of cement mortar lining in pumped/pressure sewer pipelines are recommended:

AS 3972 Type SR (Sulfate Resistant) cement is recommended for sulfate levels up to 6,000mg/L, for continuous exposure to pH values down to 6.0 and for air gap hydrogen sulfide levels (H_2S) up to 0.5 ppm.[1]

Calcium Aluminate Cement (CAC) (as specified in EN 14647) is recommended for sulfate levels up to saturation (no limit), for continuous exposure to pH values down to 4.0, and for hydrogen sulfide levels (H_2S) up to 10 ppm.[1]

Cement	Sulfate limit mg/l	Continuous exposure pH limit	H_2S limit mg/l
AS 3972 Type SR	<=6,000	>=5.5	<0.5
CAC to pr EN 14647*	No limit >=4.0	<10	

[1] WSAA Technical Note 6.

THE SINTAKOTE® PIPELINE SYSTEM

Over the past 50 years there have been many significant developments in Steel Mains Steel Pipeline Systems covering the full spectrum of materials, manufacturing, quality assurance, products, services, feedback systems, design, distribution, along with handling and installation. The Sintakote Steel Pipeline System includes a range of products and services, which are new or have significant enhancements. These include amongst others: Sintakote® coating, Sintajoint® rubber ring joint and Sintalock® I & Sintalock® II welded rubber ring joints.

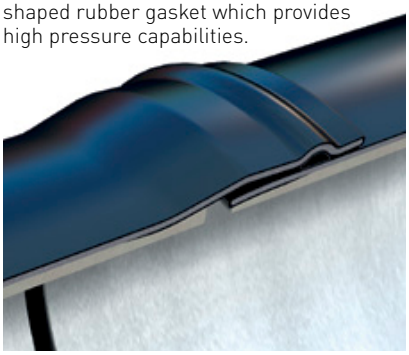
EXTERNAL SINTAKOTE PROTECTION SYSTEM

Sintakote fusion bonded medium density polyethylene coating is a proven high chemical, high impact and load resistant external coating which provides a complete joint and external pipe corrosion protection system.

Sintakote is resistant to all the relevant chemicals, compounds and solutions commonly encountered in water and wastewater industry applications, including muriatic acids, as well as marine organisms and compounds found in aggressive soils.

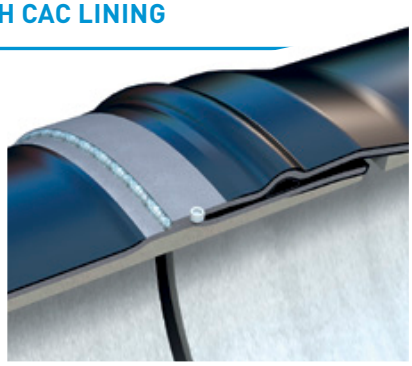
SINTAJOINT® AND SINTALOCK® WELDED RUBBER RING JOINTS WITH CAC LINING

Sintajoint rubber ring push-in steel pipe joint is the most robust flexible pipe joint available. It features a single, specially shaped rubber gasket which provides high pressure capabilities.



Full corrosion protection of the steel pipe is achieved by extending the Sintakote coating around both spigot and socket ends to underlap the cement mortar/ calcium aluminate cement lining.

No field heat shrink sleeves or wrapping, application or reinstatement of cement mortar corrosion protection is necessary, either internally or externally. This tried and proven jointing system has been used for more than 35 years.



Steel Mains Sintalock joint consists of a rubber ring push-in joint and external site fillet weld. Sintalock does not require internal welding or CAC lining reinstatement and enables construction of a fully, end restrained pipeline without the need for concrete thrust blocks. This is a significant improvement on standard welded joints as it eliminates the safety issues associated with man entry as well as the need for joint reinstatement of the lining.

Sintakote Steel Pipe combines the best features of unique steel pipe jointing systems (Sintajoint & Sintalock) with materials that provide superior resistance to chemical attack and abrasion

> Now designers, installers and operators can have the confidence, not only in the proven mechanical strength of Sintakote steel pipe, but in its enhanced ability to resist internal attack from aggressive fluids such as sewage and industrial waste.
>
> This is achieved by using calcium aluminate cement (CAC) in lieu of sulfate resisting (SR) cement in the barrel lining.
>
> CAC is an effective lining for aggressive fluids with extreme pH values and/or abrasive particulate.

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