

Enhancing Infrastructure

Corrosion protection for boilers

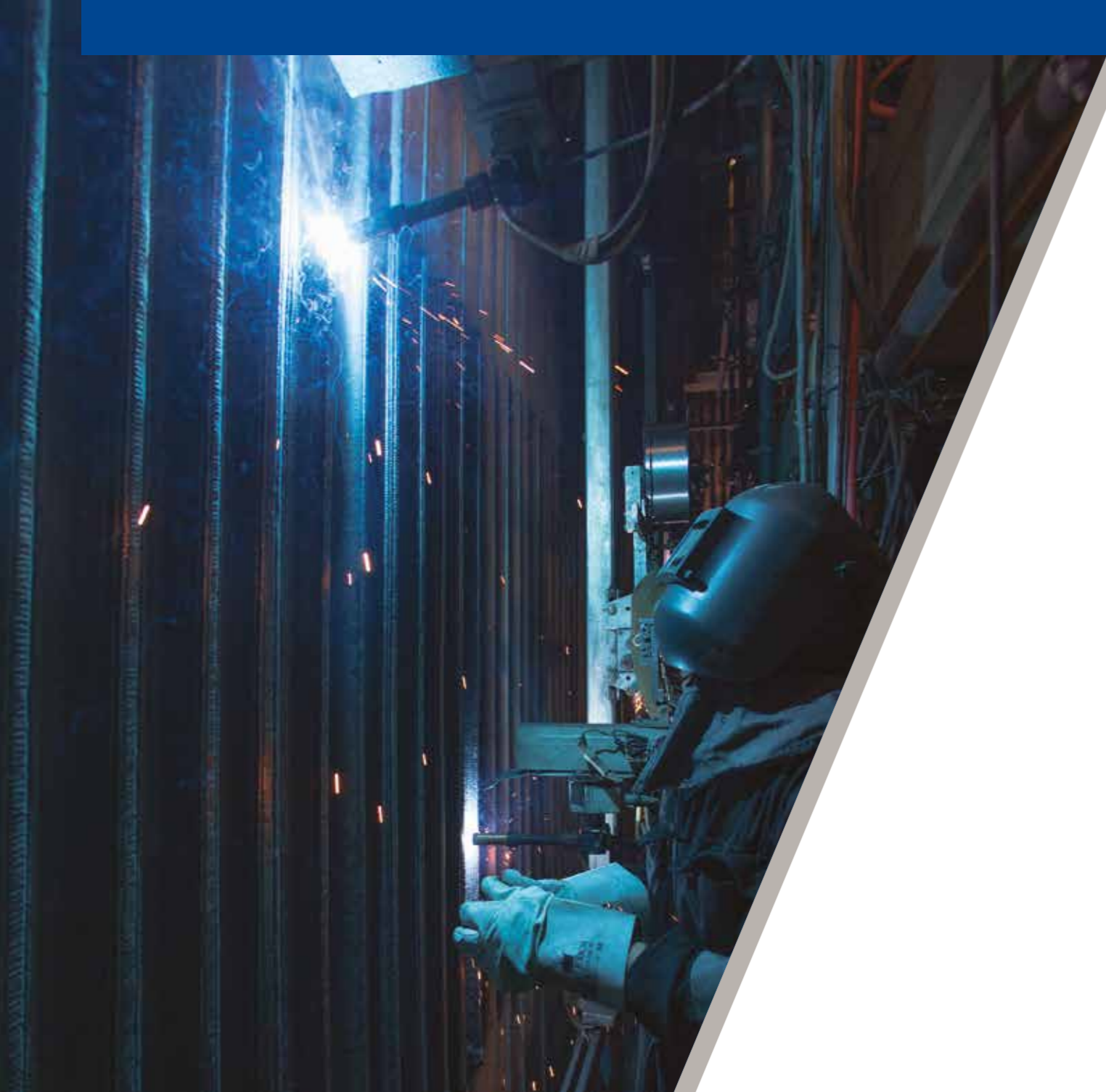


[Waste to Energy Boilers](#) ←

[Biomass Boilers](#) ←

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Corrosion protection for boilers

In today's increasingly competitive commercial environment, engineering solutions are expected to improve product yields and plant operational reliability.

AZZ WSI®, with European headquarters in Hellevoetsluis, The Netherlands, is the largest global automated repair provider. In our manufacturing facility in Radom, Poland as well as in the field, we have applied numerous corrosion/erosion-resistant weld metal overlays to boilers worldwide in some of the most demanding environments in the world.

