



# MAINTAINING ASSET INTEGRITY IN THE OIL AND GAS INDUSTRY – DOWNSTREAM

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Belzona Protective Coatings and Engineering Composites

## OUR HISTORY

Established in 1952, Belzona has pioneered innovative polymer technology that has revolutionised industrial repair and maintenance procedures. Proven success has also led to a growing number of prominent clients specifying Belzona materials as a cost effective solution at the design stage of a project.

Today, Belzona is the world leader in the supply of polymer repair composites and industrial protective coatings and is continuously developing solutions to meet the ever increasing market demand.



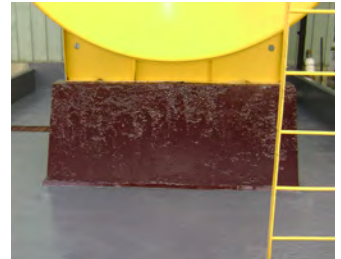
100% solids epoxy protective linings



Breathable membranes for sealing applications



Composites for bonding, shimming and rebuilding



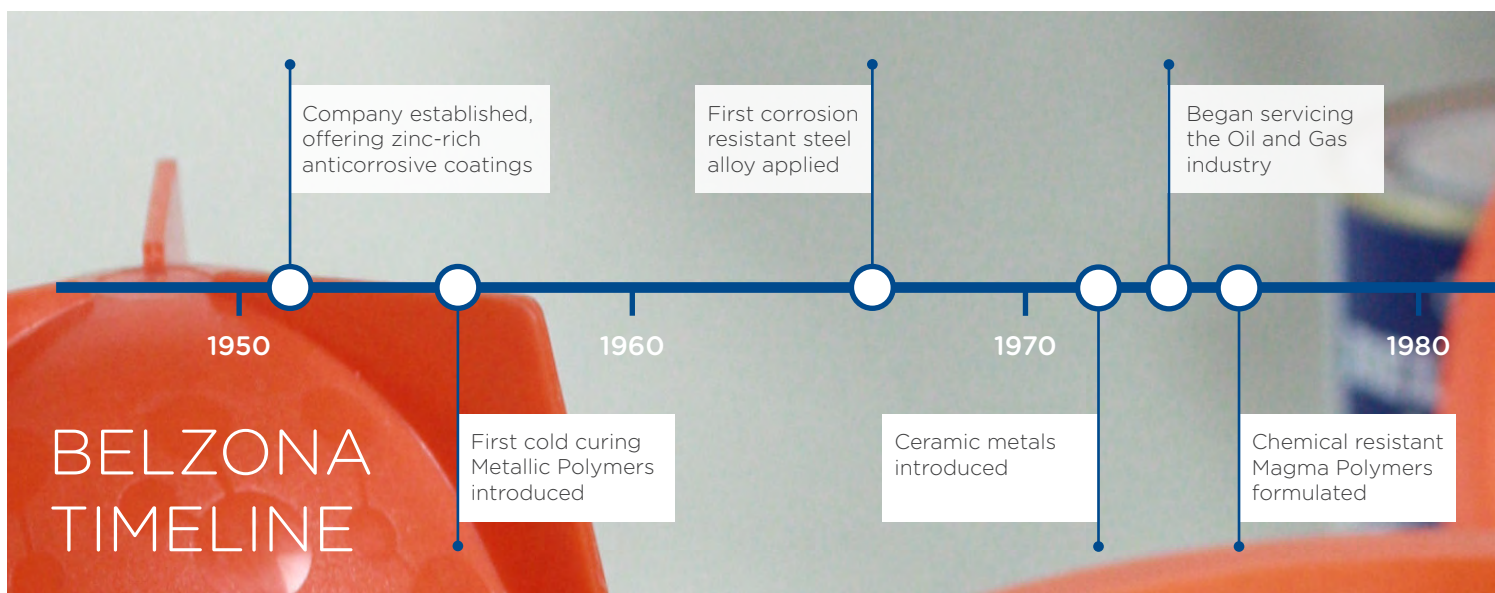
Chemically resistant mortars and coatings

## NOVEL SOLUTIONS TO AGE-OLD PROBLEMS

Aggressive chemicals and erosion-corrosion can take their toll on equipment and structures, resulting in increased capital and operating expenditure. Elevated temperature and pressure levels tend to exacerbate the problem and necessitate the use of high performance protective and repair materials with a proven track record. By utilising a Belzona solution, asset owners and engineering houses can incorporate suitable protection into the design of a newly built piece of equipment. Components that have been damaged in service can also be refurbished. Oil and Gas companies choose the Belzona solution because it helps them to:

- Reduce capital expenditure
- Lower maintenance costs
- Improve efficiency and safety
- Reduce downtime
- Simplify maintenance procedures
- Extend machinery and equipment life

Belzona offers a range of coatings and composites carefully formulated to address various issues faced by the Oil and Gas industry. We take pride in the quality of our materials as well as the comprehensive training and field support we provide to ensure the highest possible application standards.



