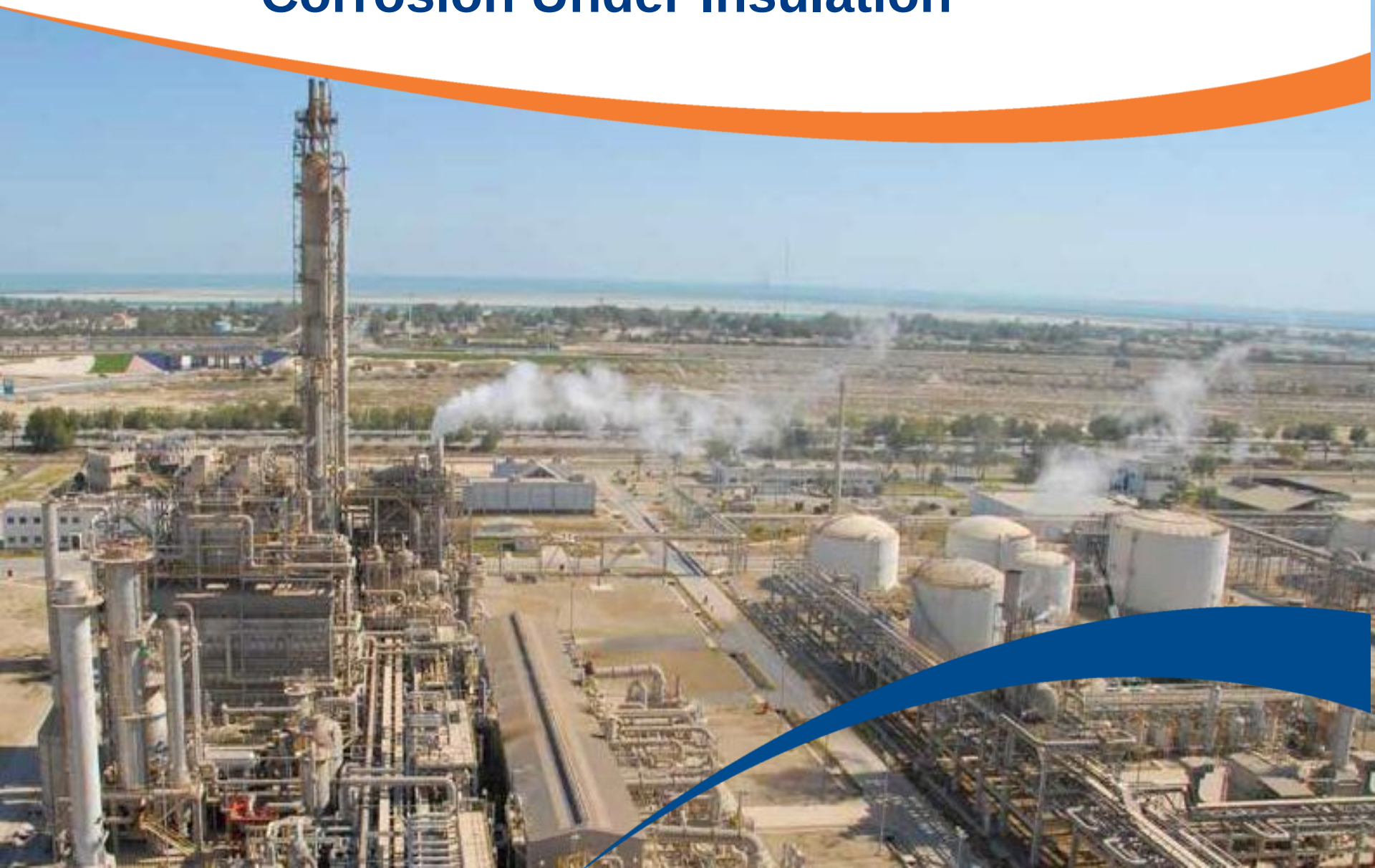
Composite Repair Solutions for Corrosion Under Insulation