Waterwall repair at an Energy from Waste facility

Achieving maximum return on investment

AZZ WSI has a reputable track record in industries across the world and delivers significant return on investment by the application of our solutions.

Challenges	Solutions
Extend operational life span and enhance asset performance	We offer long-term solutions avoiding the need for replacement. Weld overlay solutions last longer than other conventional methods and can be repaired and maintained.
Improve asset mechanical integrity	Integrity of industrial assets such as pressure equipment is vital for safety, return on investment and operating reliability reasons. Existing equipment can suffer from process changes resulting in higher corrosion rates. Upgrading with advanced technology will maintain mechanical integrity and ensure high levels of reliability.
Reduce maintenance costs	Long-term repair rather than replacement of existing panels could mean less maintenance. We have the capacity to respond to short lead times and tight schedules.
Consistent quality according to standards	Quality Assurance and Quality Control come as standard in all our solutions, with EN and ASME certification for our automated welding in combination with a fully trained specialized workforce.
Issues in challenging materials, locations, geometries and environments	We offer total engineering support that includes tooling design, metallurgical consultation, and welding process design.
Meet safety requirements	Attention and commitment to HSE standards is one of our core values and drives all our projects and solutions.



Welder training



Our manufacturing facility in Radom, Poland with 24/7 manufacturing capabilities



Unifuse 360 tube line

Unifuse® technology

Strict standards and codes, such as the EN and ASME codes, govern the strength requirements for the design and construction of boilers. Most of these components have a corrosion allowance built into their initial wall thickness but operational conditions and the surrounding environment can result in excessive wear. This can lead to boilers not operating economically without the proper surface protection against corrosion, erosion and even cracking.

With over 30 years' experience in boiler protection, AZZ WSI's **Unifuse**® technology answers this need by providing optimal surface protection for waste to energy boilers, biomass boilers, coal-fired boilers, black liquor recovery boilers, and furnaces and hoods in steel manufacturing, such as Electric Arc Furnaces (EAF) and Basic Oxygen Furnaces (BOF).

Unifuse is a cost-effective engineered solution against corrosion/erosion attacks from combustion products in boilers and from the hot, exhaust flue gas stream in waste heat recovery systems. **Unifuse** extends the operational life of tubes and waterwall panels, thus avoiding or delaying costly replacements.

It is crucial to determine what kind of damaging process is affecting the asset. Weld overlay protection can wear down as time goes by and its longevity depends not only on the quality of the application but also on the operational conditions within the boiler. Highly localized temperature, turbulence, flue gas impingement, and ash may cause a reduction in the overlay service life. **Unifuse** delivers the best quality with the lowest dilution possible whether used in the build-up process to achieve minimum thickness recovery (assuring the restoration of the pressure wall) or whether applied as a corrosion-resistant overlay, allowing the boiler to operate in the most cost-effective way.

Automated weld overlay in our manufacturing facility

AZZ WSI is a world leader in its fabrication capability with extensive shop overlay capacity in Radom, Poland.

Unifuse 180 – Boiler panel life extension

The **Unifuse** 180 process delivers high-quality surface protection for panels. Our equipment facility include GMAW technology and panel mounting systems that feature the ability to overlay flat panels up to 18 m long and 2 m wide.



