FUSE TECH
INTERNATIONAL GmbH

# Contents

## Fuse Tech International

# The Company

Founded 1993 in the United States, Fuse Tech Inc. provides ceramic welding for various industries. Initial customers were in the glass and coking industries and the first jobs were completed by February 1995. During the following 13 years Fuse Tech Inc. successfully provided ceramic welding services to customers in a range of industries on the North American continent.

The formation of Fuse Tech International in 2007 made it possible to offer ceramic welding services in other parts of the world. The experience in ceramic welding already gained by its North American operation gave Fuse Tech International a head-start in establishing itself in the worldwide market place.

The combined experience of current Fuse Tech International employees now amounts to well over 100 years. Their ABILITY, ADAPTABILITY and EXPERIENCE have been major factors behind the Company's past achievements and are the guarantee for future successes.

Fuse Tech International is part of the SORG Group of companies and has its main office in Lohr am Main, Germany.


To contact Fuse Tech:

**For all countries except USA, Mexico, Canada**

Fuse Tech International GmbH.
Stoltestrasse 23
97816 Lohr am Main
Germany

Tel. +49 9352 508 100
Fax. +49 9352 508 120
Email info@fuse-int.com
Web www.fuse-int.com

**For USA, Mexico, Canada**

Fuse Tech Inc.
546 Main Street
Cadiz OH 43907
United States

Tel. +1 800 301 3873
Fax. +1 740 942 3565
Email sales@fusetech.com
Web www.fusetech.com

## Fuse Tech International Services

Fuse Tech International offers a wide range of services designed to prolong the life of refractory installations without expensive cooling down for a cold repair.

Ceramic welding is the core activity of Fuse Tech International. The Company provides both hot and cold face ceramic welding (see pages 7 and 15 respectively).

Hot face welding is normally used to repair damaged refractories in a high temperature environment. Cold face welding is executed on the outside of the furnace to provide, for example, effective sealing of expansion joints after heat-up.

Other specialist services provided by Fuse Tech include the removal of solid deposits in port necks and on top of regenerator packings using extremely high pressure water lances (see page 20). Another important function is the introduction of metallic anchors to secure unstable refractory structures (see page 18).

Safety has a high priority within the organisation. Employees receive regular training and the safety programme is routinely monitored and upgraded.

Fuse Tech International specialist services offer methods for extending furnace life and operating efficiency improvement without causing significant production losses.

## Ceramic welding

# Introduction

The original process of ceramic welding was developed by a Belgian glass manufacturer in the late 1960s. The technology has since become an effective method for carrying out a wide range of repairs during furnace operation.

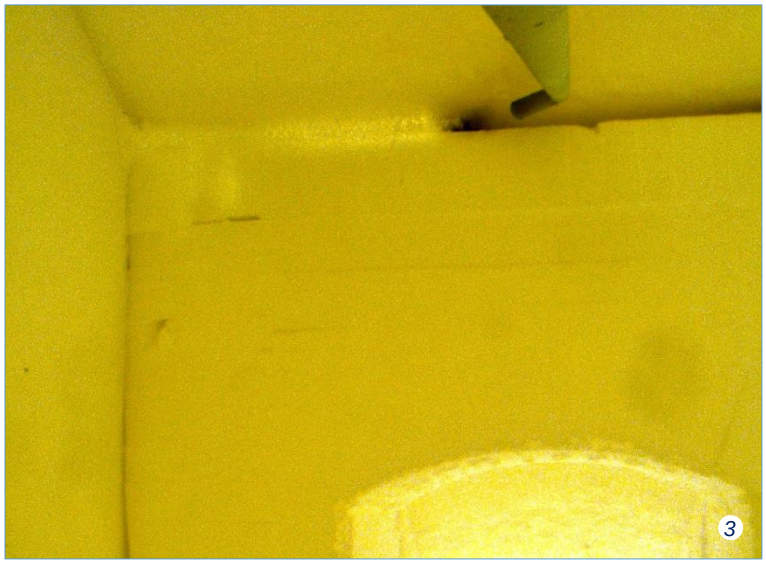
Fuse Tech International offers two types of ceramic welding. Hot face welding is used to repair damaged refractory material inside the furnace, while cold face welding takes place on the outside of the furnace.

Ceramic welding can eliminate the need for extensive conventional repairs, such as the exchange of damaged refractories. The welding can be performed during normal furnace operation and its key benefit is the limitation or prevention of production losses. Today manufacturers of containers, float glass, fibres, sodium silicate and other special types of glass use ceramic welding to prolong the lifetime of the furnace refractories.

Fuse Tech International has the competence and experience to carry out ceramic welding in all sectors of the glass industry as well as in other industries including steel, coking, aluminium, copper, cast iron and cement.

