Since 1943, as STORK KST, a heritage of Service Expertise, Manufacture and Supply of Fine T-GRIP™ lining to the Environmental and Wastewater Management Industries.

KST HOLLAND

- **6 decades of reliable service to our customers on 4 Continents**
- **T-GRIP™ lining for Concrete Pipes, Tunnels and Structures**
- **T-GRIP™ lining systems that are Engineered to meet the most demanding of specifications**
- **T-GRIP™ lining systems that are highly adaptable for general chemical tank-linings service**

QM S

ISO 9001
REGISTERED FIRM

T-GRIP™ lining systems in PVC, HDPE, LLDPE, FPP to meet the challenges of a changing world

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DRY-CAST
PLASTIC LINED
PIPE PRODUCTION

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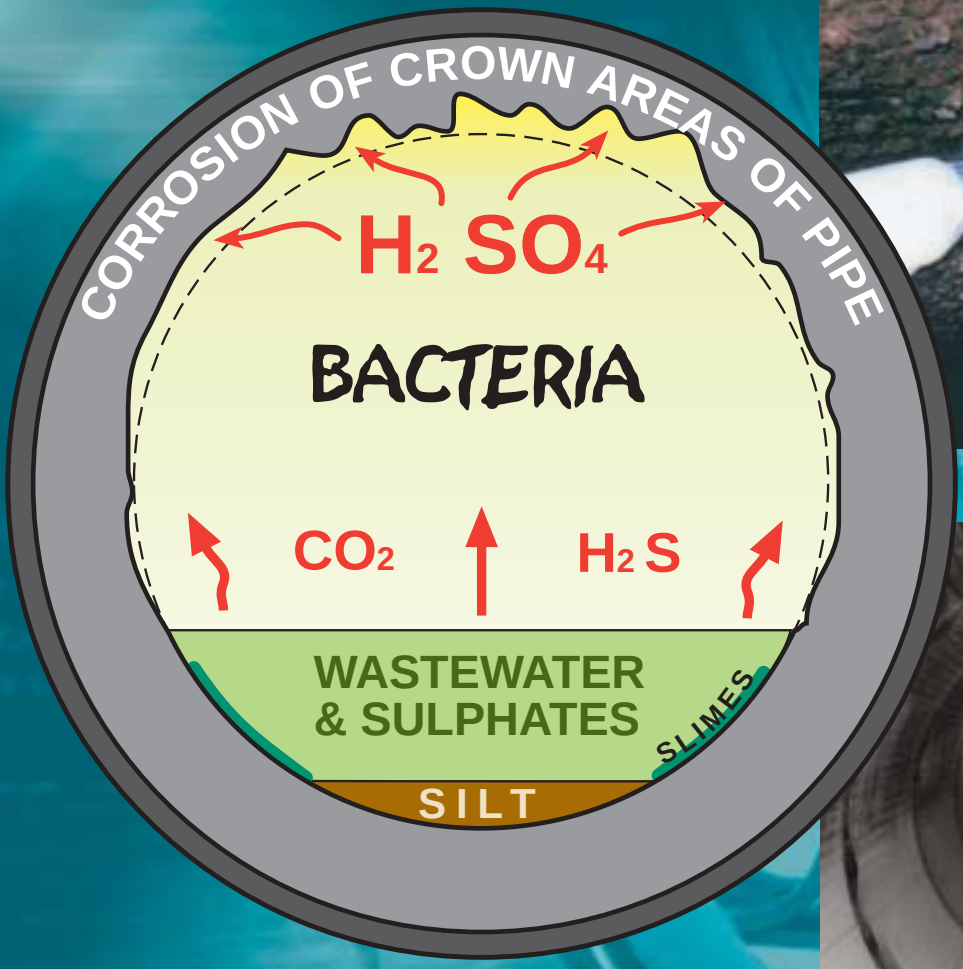
THE PROBLEM