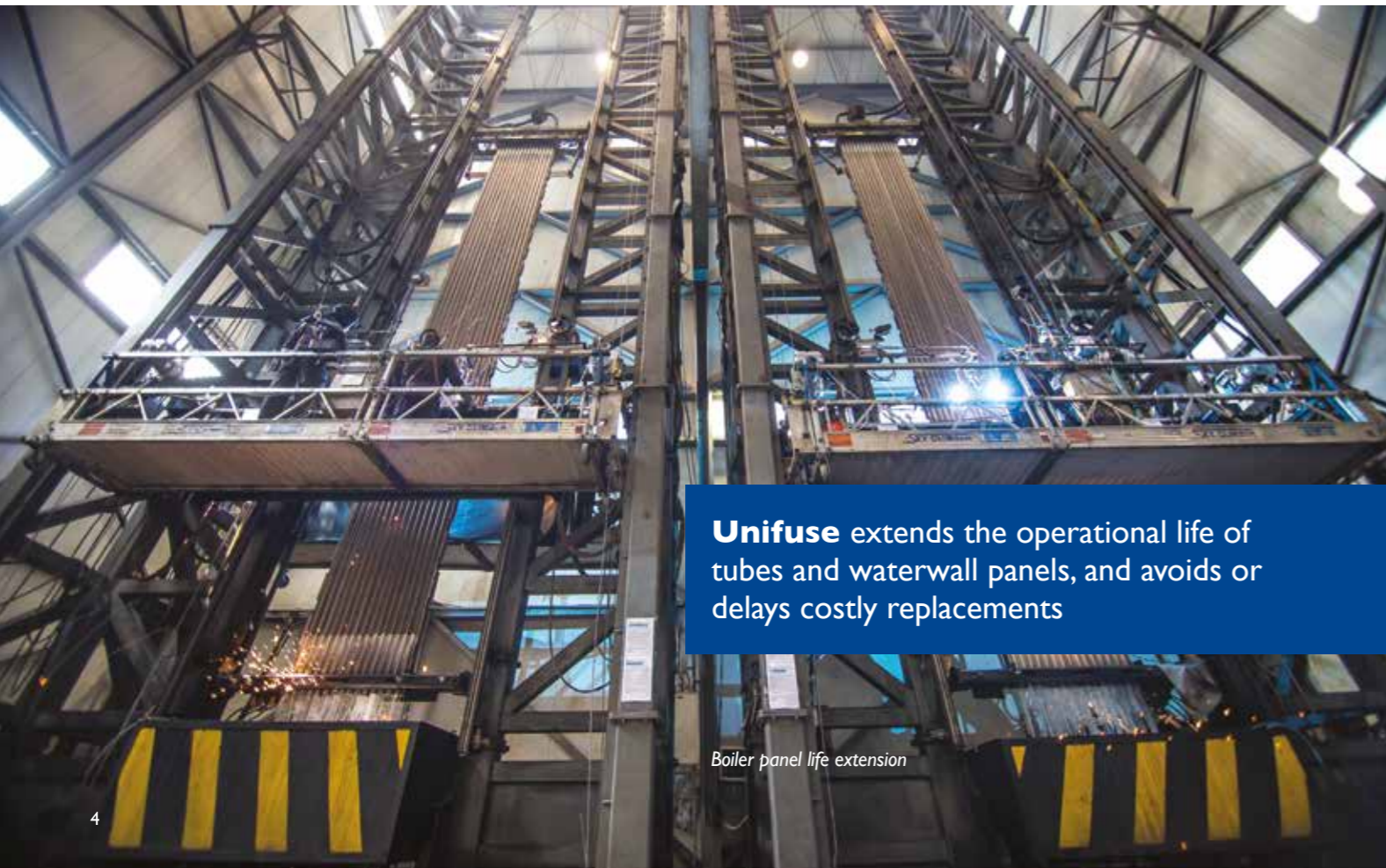
Unifuse 180 - Boiler panel life extension

Unifuse 360 – Boiler tube protection

The **Unifuse** 360 process provides 360° protection for boiler tubes from corrosion and erosion. Our facility can apply an overlay thickness of 1,2-3,0 mm (or even more if required with multilayer overlay) for tube designs and headers up to 15 m long with diameters between 21–273 mm.



Unifuse 360 - Boiler tube protection



Unifuse extends the operational life of tubes and waterwall panels, and avoids or delays costly replacements

Boiler panel life extension



Unifuse 180
Overlay of flat straight panels



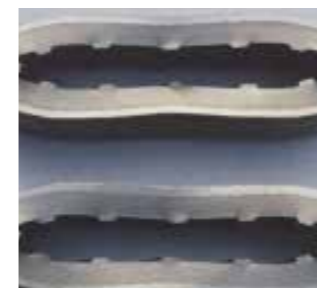
Unifuse 360
Our unique GMAW/GTAW process



Superheater bank



Panel manufactured with spiral tubes



Flattening test



Thickness control



PMI for dilution control



Spiral tubes with openings

Automated weld overlay on site

In addition to our fabrication shop, we also perform repairs and upgrades on site. Specific operating conditions affecting the boiler can cause aging of the protective weld overlay, resulting in excessive wear, in which case we can perform the necessary repairs on site. We can apply weld overlay on new or worn carbon steel tubes and we can also re-apply weld overlay on top of old overlay such as inconel.

Pre-job audit

During the evaluation phase of the project, we perform a pre-job visit to be sure our personnel and procedures comply with the customers' requirements on Health, Safety and Environment and Quality Assurance.

We will determine, through various tests, whether there is a need for tube build-up, a specific repair to restore the pressure boundary, or if the boiler can be directly overlaid.



Surface preparation

Prior to the overlay, our level II and/or level III Quality Inspectors will inspect the blasted surface (SA 3), determine the thickness and identify defects.