1


2


3

## Ceramic welding

# Principle

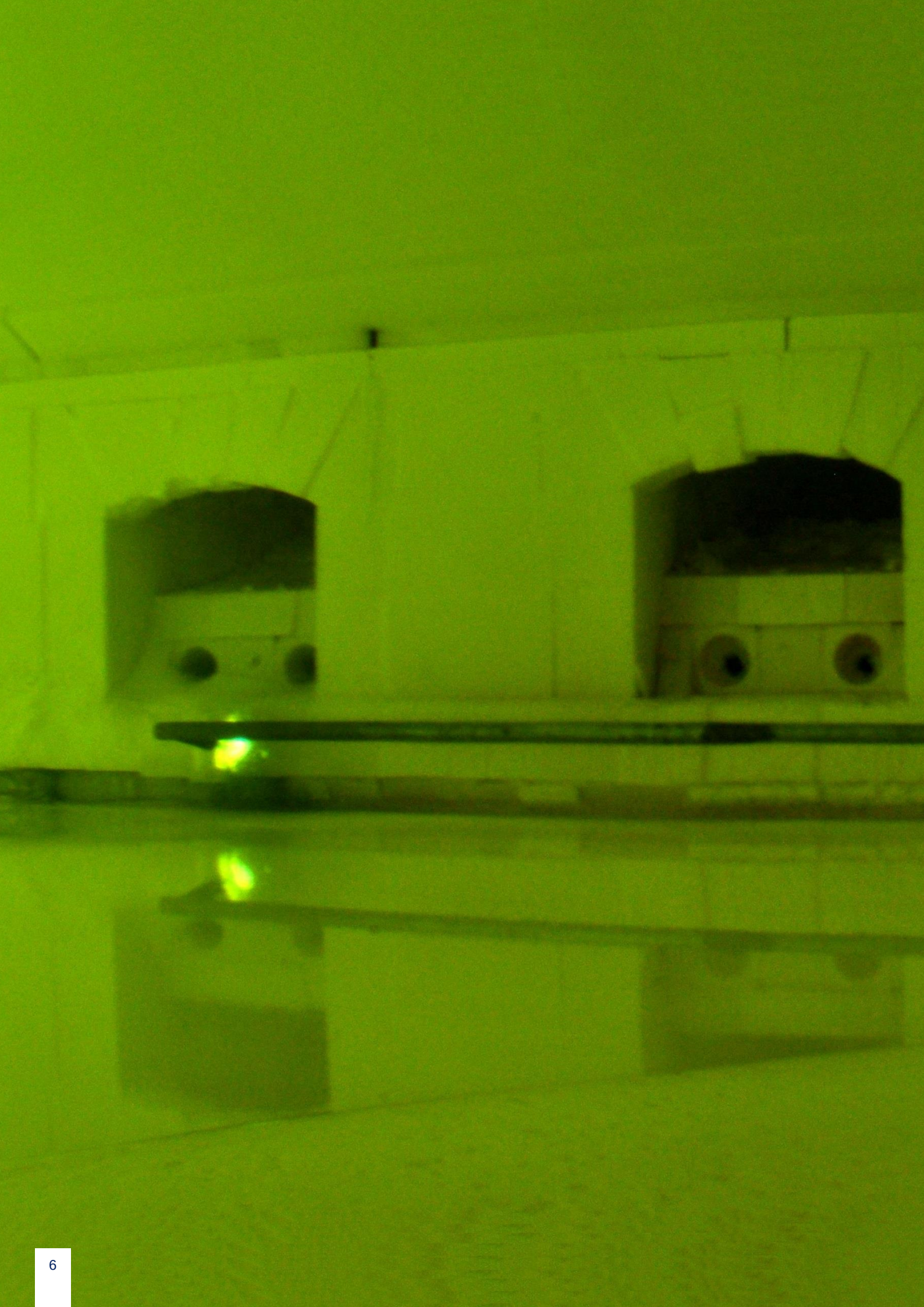
In principle ceramic welding is similar to the conventional welding of metals. A mixture of metallic compounds, a suitable welding material, and oxygen are sprayed into the affected area under pressure by a welding lance.

The metallic compounds oxidize in a highly exothermic reaction and the heat released creates a localised zone of extremely high temperature, typically in the range 1600 – 2200 ºC. At these high temperatures the welding material and the original refractory materials fuse together to produce an extremely strong bond. This procedure can be used to conjoin existing refractory parts or to fill cracks or joints.

Fuse Tech International has access to a range of welding materials based on alumina, fireclay, AZS materials or silica in order to be able to select the optimum material for each individual application.

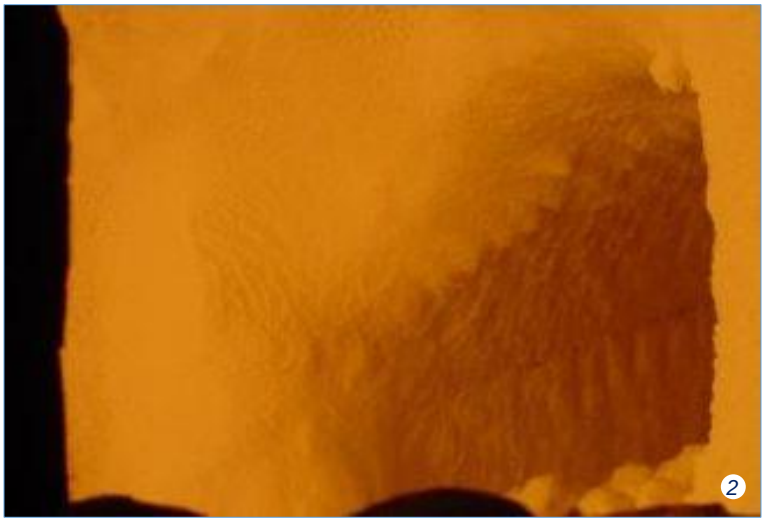
*The figures show:*

1. *A ceramic welding pump unit*
2. *A ceramic welding lance*
3. *Ceramic welding on the sidewall / crown joint of a regenerator chamber*



## Hot face welding

# Applications


As the name implies this procedure takes place on the inside of the furnace refractory structure during furnace operation. Damaged areas can be welded together, holes and cracks filled and the mechanical stability of endangered areas restored.