BELZONA®
Repair • Protect • Improve



Composite Repair Solutions for Corrosion Under Insulation

Presented By : Mr Ron Campbell
Belzona Polymerics Ltd

18th May 2014 WORKSHOP
COATING AND LINING
for Industrial Application

NACE JUBAIL

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Root Causes and Effects

Water Ingress

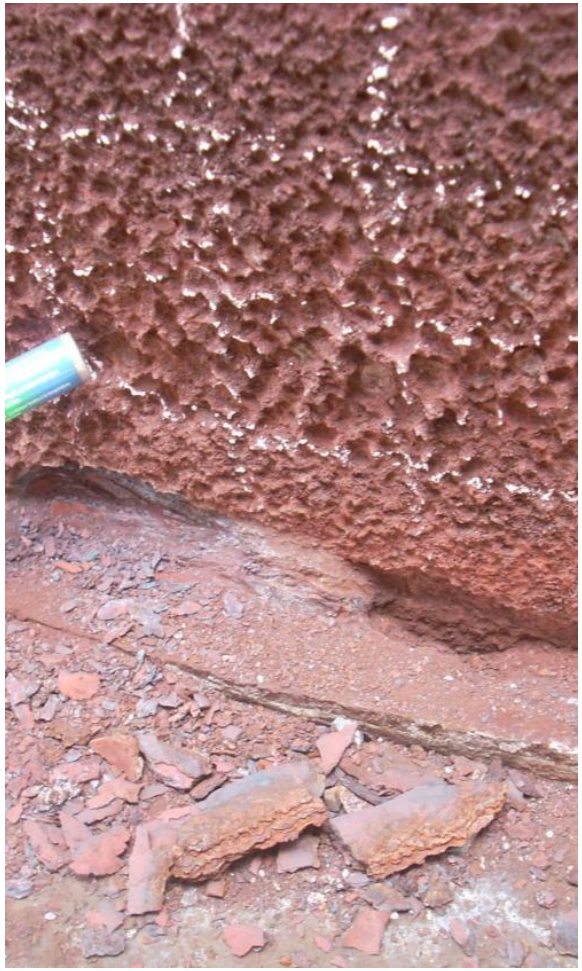
- Trapped during construction
- Leakage of weather-proofing
- Sprinkler Systems

Exacerbating Factors

- Contaminants in the insulation material
- Atmospheric pollutants
- Chemical Spillage

Temperature

- CUI most aggressive in the range of 15 – 150 C
- Cyclic wetting / drying accelerates corrosion