THE PROCESS

- Organic Sulphates and Inorganic Sulphides are present in the slimes of sewerage flows and form the Total Sulphides present in the sewerage.
- A fraction of the dissolved Hydrogen Sulphide is released into the sewer atmosphere as a gas.
- A process of bacterial reduction occurs when the Hydrogen Sulphide, in combination with the other gases, such as Carbon Dioxide, is progressively oxidised, reducing the Ph to the point where it splits off with water molecules to form Sulphuric Acid.
- The powerful inorganic Sulphuric Acid reacts with hydrated calcium silicates and lime in the cement structure and reduces it to a soft swelling paste.
- Conditions are optimal for this process of Sulphide attack when there is high BIOLOGICAL OXYGEN DEMAND, PRESENCE OF SULPHATES (Common in all water systems), HIGHER AMBIENT TEMPERATURES (quickening the kinetics of breakdown and reduction), LONG DETENTION TIMES (Flat grades – low velocities)

THE OPTIONS

Various methods have been used and tried in the past, these include :

- Overdesign of Sewerage Systems, including greater wall thickness in pipes and tunnels and the provision of ventilation shafts and machine ducted air to reduce and remove the Hydrogen Sulphide gas.

  These methods are very expensive and are only partially effective.

- Bacteriocides : These are added into concrete, using a special process of Octration with the express aim of preventing bacteria forming on the concrete surface.

  The effect is strictly limited and is practically ineffective, being, at best, a palliative measure.

- Provide special concretes : [Calcareous aggregates, Type 5 Seawater cement, Hi Alumina cement such as Ciment Fondue.]

  These can sometimes delay the onset of serious Hydrogen sulphide corrosion [in case of calcareous aggregate] but they are purely palliatives, in the medium term.

- Liquid applied coatings : Such as Bitumens, Coal-Tar epoxies and even expensive urethane elastomers.

  These all eventually fail owing to the phenomenon of 'pin-holing' that occurs when coatings are sprayed onto a surface. These small asperities in the body of the applied film provide an easy route to the concrete substrate for the small Hydrogen Sulphide molecule. Also concrete provides a difficult and uneven substrate to paint or coat, with unviable surface tension effects.

HDPF T-GRIP™ palletized for export

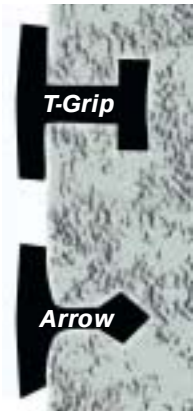
HDPE Lined pipe at U.A.E. Factory

Soffit of wastewater tank structure

THE SOLUTION

- Provision of a lining made of flexible plastic that is chemically inert when subjected to Sulphuric Acid attack. The lining shall be made from thermo-plastic PVC or other flexible plastic, provided there are no pin-holes and that an effective way of attaching the plastic to the concrete is devised.
- Paint or coatings do not adhere very well to concrete – neither do glues or adhesives - PROBLEM
- The solution was found in 1947 when the first T-ribbed liner were made in the USA. Being cast into concrete, at the time of manufacture, the T-ribbed lined pipes were fully protected by mechanically anchored PVC plastic liners.
- These linings were extruded under heat and pressure to form a high grade plastic of high molecular weight, intrinsically free of voids and pin-holes in its structure. Further, the lining was thermo-plastic, meaning that it could be heated to melting point, allowed to cool, and it would remain unchanged in all physical and chemical characteristics. This meant that the material could be fused to itself by the application of heat, thus rendering it weldable into continuous lengths.

- In the early 1990's, KST HOLLAND BV, then a supplier of PVC T-GRIP™ liners innovated the T-ribbed Polyethylene lining system, thus improving the generics of the type, by providing stronger and more chemically resistant plastics such as Linear Low Density Polyethylene (LLDPE), High Density Polyethylene (HDPE) and Flexible Polypropylene (FPP).
- Since these developments our T-GRIP™ lining system which includes PVC and the Polyethylenes have been widely accepted on four continents as the benchmark of quality and innovation.
- KST offers 2 ribbed profile variants in T-PROFILE and ARROW PROFILE for various types of lining processes. The ARROWLOCK PROFILE is most suitable for Spun Pipe-Making.
- The KST T-GRIP™ lining system is the ultimate SOLUTION to the PROBLEM of Hydrogen Sulphide attack in wastewater storage and conveyance systems.



THE PRODUCTS

KST Holland BV manufactures HDPE and PVC linings in different profiles and thicknesses for our Pipe-Lining business. The same grades, plus Flexible Polypropylene are available for lining structures and tanks. We can supply our T-GRIP™ lining in any colour, the main colours are Black, White and Blue.

THE APPLICATIONS

The primary application for these T-GRIP linings is for Pipe and Tunnel and concrete structures linings in Wastewater service.