Hot face welding can be performed on all parts of the furnace refractory structure located above the glass bath surface. All refractory materials normally used in these areas can be welded by the employment of one of the range of materials available to Fuse Tech International.

There are many different lance designs and sizes available, so it is also possible to work on damaged areas in the furnace that are normally difficult to reach, e.g. the crown, port necks, burner arches and doghouse arches.

Modern observation technology methods, such as periscopes, cameras and monitors are used to oversee the progress of the work.

*Figure 1 shows damage to a port neck.*

*The same area is shown in Figure 2 after the damage has been repaired by hot face welding.*

# Access openings

Hot face welding requires access to the furnace interior. Suitable access is not normally available and so must be created. Fuse Tech International achieves this by the use of a water-cooled diamond tipped chainsaw that to cut clean access openings in the refractory walls or crown at the most convenient location.

After completion of the work the opening is either closed or modified to provide an additional peep hole. Openings that are to be closed are sealed by cold face welding.

1


2

*The figures show:*

1. *The water-cooled chainsaw with service unit*

2. *The saw in use to cut an access hole for hot face welding*

# Furnace periscope

In order to determine the extent of the damage a furnace periscope is inserted before welding is begun. The precise work necessary is then agreed with the customer.

The periscope can also be used during the welding process to provide views into difficult corners so that, if necessary, the work can be carried out with reference to a monitor.

After completion of the work the periscope can be used to present the results obtained.

Pictures or videos taken at regular intervals with the periscope can provide the factory management with an appraisal of the furnace condition over its complete life.

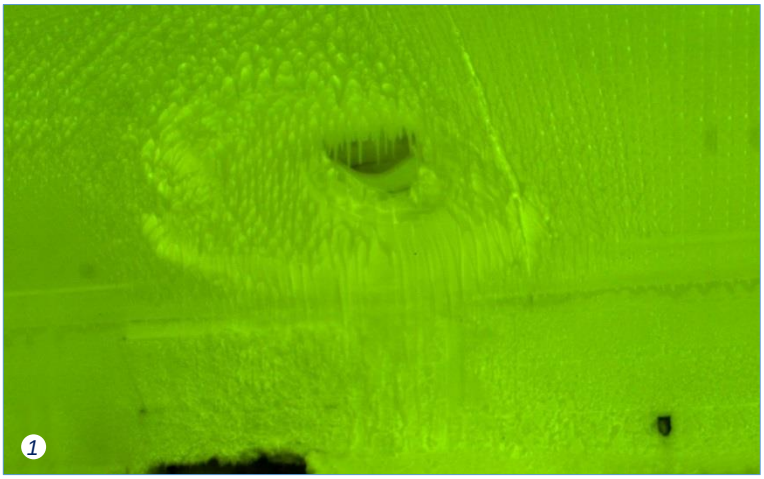
*The figures show:*

1. *A furnace periscope with service unit.*
2. *The periscope in use to inspect the inside of the furnace superstructure.*

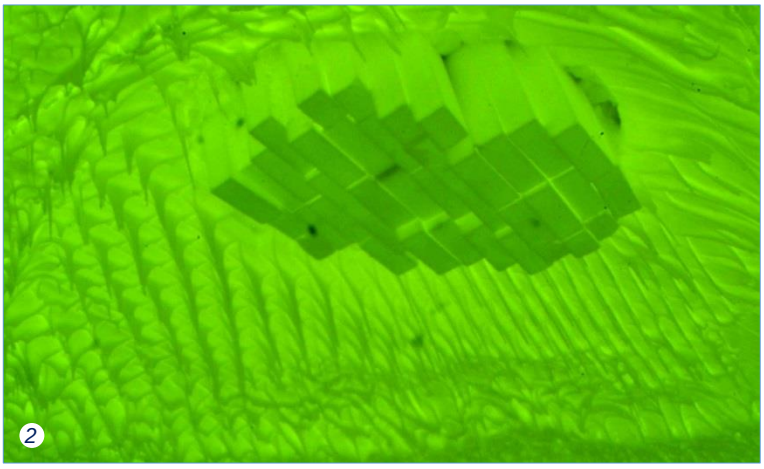
## Hot face welding

# Crown repair

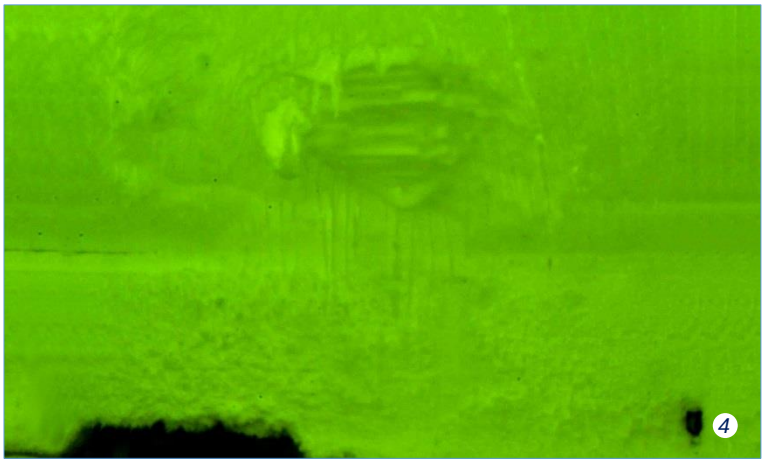
*Figure 1 shows an area of the crown from the inside. A significant area of extreme crown damage is visible.*