BELZONA®
Repair • Protect • Improve

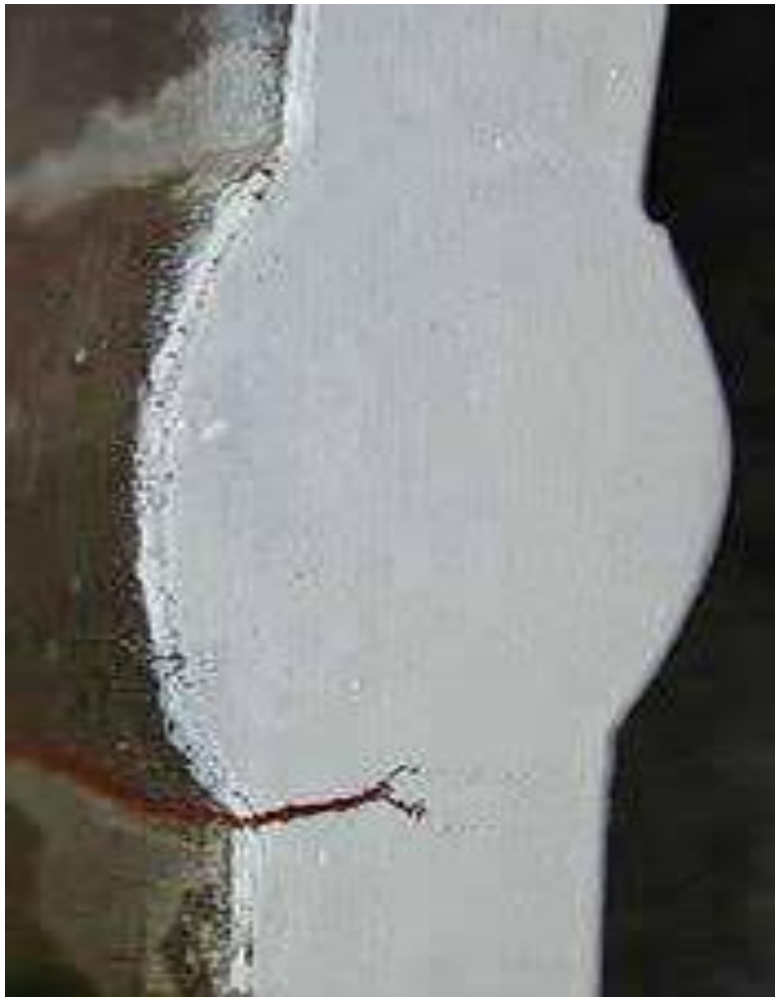
Corrosion Under Insulation – Effects

Carbon Steels

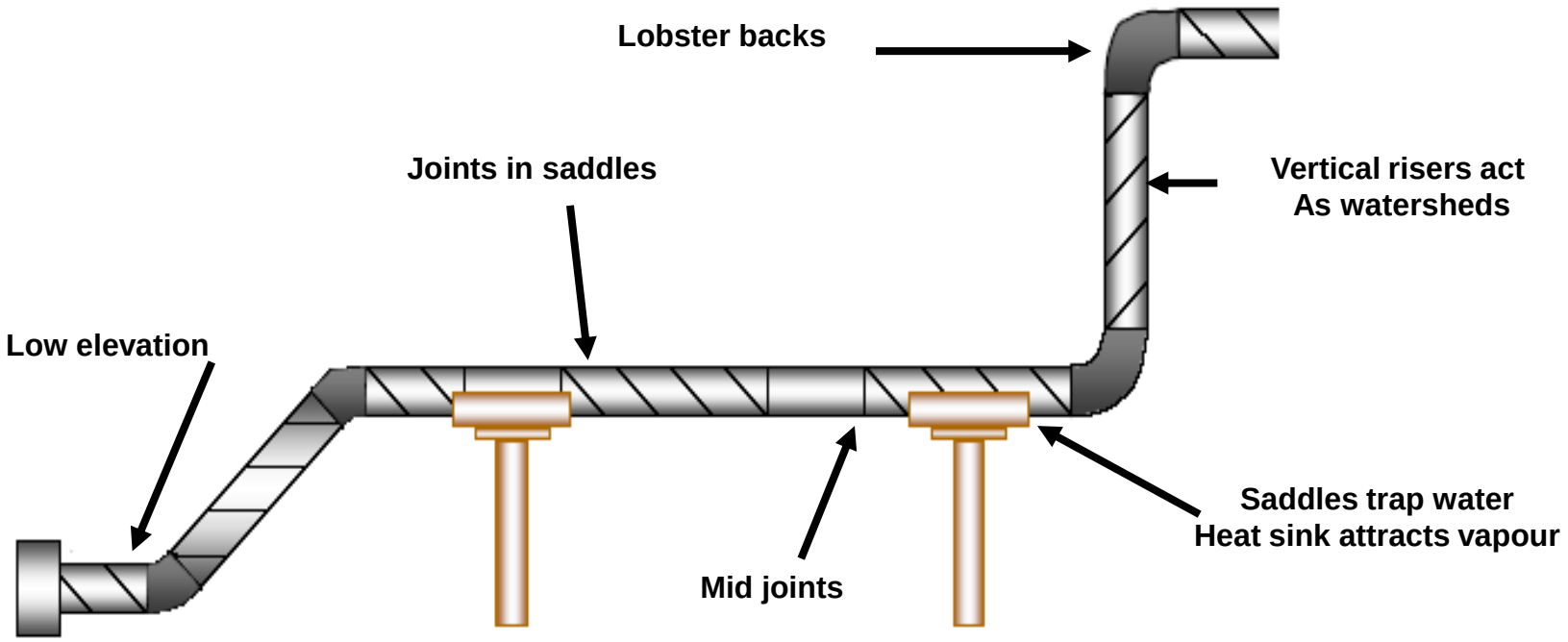
- Accelerated Corrosion
- Pitting

Stainless Steels

- Crevice Corrosion
- Pitting corrosion
- SCC (high risk: chloride + T>60 C)



Corrosion Under Insulation – Problem Areas



Water penetration into Insulation is the primary cause of CUI – if the water can be prevented from entering the Insulation – CUI can be negated.

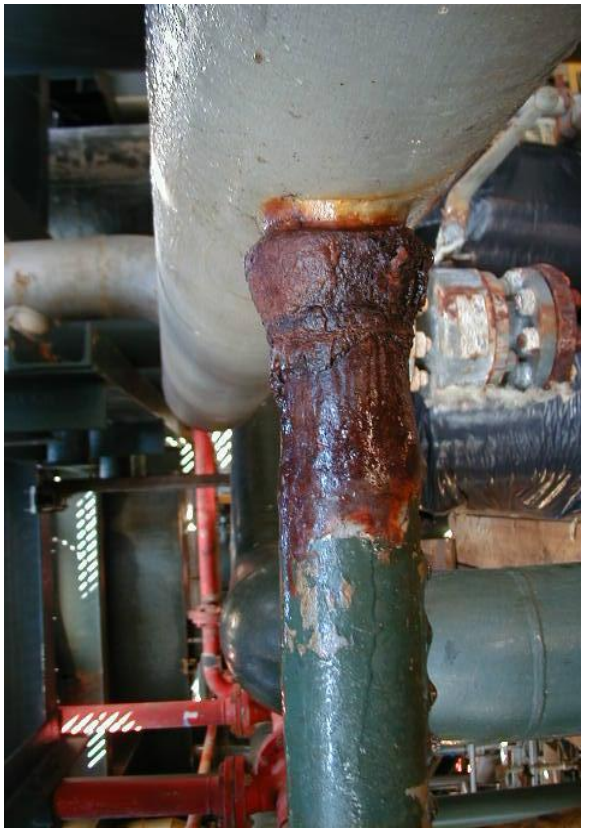
BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Results