# GLOBAL PRESENCE - LOCAL SUPPORT

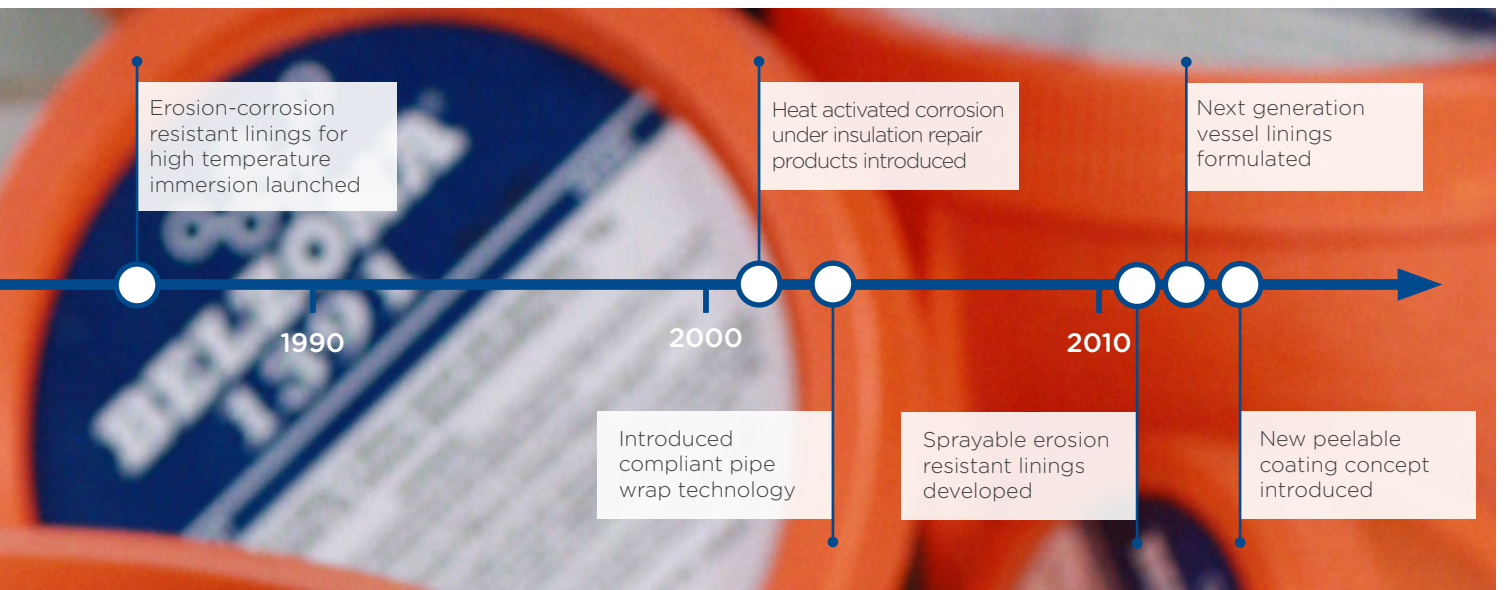
Belzona have over 140 Distributors in more than 120 countries ensuring not only the availability of Belzona materials, but also specification support, project management, application and supervision services. Distributorships and their teams are supported by Belzona Corporate offices in Europe, North America and Asia.

To find your local Belzona representative visit [belzona.com/find](http://belzona.com/find)

**● CORPORATE OFFICES**

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Our expert Technical Consultants with years of field experience and advanced training are available to assist you every step of the way to: discuss material selection options, diagnose the problem, recommend a solution and provide on-site application support.





# INTERNAL SURFACE PROTECTION FROM FLOWING CORROSIVE MEDIA

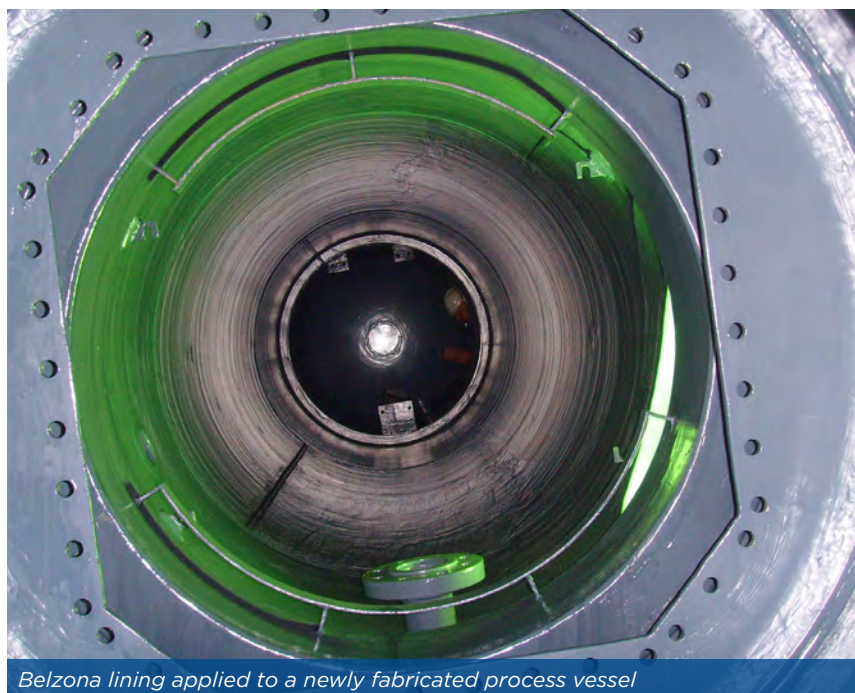
Process vessels - protective linings and repair composites