*In the first stage of the repair work the opening is filled from the outside using suspended blocks, clearly visible in Figure 2.*

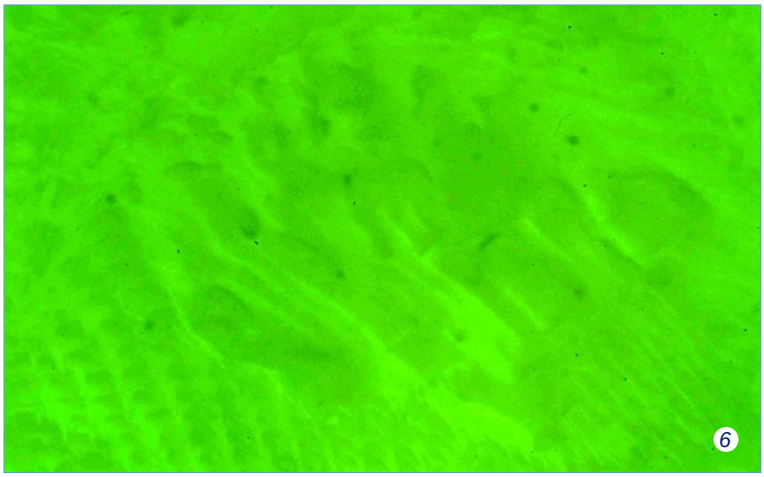



*At this stage the suspended blocks are secured, but there are still openings visible between and around the edges of the blocks, as shown in Figure 3.*



*Hot face welding is used to close all openings between and around the blocks and to bond the original and new materials together as shown in Figure 4.*

*Figure 5 shows the situation on the outside of the repair after the hot face welding has been completed. This can be compared with the view shown in Figure 3 prior to welding.*



*In Figure 6 a close-up view of the repaired area of the crown shows that the original opening has been eliminated. A long-lasting repair is produced by the seal made by the hot face welding.*

## Hot face welding

# Doghouse arch repair

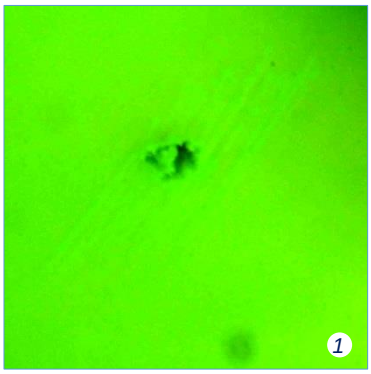
*In Figure 1 extensive damage to the left-hand side of the doghouse arch is clearly visible.*

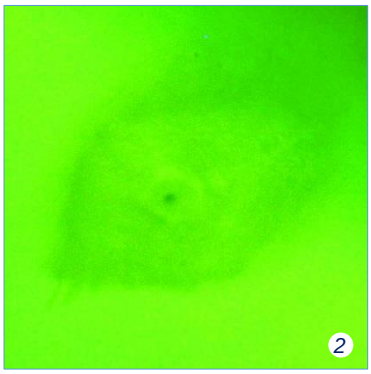

*Refractory plugs are introduced into the damaged area through holes drilled from the outside as shown in Figure 2. These plugs improve adhesion of the welding material to be applied.*


*Figure 3 shows the situation after the hot face welding has been completed. The missing material has been replaced and the new material is completely bonded with the remaining existing refractory.*

## Hot face welding

# Crown rat hole repair


1


2


3

4

Rat holes in the furnace crown may occur anywhere but are particularly common around thermocouple blocks. A conventional repair involves the use of ramming mix to close off any opening from the outside. However, it is well known that repairs of this type have only a limited life and that further sealing work will be required in the future.

Fuse Tech International has developed a much-improved repair method that provides a permanent solution to the problem.

The affected area is cut out with a water-cooled, diamond-tipped chainsaw. This leaves an opening just the size of a new thermocouple block, or a number of crown arch bricks. When the new blocks are in position the joints around the new block(s) are completely sealed on the inside of the crown by hot face welding. The remaining openings on the outside of the crown are then filled with castable silica material.

The complete seal established on the inside ensures that the problem does not reoccur.

*Crown damage around a thermocouple block is visible in Figure 1. Hot face ceramic welding has eliminated the opening around the block, as shown in Figure 2.*

*Figure 3 shows the view of the same location from outside before the repair. The complete elimination of the problem by the repair is even more apparent from the outside, as shown in Figure 4.*




## Cold face welding

# Applications

Cold face welding is performed outside the furnace. It is generally used to ensure the gas-tight sealing of expansion joints after completion of the furnace heat-up. Ceramic welding is a much superior method of sealing joints as it provides a reliable and long-lasting seal.