CUI problems can be Repaired and Negated On Line using Specialized Solutions

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On Line Composite Repair Solutions

Compliant Repairs
Where there is a accepted International Standard for the use of composite materials for repair of pipe - work and tanks and where the client requires certification:

- ASME PCC-2-2008
- ISO / TS 24817

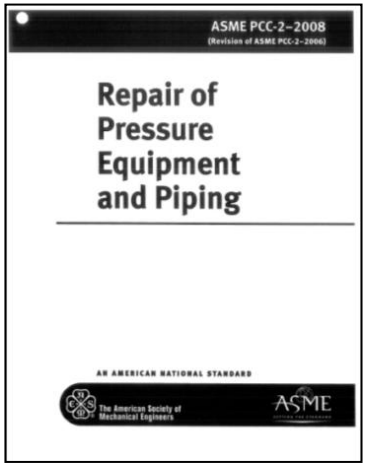
Non-Compliant Repair and Protection
Where there is no internationally recognized standard required for the application
but they are effective and have been and are currently in use within industries worldwide and are widely accepted based on historical performance.

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Compliant Composite Repair Solutions

ASME PCC-2-2008

This Standard provides methods for repair of equipment and piping within the scope of ASME Pressure Technology Codes and Standards[1] after it has been placed in service. These repair methods include relevant design, fabrication, examination, and testing practices and may be temporary or permanent, depending on the circumstances.



ISO / TS 24817

The objective of ISO/TS 24817 is to ensure that composite repairs to pipework when qualified, designed, installed and inspected using ISO/TS 24817 will meet the specified performance requirements. Composite repairs are designed for use in oil and natural gas industry processing and utility service applications. The main users of this Technical Specification will be owners of the pipework, design contractors, suppliers contracted to deliver the repairs, certifying authorities, installation contractors and maintenance contractors.

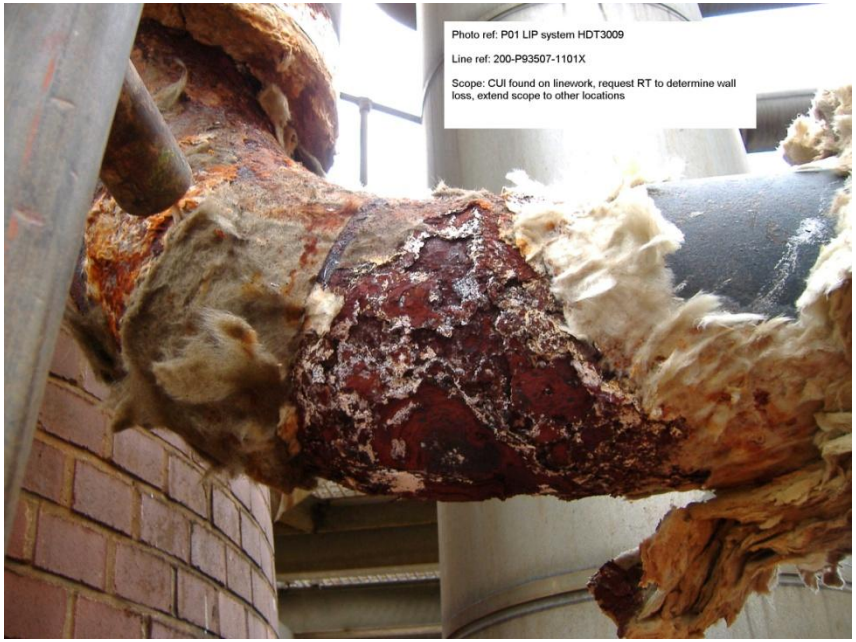
BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Compliant Composite Repair Solutions

ASME PCC-2 and ISO/TS 24817 allow for the repair of the following:

- Thinned wall defects
- Through wall defects

- Straight Pipe
- Complex Geometries, Bends, Tees, Reducers etc.
- Tanks and Vessels



Compliant Composite Repair Solution Limitations

Limitations of Compliant Composite Repairs

- Require Grit Blasted surface preparation
- Limitations on Substrate temperature during application of the composite (circa : 50C)
- Limit on upper temperature resistance of the composite materials (circa : 80-100C)

HOWEVER :

Within these parameters they still offer effective repair solutions to CUI situations

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Compliant Composite Repair Solutions

Composite Repairs are Classified within the Standards

Repairs can only be carried out by Manufacturers Trained and Validated Personnel :

Class 1 : Manufacturers Trained Validated Applicator
Class 2 : Manufacturers Trained Validated Applicator and Supervisor
Class 3 : Manufacturers Trained Validated Supervisor

Repair class	Typical service	Design pressure	Design temperature
Class 1	Low specification duties, e.g. static head, drains, cooling medium, sea (service) water, diesel and other utility hydrocarbons	< 1 MPa	< 40 °C
Class 2	Fire water/deluge systems	< 2 MPa	< 100 °C
Class 3	Produced water and hydrocarbons, flammable fluids, gas systems Class 3 also covers operating conditions more onerous than described.	Qualified upper limit	Qualified upper limit