Other applications :

- Tanking of Structural foundations to protect concrete against aggressive salts and chemicals
- Tank-Linings in the electro-plating industry (PVC, HDPE and FPP grades.)
- Cell-Liners in Copper and Zinc refining (Used instead of Lead Linings)
- Linings for clean products storage
- Linings for Hydrofluoric Acid Tanks
- HDPE tanking for jetty caissons

Innovative digester tank construction in U.S.A. with black T-GRIP™ polyethylene lining. (In U.S.A. also under the trade name Corr-Tite)

Construction of T-GRIP™ PVC lined culvert

Digester Dome construction with blue polyethylene T-GRIP™ lining in U.S.A.

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QUALITY CONTROL ASPECTS OF T-GRIP™ LINING SYSTEMS

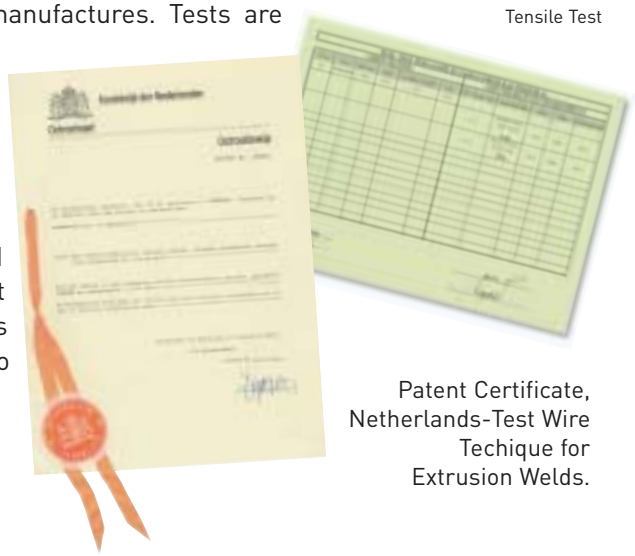
Density Test

The main attractions of the T-GRIP™ lining systems are their USER FRIENDLINESS. This makes them popular with the pipe-making community and contractors everywhere.

KST T-GRIP™ LININGS are subjected to regular Batch Testing as part of our ongoing programme of QA/QC which starts at the factory were the linings are made. Our linings go through the following routine tests :

- Batch tests are carried out at our factory laboratory, which is certified to ISO 9001 EN Standard. These tests are carried out on each batch manufactured and cover Physical properties such as Melt Flow Index, Specific Density, Tensile properties, Hardness and Pigment content.
- Independent Laboratory testing is carried out periodically in order to properly codify each type of lining that KST manufactures. Tests are carried out on LLDPE, HDPE and PVC types to check on all Physical and Chemical properties under 112 immersion conditions, as called for in the GREEN BOOK FOR PUBLIC WORKS CONSTRUCTION of the CITY OF LOS ANGELES.
- Weld tests are carried out in our laboratory and at job sites everywhere our linings are supplied to. The testing of welds is probably the most important aspect of overall Lining quality, as CONTINUITY OF THE LINER SYSTEM is crucial to long-term security and peace of mind.

Tensile Test



Patent Certificate, Netherlands-Test Wire Techique for Extrusion Welds.

Careful Field Testing carried out on a regular basis

QUALITY CONTROL, VERIFICATION, INSPECTION, AND CERTIFICATION

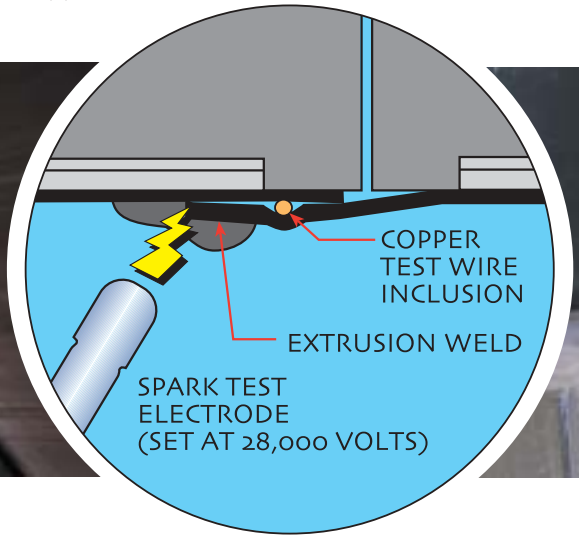
The above tests are typically carried out on a daily basis at the UK factory, KST PROTECTIVE LININGS Ltd.