Reliable gas-tight sealing is a vital aspect of the fight to reduce furnace $NO_x$ emissions as it limits the uncontrolled entry of air into the combustion process. The joints between the skewbacks and the sidewall, or between the tuckstones and the tank blocks, are typical areas where cold face ceramic welding is used for sealing.

A range of different lance sizes and combinations ensure that access to all expansion joints is possible, even at difficult locations such as behind buckstays or between burner ports.

*Figures 1 – 3 show three examples of cold face welding being carried out.*

## Cold face welding

# Joint sealing between crown and superstructure sidewall

*Figure 1 shows a view of part of the superstructure after the joint between crown and sidewall has been sealed by cold face welding. The work was done in February 2011.*


*Figure 2 shows the same area in July 2011, and confirms that the sealing work was successful.*

*In May 2012, 16 months after the work was carried out, the joint is still quite clearly gas-tight, as shown in Figure 3.*

*Figure 4 shows the same area in November 2016. After 5 years operation the joint is still in excellent condition.*

# Stabilisation of refractory structures

Refractory structures can become unstable as a result of wear or material cracking. Fuse Tech International use a combination of technologies for the installation of metal anchors to increase structure stability.

An oxygen lance is used to make a one-sided opening inside the refractory to be anchored. A high-temperature-resistant steel anchor is then inserted and the opening is reclosed by ceramic welding. The metal anchor can then be attached to the bracing steelwork.

*Figures 1 – 4 show the four stages involved in the installation of stabilisation anchors.*

*In Figure 1 an oxygen lance is used to make the opening into which the heat-resistant steel anchor is placed (Figure 2).*

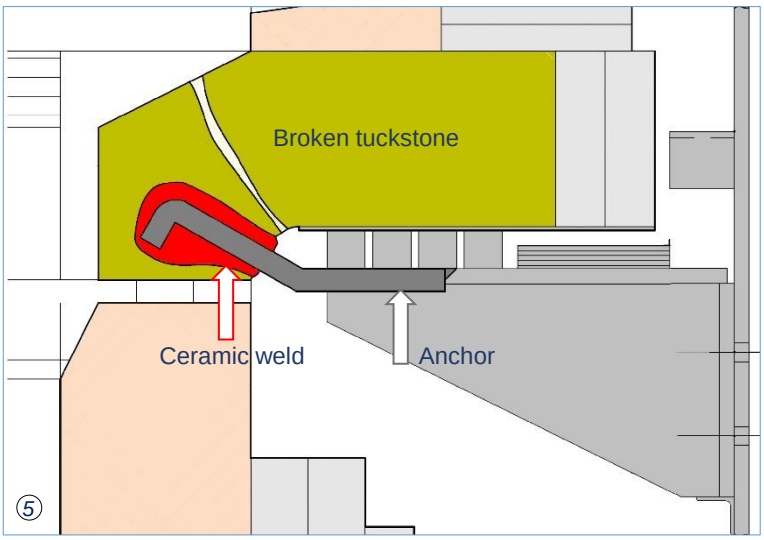
*Ceramic welding is used to enclose the anchor and close the opening (Figure 3). The final result with the steel anchor firmly attached to the refractory block, is shown in Figure 4*

In addition to securing unstable walls this technique can also be used to anchor the front ends of tuckstones that have broken off. The process does not apply any force to the broken pieces so they do not move away from their original position. Anchoring them in this way keeps the joint above the tank blocks filled and does not inhibit future tank block overcoating.

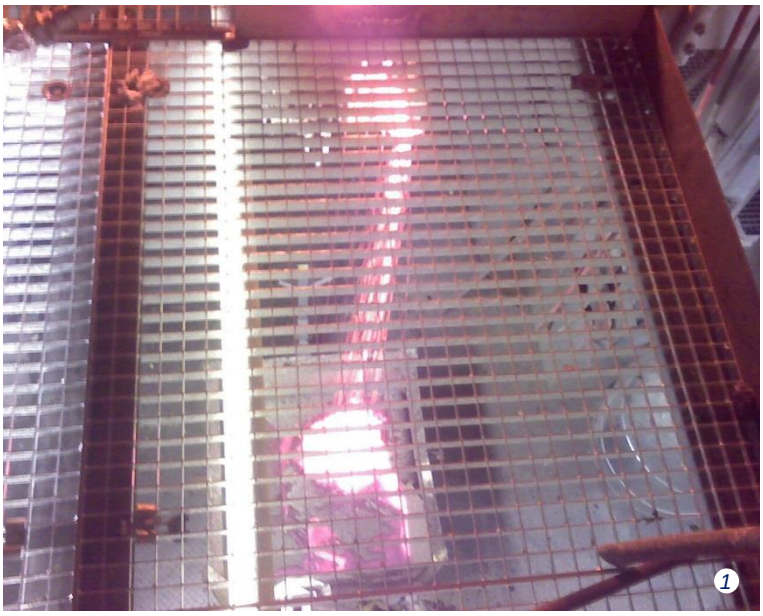
*This principle is shown in Figure 5.*







# Removal of solid deposits in waste gas flues





Solid deposits in waste gas flues can reduce the thermal efficiency of furnace heating systems that use recuperative waste heat recovery.