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Compliant Composite Repair Solutions

Types of Defects

The standards detail the types of repairs that can be carried out using compliant composite systems

Repair Life

Repairs are designed to design lives of up to 20 Years using standard safety factors

Type of defect	Applicability of repair system
General wall thinning	Y[a]
Local wall thinning	Y
Pitting	Y
Gouges	R[b]
Blisters	Y
Laminations	Y
Circumferential cracks	Y
Longitudinal cracks	R
Through-wall penetration	Y

[a] Y implies generally appropriate.

[b] R implies can be used, but requires extra consideration.

BELZONA®
Repair • Protect • Improve

Compliant Composite Repair Solution – Total Refinery France

Repair to 34” Crude Oil Line suffering localised wall thickness loss from 6.2mm to 2mm operating at a pressure of 19 bar. Composite repair applied at 5mm thickness and 4 layers of composite reinforcement

BELZONA®
Repair • Protect • Improve

Compliant Composite Repair Solution – Statoil Production Platform Norway

Repair to various produced water lines suffering localised wall thickness loss and through wall defects operating at a pressure of 80 bar. Composite repair applied at 14mm thickness and 6 layers of composite reinforcement

BELZONA®
Repair • Protect • Improve

Compliant Composite Repair Solution – Petrobras Buried Gas Pipework in Brazil

Cleaning using High Pressure Water Jetting

Surface Preparation using Grit Blasting to SA2.5 with 75 micron Profile

BELZONA®
Repair • Protect • Improve

Compliant Composite Repair Solution – Petrobras Buried Gas Pipework in Brazil

Application of Base Layer of Composite to Repair Pitting

Wrapping of Composite Fibres

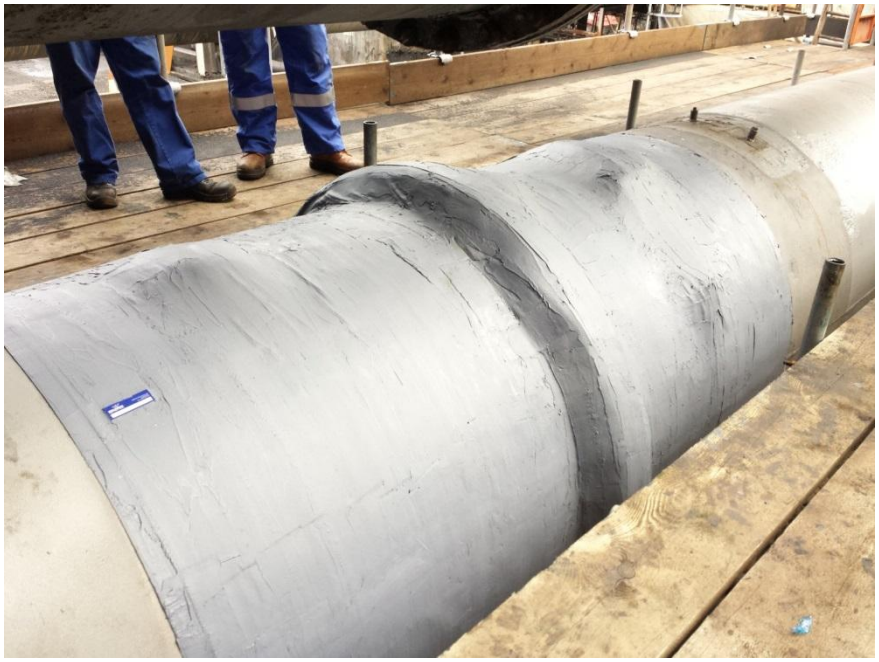
BELZONA®
Repair • Protect • Improve

Compliant Composite Repair Solution – Petrobras Buried Gas Pipework in Brazil

Further Layers of Composite Resins and Reinforcement Fibres applied to Complete the Application.

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – Compliant Composite Repair Solutions



- Compliant to ISO and ASME Standards
- Designs to match system requirements
- Suitable up to 85C operating temperature
- Pressures up to 200bar

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

Heat Activated Repair and Protection System

- Can Be applied to Hot Surfaces
- Surface Temperatures of 30C – 180C
- Minimal Surface Preparation (ST2)
- High Adhesion
- Resists Insulation Saturation / Immersion
- Simple to Use
- Long Service Period
- Can be combined with reinforcing fibres to produce composite repair system for pipe strengthening and pressure containment.