Surfaces must be free from any possible contamination such as refractory, coatings or old inconel. If there is previous weld overlay applied, the surface must be ground-off to eliminate all possible defects such as pores. All visible defects will be repaired during this stage.



Unifuse process

This is carried out in the vertical down mode from the membrane to the tube section, following a pre-programmed weld bead sequence to achieve uniform coverage and a smooth surface. Each weld bead is overlapped by a subsequent weld bead to ensure full coverage with a 2 mm-thick overlay.

If the tube thickness is below the minimum level for overlay, ie 2.2 mm vertical and 2.5 mm in non-vertical then carbon steel build-up is required prior to weld overlay.



Inspection

Our inspectors produce a comprehensive report of the overlay carried out, which includes the following Non-destructive Testing (NDT)

- Ultrasonic Testing (UT) and Visual Testing (VT) prior to overlay
- Random testing during overlay application
- Positive Material Identification (PMI), Penetrant Testing (PT), UT, and VT after completion of the overlay



Waterwall repair at an Energy from Waste facility

Waste to Energy and Biomass boilers

Managing corrosion issues related to boilers burning municipal solid waste and burning fuel from organic materials is a major challenge for operators.

Waste to Energy boilers

Municipal solid waste is a heterogeneous fuel that contains numerous impurities such as chlorine, sulfur, sodium, zinc, lead, and other heavy metals. During fuel combustion, these impurities generate a corrosive environment which reduces the life of carbon steel. This can often lead to tube failure and consequently costly unscheduled shutdown of the boiler. The corrosive atmosphere affects boiler tubes, waterwalls, superheater tubes, furnaces, boiler banks and economizers.

Biomass boilers

Biomass boilers use fuel from organic materials such as agricultural wastes, forest and plant residuals, energy crops, and RT chips (recovered wood fuel) that can be mixed with municipal waste. These fuels often contain significant amounts of elements such as chlorine, potassium, alkali, sodium, sulfur, lead or zinc.

The combustion process releases flue gases containing low-melting temperature compounds that cause corrosion and also form deposits that melt on the superheater tube surface and limit the rate of heat transfer to the steam in the tubes.

Unifuse weld overlay with alloy 625

For a boiler to operate in these harsh conditions over an extended period of years, the tubes require a layer to protect against corrosion. **Unifuse** with alloy 625 (not limited to) has proven to be the most cost-effective solution to corrosion attacks from combustion products in boilers and from hot, exhaust flue gas streams in waste heat recovery systems, and to maintain the structural integrity of the waterwalls.

It is the choice of boiler operators to maximize the economic benefits of longer service life, to prevent the unforeseen shutdown, and to avoid maintenance costs during the next outage.

Coal-fired boilers

The global coal industry has been subject to a host of regulations, changes in economics and the increase in extracting gas from shale-rock formations. This trend has refocused Europe now as the major buyer of the high-sulfur corrosive coal.

Sulfur, the main impurity in coal, when burned causes SO_x emission resulting in problems such as high-temperature corrosion. After combustion, the ash from the coal can be entrained in flue gas and cause fly ash erosion on heat-absorbing surfaces such as furnace waterwall tubes, fluidized beds, superheaters and economizers. Slagging problems due to ash deposits on furnace walls may cause fouling issues. Ash removal methods (with steam, waterlances or water cannons) may also lead to further corrosion/erosion and thermal fatigue.

Unifuse weld overlay with alloy 622

AZZ WSI has been selected to provide weld metal overlay on many coal-fired boilers using **Unifuse 622**. **Unifuse** with alloy 622 has a proven performance record against corrosion, corrosion/erosion and thermal fatigue, and is especially effective in providing corrosion protection for waterwalls under low NO_x combustion conditions.



Fireside corrosion in a coal-fired boiler



The AZZ WSI repair with **Unifuse 622** extended the lifetime of the coal-fired boiler

Black liquor recovery boilers

The black liquor recovery boiler is one of the most critical process systems in wood pulp and paper mills and the increase of corrosion in the superheater tubes is greatly affected by boiler operating factors, such as temperature.

Superheaters are typically made of carbon or Cr-Mo steels (e.g. ferritic steel: T11, T22). Rapid, high-temperature corrosion of these steel tubes can occur where there are high-heat areas. Combustion of the liquor yields an inorganic smelt which is rich in sodium carbonate (Na₂CO₃) and sodium sulfide (Na₂S). Its combustion generates tube-wall thinning due to sulfidation in carbon steel carbonates and sulfides. Potassium salts may also deposit on tubes, smelt run floor, spout wall and primary airport openings and cause further corrosion.