A thermal lance is a tool that heats and melts steel in the presence of pressurised oxygen to create very high temperatures of up to 2500 ºC. Fuse Tech International uses thermal lances to melt out solidified slag from waste gas flues so that it can be drained off.

In order to achieve the required results effectively and economically, the core lance must exhibit optimum burning characteristics for each particular application. Fuse Tech lances provide concentrated flame bundling for controlled energy release and high flame stability, and so permit precise positioning.

*The two Figures 1 and 2 show the use of a thermal lance to melt solid residues in waste gas flues so that they can be drained off.*

# Removal of solid deposits in regenerators

Furnace energy consumption and emissions are heavily reliant on efficient regenerator operation. Deposits on top of the regenerator packing can cause deterioration of the combustion air or waste gas distribution. This in turn can influence flame development and can lead to increases in CO or $NO_x$ values and energy consumption.

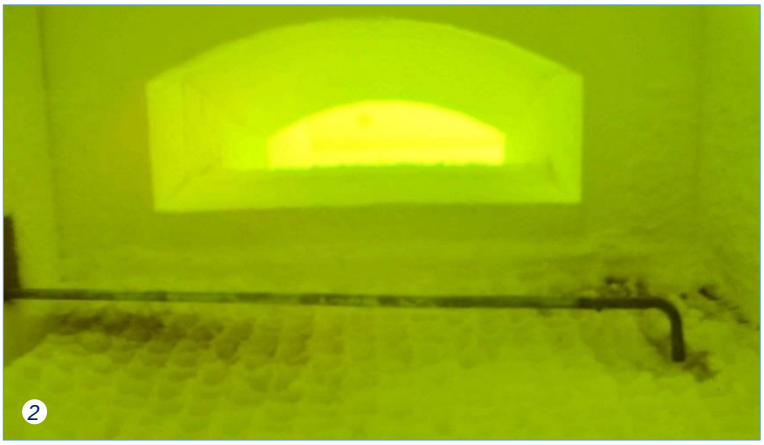
These deposits should be removed as soon as they start to have a negative effect on the combustion system.

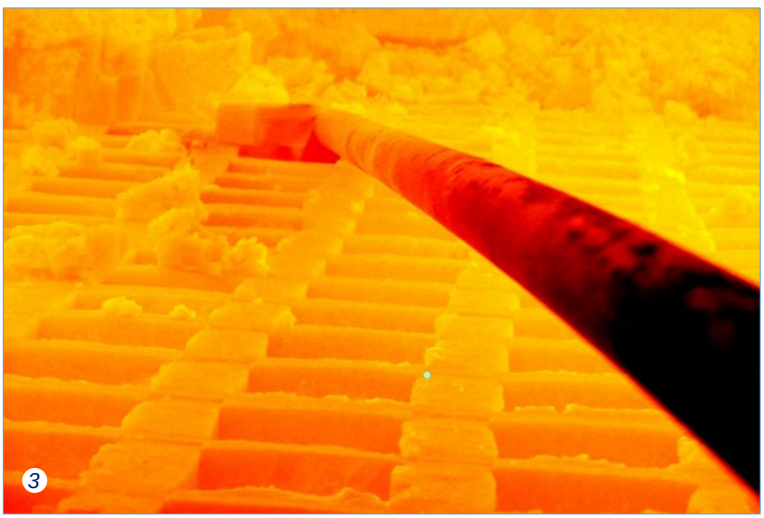
To facilitate removal of the deposits Fuse Tech International uses special water blasting equipment to break them up so that they fall down the shafts in the regenerator packing and collect at the bottom of the chamber, from where they are extracted.

This process enhances the efficiency of the combustion system, without causing undue disturbance to normal operation.

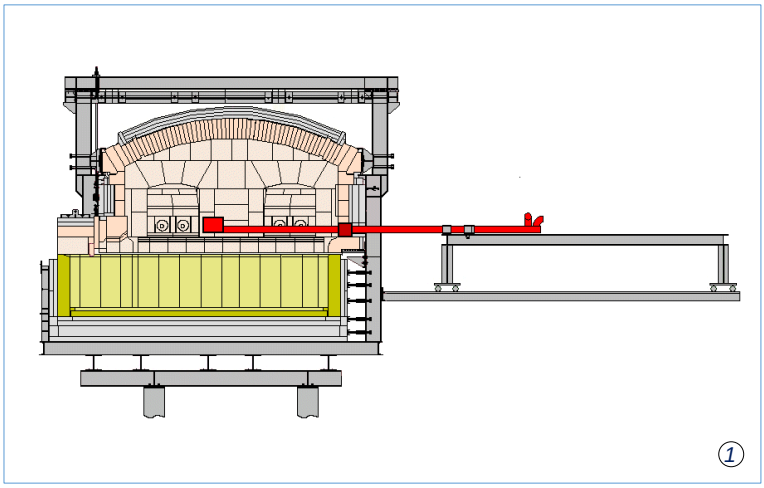
*Figure 1 shows the use of a water blast lance to remove solid deposits from a port neck.*

*The same process is also used to clear the top of regenerator packings as shown in Figures 2 and 3.*

# Use of refractory granules for tank bottom repairs



①

②

Problem areas where the remaining refractory thicknesses in the furnace bottom are low are found most frequently near boosting and bubbling systems. Early detection of such potentially hazardous locations is still difficult but, if a problem area is suspected, test drillings can be made in the bottom to determine the remaining refractory thickness.