*Applied at ambient temperatures, VOC-free Belzona linings facilitate corrosion prevention and repairs.*

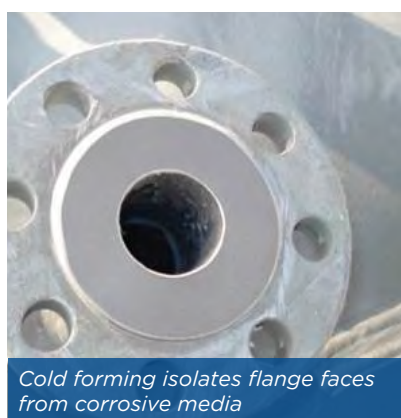
Belzona liquid applied vessel linings were first specified downstream in 1995 for a process vessel at a refinery in Hampshire, UK. The Belzona system was able to prevent damage previously caused by H<sub>2</sub>S attack and steam decontamination. Following an inspection in 1999, absorbers, scrubbers and other vessels were lined and confirmed to be in excellent condition during the 2007 shutdown. We now offer a complete solution for pressure vessels handling amines, liquid hydrocarbons, gas and process chemicals including desalters, towers, columns and many more. Based on the experience of corrosion repair and prevention, in the early 2000s asset owners and operators began to specify Belzona linings at the design stage to protect newbuild vessels.

Our linings can be spray or hand applied and, once cured in service, form a barrier between the substrate and corrosive media, enabling the operator to implement a corrosion management plan. As well as resisting erosion-corrosion, Belzona linings are designed to withstand vast pressure and temperature fluctuations, including steam-out and explosive decompression.

In addition to internal vessel lining, a complete corrosion solution includes small bore nozzle and flange face protection in order to fully isolate the substrate from a corrosive environment. The Belzona vessel lining system offers long-term corrosion protection and is easier to maintain than alternative technologies.



*Belzona lining applied to a newly fabricated process vessel*



*Cold forming isolates flange faces from corrosive media*



*Prefabricated Belzona inserts bonded into small bore nozzles*







Video: Process vessel corrosion protection



### VESSEL LINING REPAIRS

Failed coatings (or Belzona linings due for planned maintenance) can be repaired in-situ with minimal disruption to operations. Patch repair, partial recoat or full recoat options reduce downtime, prolong vessel service life and extend maintenance-free periods.



Touch up after 9 years



Glass flake lining repair



Full recoat

### FLANGE FACE FORMING

Crevice and galvanic corrosion can be prevented or repaired with a unique Belzona composite forming technology. Prefabricated formers are used to shape the specified Belzona material that bonds strongly to the flange face. The sealing face is then effectively isolated from corrosive media whilst maintaining its shape and profile.



Corroded flange



Forming technique



Completed application

### SMALL BORE NOZZLE PROTECTION

Narrow nozzles no longer need to be considered "the Achilles' heel" of process vessels. Tailor made Belzona inserts are bonded into the nozzle using a fluid grade material, eliminating the risk of pinholes or holidays. Excellent chemical and erosion resistance ensures long-term protection of the nozzle, thus extending maintenance-free periods.



Deteriorated nozzle



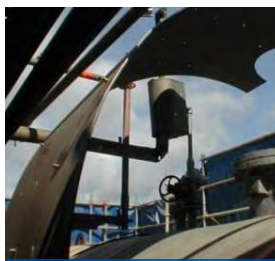
Prefabricated insert



Nozzle protected

### WALL DEFECT REPAIRS

Vessel and tank wall deterioration can lead to thin and through wall defects. Cold plate bonding allows for on-line repairs and eliminates the need for post weld heat treatment. Tensile shear, tensile and cleavage adhesion tests performed show that Belzona bonding can be superior to welding.



Dry fitting the plate



Injection bonding



Full contact

For more information read In Focus: Process Vessels, [belzona.com/vessels](http://belzona.com/vessels)



# INTERNAL SURFACE PROTECTION FROM FLOWING CORROSIVE MEDIA

Protective linings and repair composites

## TANK LINING

Tanks are susceptible to corrosion, which can lead to structural degradation and subsequently loss of containment. Sufficient long-term protection, which can be applied and maintained with minimal disruption to operations, is integral to the smooth running of tank farms. Belzona first formulated tank linings and coatings in 1971, to offer lasting protection from crude oil and oil based chemicals. As well as preventing tank corrosion, linings can be applied to newly installed tanks and offer lasting protection, thus extending maintenance-free periods.