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

Substrates: **Unprepared Steel**

Unprepared, uncorroded steel direct from the manufacturers

Surface covered in firmly attached m

Ground Steel

Unprepared steel ground using
abrasive)

Rusty Steel

Clean metal surface expose

Wire-Brushed Rusty Steel

Started with Rusty Steel

Abraded Rusty Steel

TSteel weathered ext

Rusted to ISO 8501-1

Started with rusty steel panel (ISO 8501-1 grade C)

with some pitting

Initially abraded with wire brush, then further abraded by hand with P36 abrasive paper to ISO 8501-1 St 3

Loose surface rust

preparation

Surface a combination of firmly attached rust with some clean steel showing through

Thoroughly abraded w

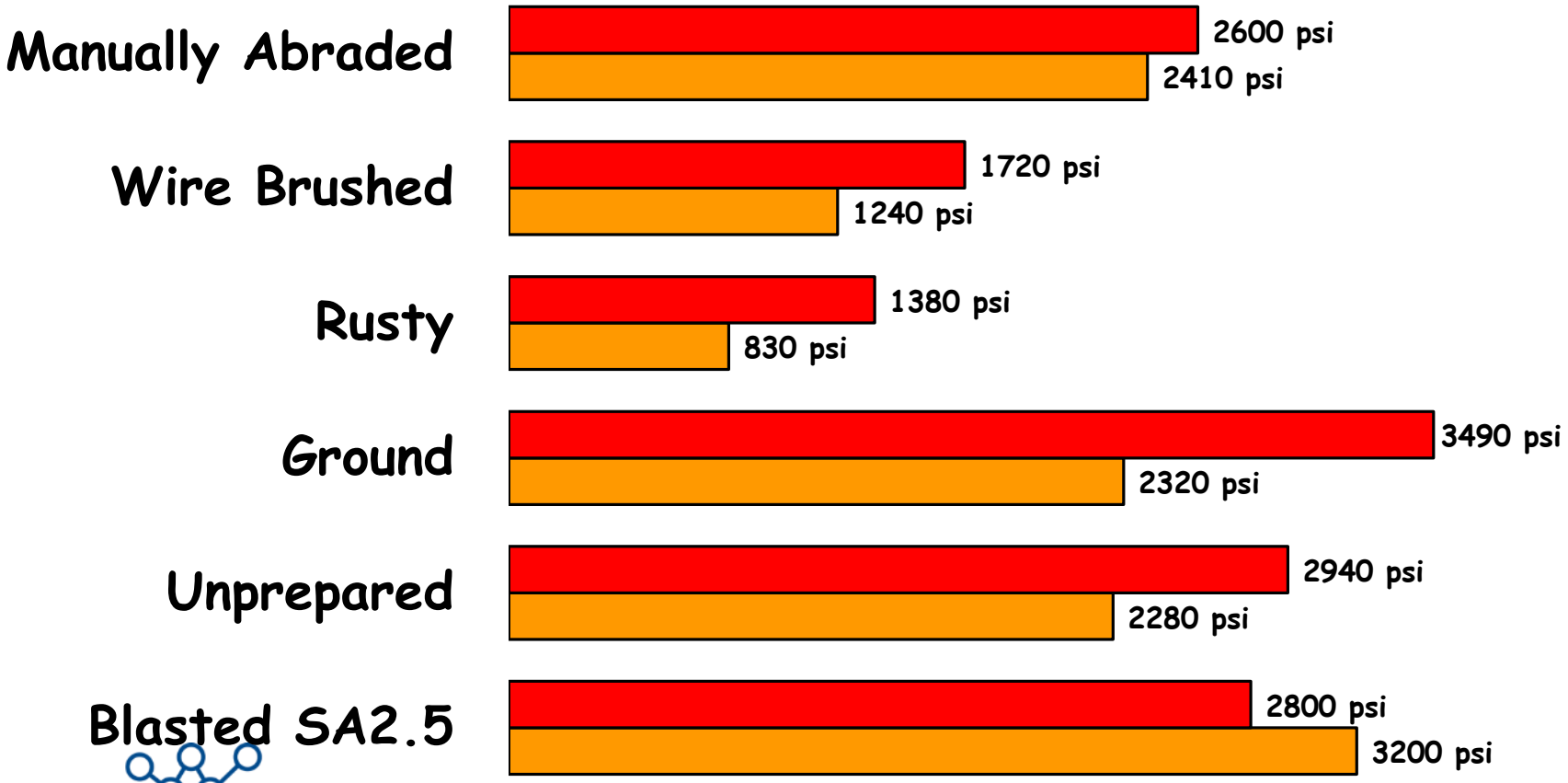
Pitted surface covere

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

Adhesion

Up to 80C / 80 to 180C



BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

Testing

Steel test panels prepared by abrading manually (no profile)
HA Coating applied onto hot panels and oven cured
Panels exposed for 1000 hours at 35ºC (95ºF) in saturated salt fog atmosphere