A special water-cooled carriage can then be used to introduce refractory granules into the furnace chamber and deposit them in the glass bath above the weak spots in the bottom.

Depending on the furnace and glass type, fused cast or chrome-based material can be introduced. Fuse Tech International has the experience to judge the amount required and specific distribution of the granulate in the damaged areas.

This repair method is a further attractive way of prolonging furnace lifetime at a relatively low cost.

*The figures show:*

1. *The use of the water-cooled carriage for tank bottom repairs*
2. *The water-cooled carriage itself*

# Shotcasting and shotcreting for superstructure repairs

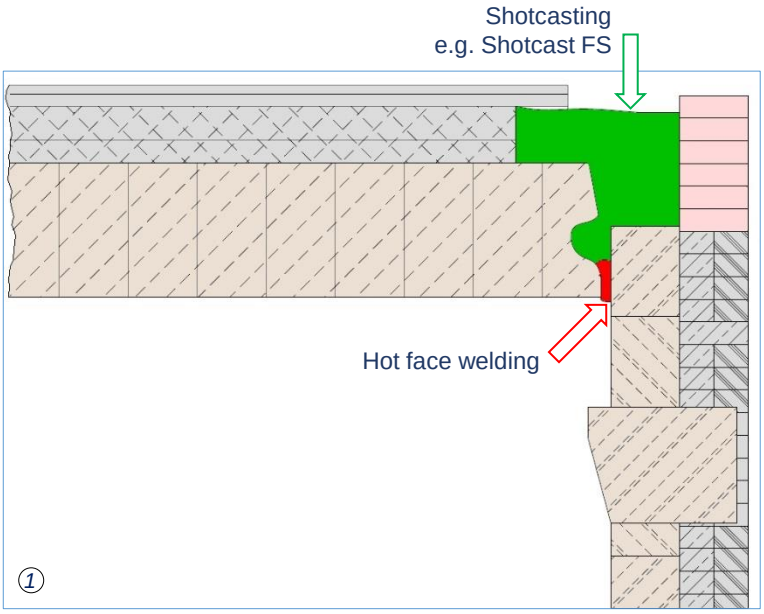
Small scale damage to the furnace crown is usually repaired by hot face welding from the inside and sealing from the outside using shotcasting (ramming). However, it is difficult or even impossible to handle large scale crown damage in the same way.

The shotcreting process can be used to repair large areas of damaged crown or for crown replacement, whereby a complete new crown is placed on top of the original. The new crown is built up of several thin layers of material pump cast into position. When completed, the new crown is between 150 and 200 mm thick, is self-supporting and independent of the original structure.

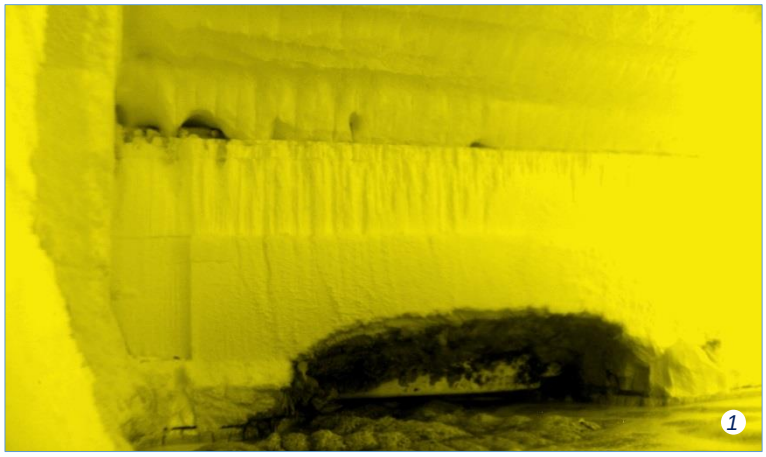
The material used is almost pure silica and therefore does not cause glass faults if it enters the glass bath. It also has good insulating properties that help to increase the hot face temperature and reduce attack by condensation of alkalis.

*The figures show:*

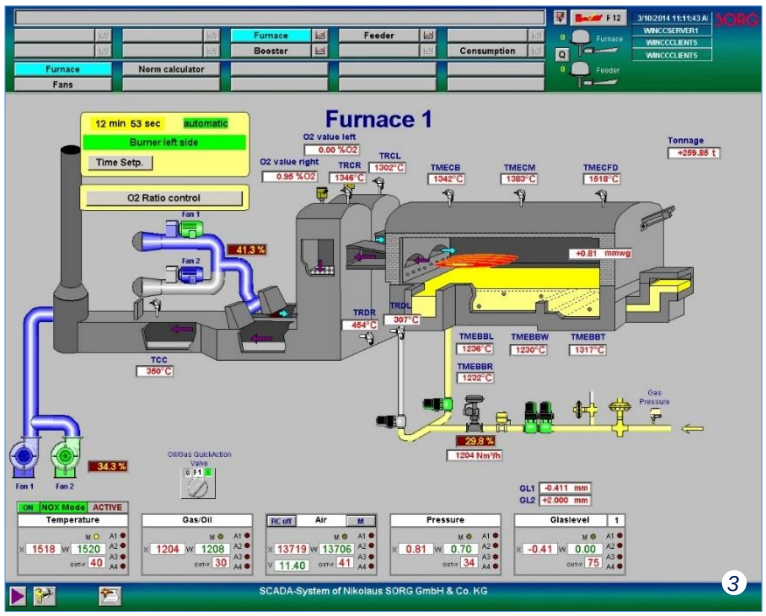
1. *The principle of using hot face ceramic welding (inside) and shotcasting (outside) to produce a permanent repair.*
2. *Hot face welding being carried out during such a repair.*