For more information visit [belzona.com/tanks](http://belzona.com/tanks)

## TRANSFER PIPE LINING

Sand entrainment and high flow rates coupled with large quantities of CO<sub>2</sub>, H<sub>2</sub>S and brine can lead to pipe corrosion rates of several hundred mils per year. In 2012, Belzona pioneered a spray-friendly pipe lining system that offers erosion-corrosion protection. The substitution of hard-ceramic fillers for a thermoplastic filler blend ensures there is very little wear to the spray equipment.

The material is spin spray applied in situ at wet film thickness up to 2000 microns without sagging, effectively covering girth welds and joints in a single coat. The thermoplastic filler blend is formulated to achieve excellent impact and sliding abrasion resistance, a high degree of toughness and chemical resistance. Belzona also offers barrier coatings for the external protection of buried pipework.

For more information download a white paper on [belzona.com/1331](http://belzona.com/1331)



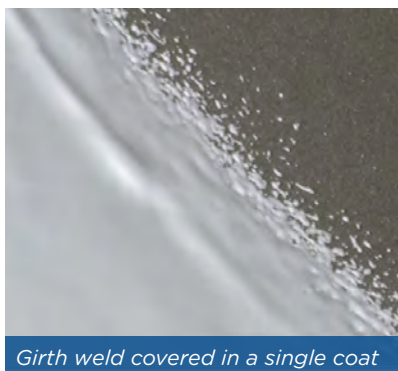
Unprotected tank



Tank lining application



Newly fabricated transfer pipes coated



Girth weld covered in a single coat



Spin spray application



Video: Spin-sprayed pipe lining



## HEAT EXCHANGER REPAIR AND PROTECTION

When exposed to an electrolytic solution, galvanic corrosion occurs at the interface of the tube and the tube sheet. Belzona composites and coatings have been used for heat exchanger repair and protection since the 1970s, with known applications in service for over three decades. The Belzona solution eliminates the need for part replacement, therefore significantly reducing maintenance expenses, and offers excellent adhesion as well as erosion and chemical resistance.

In order to prevent galvanic corrosion, new heat exchangers can be designed and coated with Belzona, thus reducing expenses associated with repairs or replacement.

For more information visit [belzona.com/hex](http://belzona.com/hex)

## PUMPS – PROVEN LONG-TERM PROTECTION

Pump deterioration leads to decreased pumping efficiency and eventually costly part replacement. Pitting, worn wear ring clearances as well as casing thin and through wall defects can be rebuilt using composites specifically designed for erosion-corrosion resistance under immersion. Pumping efficiency is restored and enhanced with the use of a hydrophobic smooth lining, which also protects from erosion and corrosion. Once the pump has been protected with Belzona, it can remain maintenance-free for many years with applications still in service after several decades.

Due to over 30 years' experience in repairing and restoring pumps, Belzona linings are now specified to protect new pumps, thus significantly extending the lifetime of the assets and subsequent maintenance-free periods. Belzona linings have become a first choice in protecting centrifugal and positive displacement pumps from erosion-corrosion and cavitation damage.

For more information on Belzona solutions for pumps view a 3D map detailing various application areas and case studies on [belzona.com/pumpmap](http://belzona.com/pumpmap)