Unifuse weld overlay with alloy 309, 310 and GR383

Tubes protected with **Unifuse** with alloy 309, 310 or GR383, using the AZZ WSI patented GMAW/GTAW process, are a cost-effective, long-term solution to the superheater corrosion problem while also eliminating the need for dissimilar metal welds.



Field repair on a black liquor recovery boiler

Safety, quality, engineering and analysis

AZZ WSI has the experience and global structure to offer a complete solution to all aspects of automated boiler repair and upgrade. The same attention to engineering detail, market-leading technical capability, and absolute focus on health and safety governs all our activities and services to give you total confidence and help you achieve success now and in the future.

The health, safety and environment plan

Quite simply, safety is the number one priority for AZZ WSI. Therefore, total compliance with all Health, Safety and Environment (HSE) standards is fundamental at each stage of every project we undertake. A comprehensive plan covering all HSE issues supports all our actions from analysis to implementation and includes a full risk assessment that reflects the appropriate certifications, planning, responsibilities, training and the task risk analysis.



Daily safety meetings

Quality assurance

Quality Assurance (QA) and Quality Control (QC) come as standard in all our solutions along with EN and ASME certifications for our automated welding and fully trained, specialist workforce.

All AZZ WSI craftsmen are qualified to EN 287-1, EN 1418 and EN ISO 14732 or ASME, and the work scopes are performed in accordance with the requirements of PED 97/23/CE and applicable design and manufacturing codes for pressure equipment. We have a Quality Assurance Program certified to EN-ISO 3834-3, AD-Merkblatt HPO (TRB 200), TRD 201 and ASME U & S. All welding procedures meet the requirements of EN-ISO 15614-1 and 7 and/or EN 288 and TÜV Merkblatt I 156/1166 or ASME BPVC.



Training of employees

Engineering

Our engineering department offers a complete range of analysis, including distortion mitigation, stress analysis, structural stability, and special welding procedures to ensure optimal performance at all times whether applied in-shop or in the field. In addition, highly qualified tooling, metallurgical, corrosion and welding engineers strive to determine the most suitable technical solutions for our customers.



A complete range of analysis

Qualitative and quantitative analysis

Our automatic process delivers a high-quality weld overlay. The process qualification and parameters we have developed include destructive testing to check for weld overlay characteristics, such as dilution into the base material, which is precisely measured at all times by controlling the process parameters. It is also important to keep the Fe content from the base material at a minimum, as this is responsible for deterioration of the corrosion.



Qualitative and quantitative (energy dispersive X-ray) analysis



A tailored maintenance program is the most cost-effective way to protect your asset. During the maintenance program, we monitor the performance of your assets on a regular basis.

Field inspection of existing overlay

The AZZ WSI boiler maintenance program

Changes in operations, or fuel type, can result in increased degradation of pressure parts and reduced performance; ignoring the maintenance of these valuable assets can lead to expensive repair or replacement.

A tailored maintenance program is the most cost-effective way to protect your asset. During the maintenance program, we monitor the performance of your assets on a regular basis.

By using regular inspection of the existing overlay we are able to provide a dedicated customer report with detailed information on the status of the overlay and advise on the most effective repair and an indication of life expectancy.

In the case of exposure of base metal, spot repairs to the overlay will be applied after surface preparation of the area. In the event of larger repairs being required, AZZ WSI can offer a repair solution using the **Unifuse** technology that has been successfully proven in boiler applications for more than thirty years and provides a cost-effective solution to corrosion attack from combustion products in boilers and from the hot, exhaust flue gas stream in waste heat recovery systems.



Waterwall after copper sulfate test



Spot repairs on an old 625 weld overlay



If the damage is extensive, an automatic **Unifuse** weld overlay should be performed to reinstate the required weld overlay thickness



Spiral tubes with windows

Warranties

Our services guarantee accurate adherence of the protection to the tubes and flat bar membranes that have been applied with the corrosion-resistant alloy. Warranties from the date the overlay will be exposed to fire/flue gas can be supplied. These warranties are subject to agreement following receipt of the overlay parameters to which the overlay is exposed. Our evaluation takes account of all the relevant operational factors such as boiler type, flue characteristics, boiler operation conditions, and current tube conditions.

Enhancing Infrastructure



AZZ WSI® is a specialized global service company offering innovative maintenance through automatic weld repair solutions that extend the lifetime and maximize the value of our customers' assets in the energy industry.

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