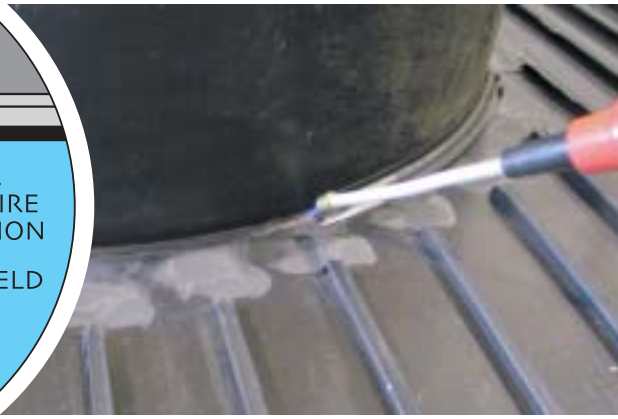
Field welds are tested by spark-testing and by tensile testing at a laboratory in Abu Dhabi, where the SEWERAGE PROJECTS COMMITTEE maintains one of the highest standards of Quality Control in the world today.

Independent Test Reports

Close inspection and maintenance of pipes before use

Test Wire inclusion





Live Spark Test

Lined Manhole

KST Liner in rolls ready for Export by Air Freight

THE PROPERTIES

- PVC linings have excellent hot-air welding properties and are suitable for use as man-hole linings.
- PVC has great flexibility and is highly suitable for lining complicated shapes
- HDPE can be used in pipes and funnels and is also suitable for tanks and chambers in both sewerage and chemical storage service
- PP (Flexible Polypropylene) can be used for the lining of process tanks where higher ambient temperatures are normally obtained.
- Temperature ranges of materials :

PVC: Zero degrees centigrade up to 65 degrees centigrade

LLDPE / HDPE: Minus 35 degrees centigrade up to 65 degrees centigrade

PP: Minus 35 degrees centigrade up to 100 degrees centigrade

Mosul, Iraq

KST Liner on form. Culvert construction, Mosul, Iraq

WELDING

Hot Air Welding

High Frequency Welding Machine for Flex pvc T-GRIP™

PVC is welded using Hot Air and High Frequency methods, as per the picture gallery above.
Equipment is obtainable through your reliable KST partner.

Extrusion Welding

Butt Welding Machine for HDPE T-GRIP™

HDPE is welded using Hot-Air, Butt-welding and Extrusion welding techniques.
Generally Butt-Welding is only used for thicknesses of 2mm and above.

Photographs of Proprietory equipment, available through KST Holland BV.

Wall Crawler Welder

Welding robot

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EXPERIENCE

Having manufactured and sold over three million square metres of T-GRIP™ in both PVC and Polyethylene grades, KST Holland BV is the major European based supplier of this Liner Type, with 100% of our UK factory's production being exported to Europe, the Middle-East, the Americas and Asia.

We serve our customers by regular contact and we have a thriving associate in the USA, which handles all our structural Linings business.

Throughout the years KST Holland has introduced new methodologies in the Linings field that have now become Standard practice in the industry as a whole.

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INTERNATIONAL PROJECTS

HDPE T-GRIP™ lined pipes on SPC, U.A.E.

PVC. T-GRIP™ lined pipes, Saudi Arabia

Osman Group, Cairo, Egypt

Liner preparation, Singapore

Finished Culvert, Iraq

Manholes, Saudi Arabia

Culverts in Thailand

LLDPE T-GRIP™ lined Digester Dome, U.S.A.

Manufacturing T-GRIP™ lining since 1975

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THE COMPANY

The Company has been going since 1943, when it was called STORK KST, and rapidly became a big name in Synthetics, working with hard plastics and the early developing PVC. Throughout our lifetime KST HOLLAND BV has always been a 'hand's on' Company, developing its vast experience through long-term involvement in plastics linings in Wastewater Utilities and the Environmental field. Today the Company is part of the Duursema Group and is a multi-million Euro organization with Total Group Sales of over 75 Million Euro.

KST HOLLAND BV

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Production and Laboratory
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KST Protective Linings Ltd., England

U.K. Factory