Results

- No field blistering or corrosion
- Minimal corrosion creep under the scribe mark

BELZONA®
Repair • Protect • Improve

Heat Activated Composite Repair Solution – Shell Refinery New Zealand Year 2013

De-Asphalting Column in service with operating of 120 C

Surface Preparation Carried out Using High Pressure Water Jetting

Application of Heat Activated Coating System using rollers and brushes

Ongoing Inspection shows no deterioration of the coating after <u>11 years in Service.</u>

BELZONA®
Repair • Protect • Improve

Heat Activated Composite Repair Solution – Exxon Refinery Singapore Year 2001

Fractionator Tower T102 in service operating at 120C

Surface preparation carried out using scrapers to remove loose rust to ST2 finish

Application of Heat Activated Coating System using rollers and brushes

Ongoing Inspection shows no deterioration of the coating after 13 years in Service.

BELZONA®
Repair • Protect • Improve

Heat Activated Composite Repair Solution – British Gas Offshore Platform Year 2005

Gas - Condensate Pipework operating at temperatures up to 115C

Surface preparation carried out using high pressure water jetting

Heat Activated Composite wrapping and coating carried out on-line

Ongoing Inspection shows no deterioration of the repairs and after 9 years in Service.

BELZONA®
Repair • Protect • Improve

Heat Activated Composite Repair Solution – Shell Stanlow Refinery UK Year 2006

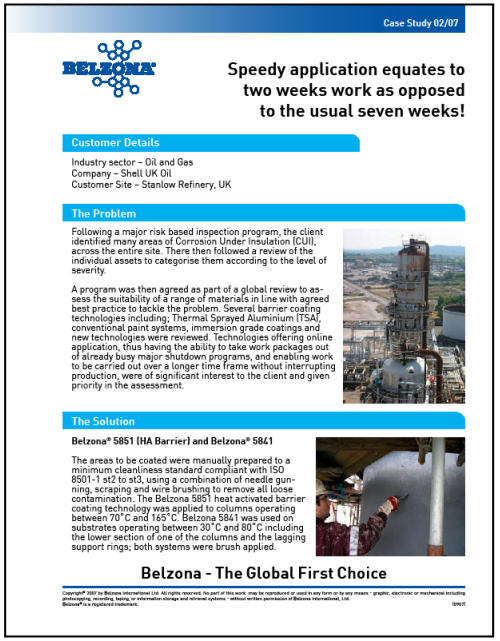
Severe CUI on distillation columns and fractionator towers operating between 50-120°C

Manual preparation of the steel substrate using scrapers and wire brushes

Application of Heat Activated Coating System to Manually Prepared Surfaces

BELZONA®
Repair • Protect • Improve

Heat Activated Composite Repair Solution – Shell Stanlow Refinery UK Year 2006



Case Study 02/07

BELZONA

Speedy application equates to two weeks work as opposed to the usual seven weeks!

Customer Details

Industry sector – Oil and Gas
Company – Shell UK Oil
Customer Site – Stanlow Refinery, UK

The Problem

Following a major risk based inspection program, the client identified many areas of Corrosion Under Insulation (CUI), across the entire site. There then followed a review of the individual assets to categorise them according to the level of severity.

A program was then agreed as part of a global review to assess the suitability of a range of materials in line with agreed best practice to tackle the problem. Several barrier coating technologies including; Thermal Sprayed Aluminium (TSA), conventional paint systems, immersion grade coatings and new technologies were reviewed. Technologies offering online application, thus having the ability to take work packages out of already busy major shutdown programs, and enabling work to be carried out over a longer time frame without interrupting production, were of significant interest to the client and given priority in the assessment.

The Solution

Belzona® 5851 (HA Barrier) and Belzona® 5841

The areas to be coated were manually prepared to a minimum cleanliness standard compliant with ISO 8501-1 st2 to st3, using a combination of needle gunning, scraping and wire brushing to remove all loose contamination. The Belzona 5851 heat activated barrier coating technology was applied to columns operating between 70°C and 145°C. Belzona 5841 was used on substrates operating between 30°C and 80°C including the lower section of one of the columns and the lagging support rings; both systems were brush applied.