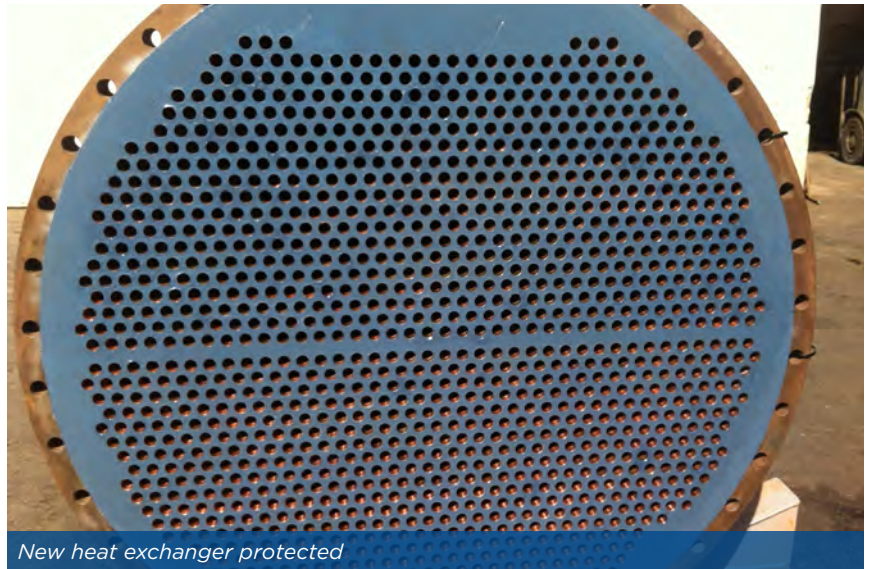
Video: Pump repair and protection



Repaired tube sheet after 35 years



HEX head repaired and protected



New heat exchanger protected



Pump replaced annually



Repaired, in service for over 3 years



Severe erosion-corrosion



Belzona repair after 9 years in service



## COLD BONDING

Restoration of structural integrity and bonding of fittings

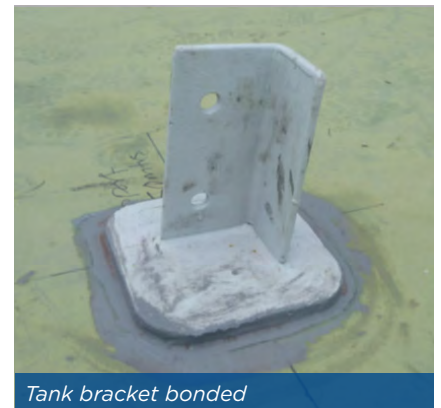
*Applied at ambient temperatures, 100% solids Belzona materials create a high performance adhesive.*

Design and maintenance scenarios that would historically involve hot work can be completed with the use of polymeric cold bonding composites. This technology is applied and cures at ambient temperatures, thus improving safety and reducing downtime.

Belzona bonding was first used in the late 1950s to attach equipment ID tags. Over the years, materials were enhanced to resist higher pressures and temperatures as well as demonstrate comparably high adhesion and compressive strength.



Pipe supports bonded



Tank bracket bonded

## COLD BONDING FITTINGS

Cold bonding of fittings eliminates the need for hot work and facilitates rapid installation. With tensile shear adhesion of up to 2,960psi (20.4MPa), pull off adhesion of up to 3,240psi (22.3MPa) and flexural strength of up to 14,300psi (98.6MPa), fittings, framework, handrails and supports can be bonded permanently and safely.



Sprinkler system bonded

## RESTORING STRUCTURAL INTEGRITY - PLATE BONDING

In order to facilitate in-situ repairs of severely corroded equipment and structures, Belzona pioneered cold plate bonding technology. This technique has been successfully utilised for structural integrity restoration whilst maintaining site safety. Over a decade of successful applications which are still in service today attest to this method's effectiveness.

To see Belzona Know-How in action, including bonding applications, visit our dedicated case study database [khia.belzona.com](http://khia.belzona.com)



Through wall defect



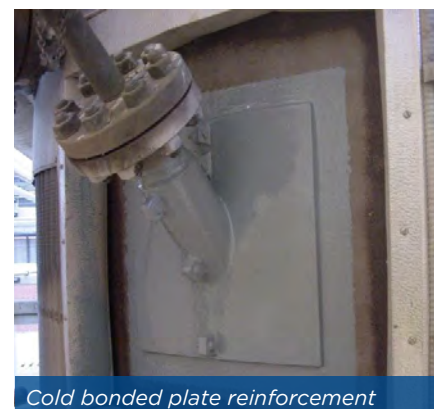
Belzona plate bonding



Video: Injection bonding



Corroded nozzle



Cold bonded plate reinforcement



# EXTERNAL CORROSION REPAIR AND PROTECTION

Wraps, plating and peelable coatings

## PIPE WRAPS AND PLATE BONDING

Thin and through wall defects caused by external and internal corrosion can be repaired using composite wrap systems. A wrap system is composed of a reinforcement sheet and a Belzona material, tailored to the asset's performance criteria, such as presence of contaminants, operating temperatures and pressures amongst others. A wrap system can also be applied in conjunction with a bonded plate where additional structural reinforcement is required.

Following almost five decades of pipe wrap installations, in 2007 we added Belzona SuperWrap to the range, which is compliant with ASME PCC2 Article 4.1 and ISO/TS 24817. Every Belzona SuperWrap system is individually designed and applied by validated specialists. Repairs can be carried out to a variety of defects to restore pressurised pipeline and pipework integrity. In 2014, Belzona SuperWrap II was released, which exhibits greater strength and allows for a much more efficient application procedure, therefore reducing overall costs and downtime.

For more information read In Focus: Pipe Wraps on [belzona.com/wraps](http://belzona.com/wraps)

## FLANGE PROTECTION

Repairing flange crevice corrosion can be a very costly exercise, whereas common preventative measures in most cases are not 'inspection friendly'. Belzona encapsulating membrane system seals bolted flange connections preventing corrosion. The liquid applied system includes a corrosion inhibitor and was designed to allow for periodic inspection, where the flexible protection can be cut, peeled back and then easily resealed. To maintain Health and Safety standards, the system is hand applied and cures at ambient temperatures and can resist common corrosive media.

For more information visit [belzona.com/3411](http://belzona.com/3411)



Video: Application, peeling and resealing



Leaking brinefield pipe



Belzona plate bonding



Belzona SuperWrap II on a t-piece



Belzona SuperWrap II applied



Flange in need of protection



Belzona 3411 applied



Peel to inspect, reseal to protect



# EXTERNAL CORROSION REPAIR AND PROTECTION

Pipework and towers - heat activated and cold applied materials

## CUI REPAIRS

Corrosion under insulation occurs at an accelerated rate and can remain undetected for some time. Taking affected parts of the pipework out of service for repairs or replacement can in turn lead to high costs and lengthy downtime. To address this problem, in the late 1990s, Belzona formulated heat activated composites and coatings that facilitate on-line repairs. These materials adhere exceptionally well to hot contaminated surfaces and penetrate deep into the substrate eliminating the need for an angular profile prior to application.