# The Fuse Tech International furnace audit


1


2



3

A Fuse Tech International furnace audit is designed to establish the current state of the melter and associated systems such as the regenerators and to identify any maintenance or corrective work required to sustain efficient operation. Information collected from a wide range of sources forms the basis for the audit but, in many cases, the correct interpretation of this information is the important factor for determining the final value of the audit to the glass manufacturer.

As a member of the SORG Group Fuse Tech International has access to a wide range of experience covering such diverse areas as furnace engineering, material technology, furnace operation and repair techniques during operation.

A Fuse Tech International furnace audit provides the glass manufacturer with a complete picture of the current state of the installation and highlights any necessary remedial action in all parts of the furnace or associated systems.

*A comprehensive Fuse Tech International furnace audit may include, among other things:*

- *pictures of refractory damage inside the furnace chamber, as shown in Figure 1*
- *information about external damage to any area of the furnace as shown in Figure 2*
- *information about furnace operational problems, as indicated by the SCADA system window shown in Figure 3*

# References

Since its formation in 2007 Fuse Tech International has provided ceramic welding and other specialist services to customers throughout the world.

The current customer list is much too long to reproduce here. However, the following details indicate the extent of the customer base:

Fuse Tech International has customers:

- in 16 countries in Europe
- in 15 countries in Africa and Asia

The following notable companies in the glass industry use specialist services provided by Fuse Tech International :

EUROPE

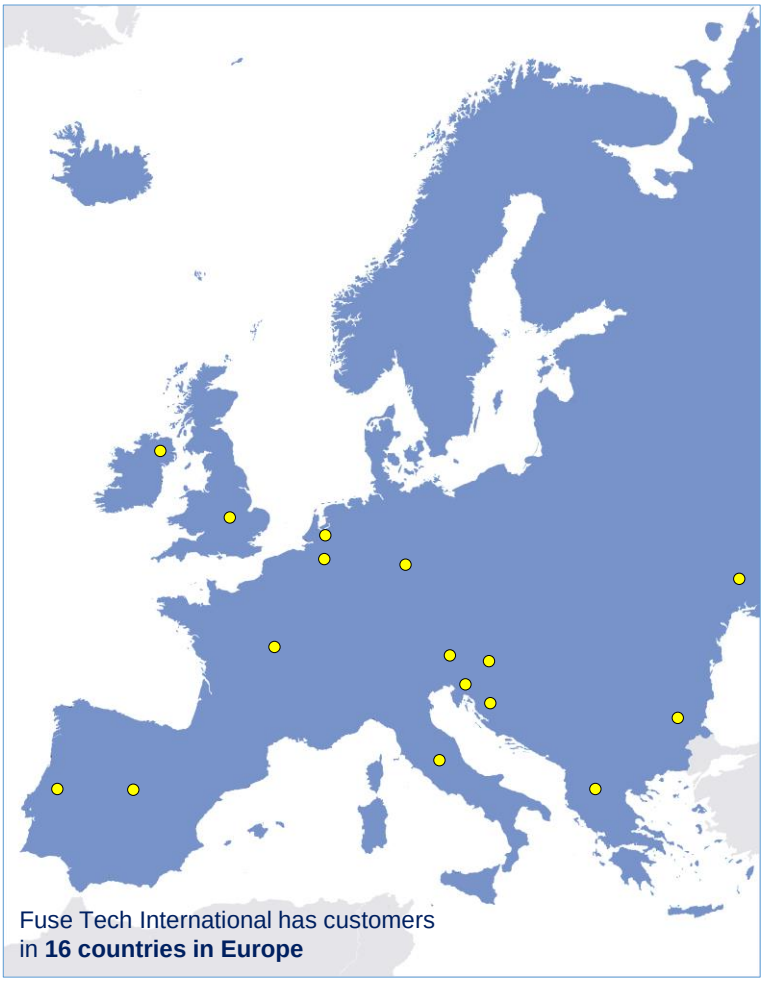
- Encirc / Vidrala
- Noelle + von Campe
- Owens-Illinois (O-I)
- Saint Gobain
- Wiegand Glas

AFRICA

- Consol Glass
- SEVAM
- Middle East Glass
- Nampak
- Vidrul

ASIA

- Al Tajir Glass
- BGC / BGF
- Fulltech
- O-I BJC
- TGI / TMG



Fuse Tech International has customers in **16 countries in Europe**

Fuse Tech International has customers in **15 countries in Africa and Asia**