Belzona - The Global First Choice

- Application to in service pipework and vessels operating at elevated temperatures dramatically reduced application time from weeks to days.
- Client impressed with the ease and speed of application and longevity of the system
- Heat Activated Coating System now globally approved by Shell

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

- Two years into a six year programme of work, Shell were able to conduct direct comparison with TSA and with other organic coating technologies

- **Heat Activated System Advantages over TSA**
  - No need to blast clean substrate
  - No need to tent in area to retain blast media
  - Not creating confined spaces to manage emergency plans for
  - Application of two coats onto hot surfaces easy
  - Avoiding equipment “hot work”
  - Less risk of misses
  - Less risk of coating failure due to thin film or missed areas
  - Significant savings in time and money

BELZONA®
Repair • Protect • Improve

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

- **Heat Activated Composite Repair Capability for Pressurised Pipework**

Heat Activated Composite Pipe Repair and Pressure Testing of Spool with 20mm Diameter Hole. Composite wrap at a Thickness of 10mm

Corrosion Under Insulation – On-Line Solutions for Elevated Temperature CUI Problem Areas

Client Testimonials

Emlyn Roberts
Works Engineer
Total Refinery , UK

"The most recent vessel inspection completed in late 2008 has confirmed that the original application, which was carried out in 2001, still remains in good condition to date and required no further action. We are very satisfied with the performance, durability and overall cost-effectiveness of the product.. We have since carried out a number of subsequent applications on site using this product with no problems encountered."

Bertrand Van Der Hayden
Fixed Equipment Reliability Inspector
Caltex South Africa

With our trial now having run to completion, we can confidently say that these products should perform in the long-term as they have been designed to do. We have no reservations in recommending these products for similar applications within the petrochemical industry. The attached photographs illustrate the surfaces prior to, during, and after application.

Bob van den Beuken
Maintenance Team Leader Mechanical
Vector Kapuni , New Zealand

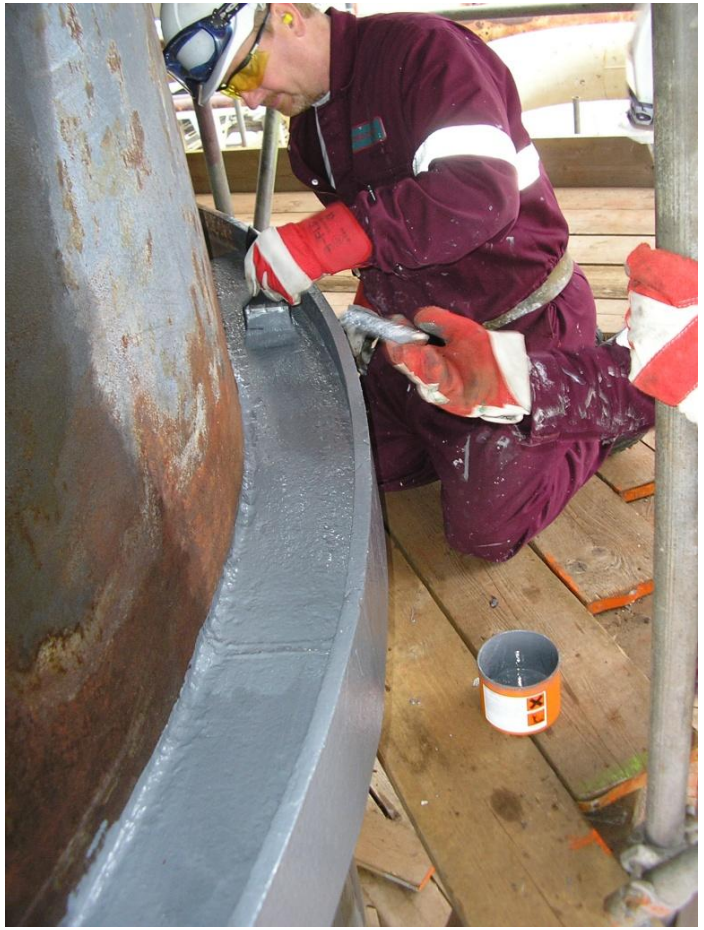
The absorber column at the Vector Kapuni Gas Treatment Plant in Taranaki required painting. It was not possible to take the column out of service long enough to complete the painting programme using normal painting specs. The column runs at approximately 100 degree C so the search began for a product that could be applied at this temperature while the plant remained online. Belzona 5851 was the pick of the products as it had already proven itself at Marsden Point. Belzona 5851 has now been in service for about 2 ½ years and as the pictures show remains in good condition. We have since applied the same product to our Regeneration tower which also runs at similar temperature with no problems encountered.

BELZONA®
Repair • Protect • Improve

On-Line Composite Repair Solutions for Corrosion Under Insulation

- **ASME and ISO Compliant Systems for Temperatures up to 85C and pressures up to 200 bar**

- **Heat Activated Systems for protective coating at elevated surface temperatures**
- **Heat Activated Composite Repair Systems for elevated temperature service and pressures up to 180 bar**
- **Applied to manually prepared surfaces**
- **Over 10 years of in-service experience and proven capability.**



BELZONA®
Repair • Protect • Improve

Composite Repair Solutions for Corrosion Under Insulation

ANY QUESTIONS ?

Presented By : Mr Ron Campbell
Belzona Polymerics Ltd

BELZONA®
Repair • Protect • Improve

Composite Repair Solutions for Corrosion Under Insulation

BELZONA®
Repair • Protect • Improve