Application is carried out on-line, avoiding downtime and the need for replacement. Simple manual preparation and brush application have inspired the use of Belzona heat activated materials to combat CUI globally.

Typical applications in the range of -10°C to 150°C (50°F – 302°F) will resist commonly found inorganic acids and alkalis at concentrations up to 20%.



CUI solution applied on-line onto hot contaminated surfaces



On-line application



Completed application

## INSULATION PROTECTION

In order to prevent CUI, Belzona designed a liquid applied breathable insulation encapsulation system in the 1980s. This membrane system can be applied to protect the lagging of pipework, towers and LNG spheres. The system keeps the underlying substrate dry by allowing for the vapour to escape and facilitates localised inspections. This system is durable and fire retardant and remains flexible in service.

For more information on CUI solutions visit [belzona.com/cui](http://belzona.com/cui)



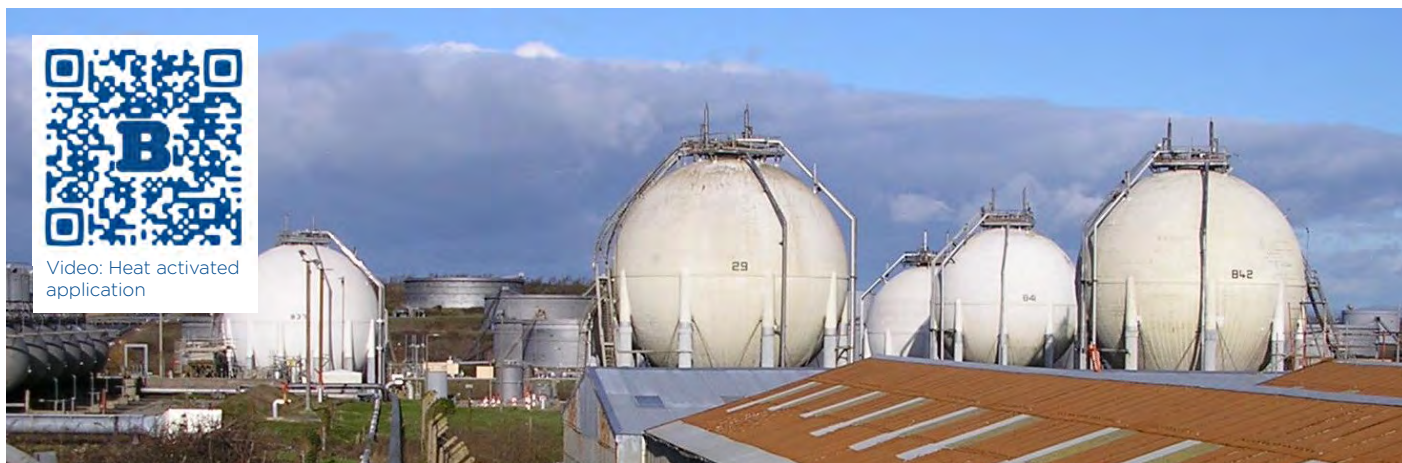
Inspected 8 years later



Pipe lagging sealed



Video: Heat activated application



LNG spheres protected with Belzona, inspected 11 years later



# EXTERNAL CORROSION REPAIR AND PROTECTION

## Tanks - sealing and plate bonding

### TANK BASE SEALING

Sealant failure, adverse weather conditions or condensation can lead to corrosion of the tank base, leakage and ultimately tank failure. To combat these problems, Belzona formulated a tank base sealing system in the mid 1960s, which is liquid applied in conjunction with a reinforcement sheet. As a membrane, the system possesses a unique breathable feature. Liquid cannot permeate the membrane while the vapour escapes freely, allowing for the base seal to stay dry. The system remains flexible in service and adapts to thermal expansion loading, while at the same time offering excellent UV resistance. NDT can be used through the system to measure the thickness of the annular ring. Following three decades of tank base repairs, Belzona membrane is now being specified as the sealant choice for new tanks.



*Corroded base*



*Base sealed*



*Composite patch repair*

### WALL AND ROOF REPAIR

Roofs are susceptible to rapid deterioration caused by the corrosive vapour of the storage media and exacerbated by external forces, in particular when tanks are located near the sea. Roof damage can be safely repaired in situ and on-line eliminating the need to degas and drain the tank.

Tank walls can also suffer from leaking welds and corrosion. Belzona repairs can be carried out on-line with the use of cold bonded doubler plates or a reinforced composite system. Cold bonding technique can be utilised not only for repairs, but also for bonding rails, pipe supports and other fittings.

For more information visit [belzona.com/tanks](http://belzona.com/tanks)



*Holed tank roof*



*Plates bonded with Belzona*





# BUILDINGS AND STRUCTURES MAINTENANCE

## Containment areas - repairs and protection

### CONCRETE REPAIR

Chemical spillages are inevitable and will corrode and deteriorate sumps and bunds designed to contain them, which could lead to potentially catastrophic consequences. Like for like concrete repairs can take 28 days to cure leading to a lengthy downtime. Belzona Magma Polymers were first used for bund repairs in the 1980s. Their adhesion to concrete is stronger than concrete's cohesive strength. Magma Polymers can solidify within a few hours and achieve their full chemical resistance properties in up to three days.



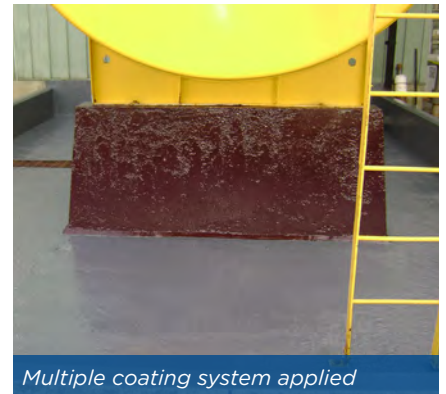
### PROTECTIVE COATINGS

In addition to repairing deteriorated containment areas, Belzona can prevent the problem from ever occurring with the use of protective coatings. With a number of coatings formulated to resist different chemicals at varying concentrations, Belzona is able to specify the right solution for each situation.

Magma Polymer coatings are simply applied at a thickness of approximately 500 microns (20 mils). These coatings provide seamless protection and eliminate the risks of undetected delamination and corrosion of the underlying substrate. Visual inspection of thin-applied coatings is sufficient to determine that chemical protection is indeed intact.

Belzona coatings adhere equally well to various substrates including concrete, metals, tiles and Belzona materials. Coupled with the ability to resist all concentrations of caustic, 98% sulphuric and other acids, Belzona offers a lasting solution where other technologies have failed.

For more information visit [belzona.com/containment](http://belzona.com/containment)





# BUILDINGS AND STRUCTURES MAINTENANCE

## Roof, wall and floor problem areas - high performance polymeric solutions

Machinery and equipment are integral to the smooth operation of the plant, however, deteriorating structures also have a potential to cause lengthy and costly downtime. Belzona has been providing reliable cost-effective solutions for facilities maintenance since the 1960s. Application simplicity and proven longevity have led numerous petrochemical and chemical facilities maintenance managers to turn to Belzona for solutions.

### ROOFING MEMBRANES

Movement, loading and freeze-thaw cycles can lead to the deterioration of roofing protection. Belzona liquid applied membranes can seal localised leaking areas or the whole roof and adhere to various substrates and geometries. Protection is seamless and moves in sympathy with the substrate, allowing for expansion and contraction. Emergency solutions are also available, applied directly onto wet roofs.

For more information visit [belzona.com/roof](http://belzona.com/roof)

### IRREGULAR SHIMMING

Load bearing floor areas, plinths and supports can suffer damage caused by impact or chemical attack. Belzona materials adhere exceptionally well to dissimilar substrates and provide excellent chemical resistance and compressive strength. Full cure can be achieved within a few days, and the shim can be formed to achieve the required dimensions.

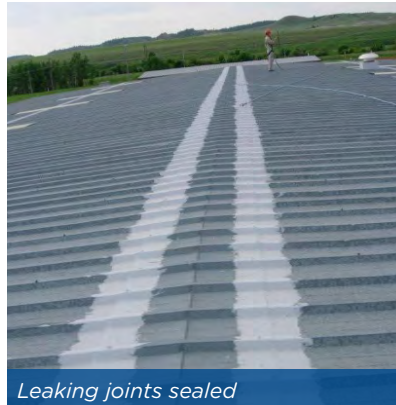
### EXPANSION JOINTS

Joints and concrete nosings are susceptible to deterioration caused by impact, thermal cycling, UV and chemical attack. Belzona Elastomers are used to recreate the expansion joint and allow for greater movement due to their up to 1000% elongation. Concrete or metal nosings can be rebuilt using fast curing Magma Polymers, which also provide excellent abrasion, impact and chemical resistance.

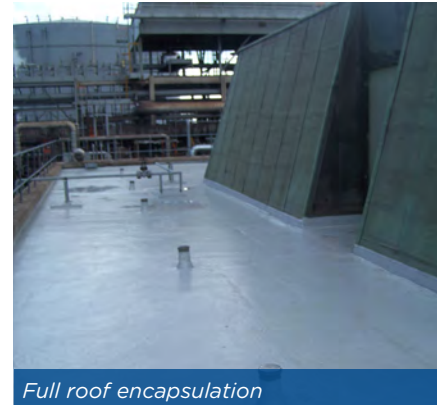
### SAFETY GRIP SYSTEMS

Unsafe slippery surfaces make for a hazardous working environment. Belzona offers safety grip systems available in various safety colours and applicable to numerous substrates, including metals, concrete and tiles. Coatings are blinded with aggregate and hand-applied to create a durable grip system. Belzona grip systems remain maintenance-free for longer as the aggregate does not wear off easily through movement and impact.

For more information visit [belzona.com/floor](http://belzona.com/floor)



*Leaking joints sealed*



*Full roof encapsulation*



*Deteriorated vessel supports*



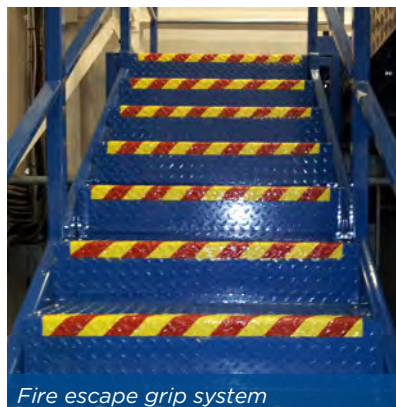
*Belzona shim secures the vessel*



*Cracks in concrete filled in*



*Edges rebuilt, Belzona joint installed*



*Fire escape grip system*



*Concrete walkway solution*

## GLOBAL APPLICATION STANDARDS



### PREQUALIFICATION

Belzona materials are subject to stringent independent and in-house testing, documented in the product specification sheets and chemical resistance charts. Testing is performed in our ISO 9001 audited laboratory to recognised standards, including NACE, ASTM, ISO, Lloyds and many more. Numerous high profile Oil and Gas companies prequalify the use of Belzona materials at the design stage and for asset maintenance.

Data collected from the field influences improved formulations and application methodology to ensure increasingly efficient in-service performance.



### SPECIFICATION

Optimum materials and application procedures are selected to meet specific design and operating conditions of the asset. Dedicated project engineers coupled with round the clock head office technical support allow for the correct material and application procedure to be specified.

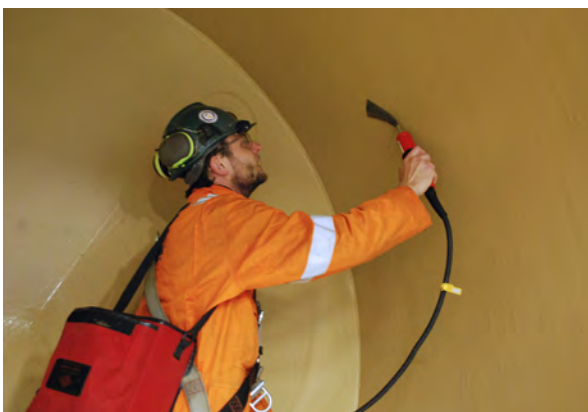
We also maintain a comprehensive database accessible by the Global Belzona Distributor network, which facilitates sharing of information and experience, improving specification and application standards.



### APPLICATION

Application standards, including surface preparation, are integral to the success of solution implementation. Belzona recognises the need to set and monitor global application standards.

Applications are carried out by experienced and trained personnel. Belzona runs training programmes with theoretical and practical courses, including validated training. Combined with method statements, quality control procedures and daily inspection reports we strive to ensure application standards are maintained.



### INSPECTION

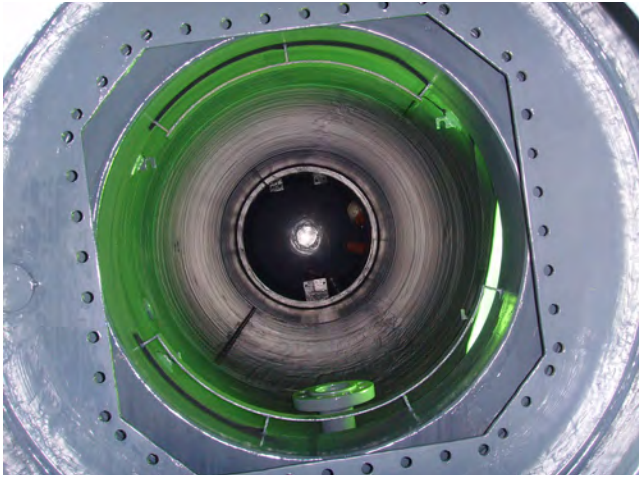
Inspection is carried out by certified inspectors (e.g. NACE, FROSIO) prior to, during and upon completion of the application to ensure Belzona systems are applied in accordance with our standards and client's requirements.

Upon nearing the end of the system's expected service life, the asset is inspected again and appropriate action recommended, which may involve minor repair work or no action, as Belzona systems tend to outlast projected service life.



# BELZONA SOLUTIONS FOR THE OIL AND GAS INDUSTRY – DOWNSTREAM

**HIGH PERFORMANCE LININGS**  
resistant to high pressures and temperatures



**COATINGS, LININGS AND WRAPS**  
for pipework protection and repair



**COLD BONDING**  
to replace hot work



**HEAT ACTIVATED PROTECTION**  
for hot surface repairs online



**MEMBRANE SYSTEMS**  
for flexible and microporous sealing



**MAGMA POLYMERS**  
for containment areas repair and protection





ISO 9001:2008  
Q 09335  
ISO 14001:2004  
EMS 509612

Belzona products are manufactured under an ISO 9000 Registered Quality Management System

UK • USA • Canada • Thailand

