

INTERNATIONAL GmbH

***Competence in Ceramic Welding
and Hot Repair Works***

有专业能力的陶焊和热修工程的公司 Fuse Tech

Ceramic Welding: Furnace repairs at operating temperature and without stop- ping production

The process of ceramic welding was developed in the late 1960s by a Belgian glass manufacturing company. The technology was introduced to the United States in 1979 as an effective method of carrying out a wide range of repairs during furnace operation.

When damage is identified early enough ceramic welding eliminates the need for an extensive conventional repair (exchange of damaged refractories).

The key benefit of using ceramic welding is that it is performed during normal furnace operation. The furnace doesn't need to be shut-off or cooled down. The final result is no or only minimum loss of production. The ceramic welding is an attractive solution for prolongation of the furnace life time considering the some times very high cost for only a partial reconstruction.

Most of the glass manufacturers chose the ceramic welding in order to prolong the life time of the furnace refractories without production loss.

This market includes manufacturers of flat glass, container glass, glass fibre, sodium silicate and other special kinds of glass.

Fuse Tech offers two types of ceramic welding: repair of damage to refractory material inside the furnace (Hotface welding) and outside the furnace (Coldface welding). Fuse Tech has the competence and experience to carry out ceramic welding in the glass industry (float, containers, fibre, sodium silicate and other special glasses) and in other industries including the steel, coking, aluminium, copper, cast iron and cement industries.

陶瓷焊接：
在正常工作温度下维修窑炉，
不用停止生产。

陶瓷焊接法发展于 60年代晚期由比利时玻璃制造公司，这项技术引入到美国在1979年作为一种有效的工法开展广泛窑炉运行过程中的维修。

当初期发现损坏，Fuse Tech陶焊技术可以进行焊接，以消除需要一个广泛的传统修复（更换损坏的耐火材料）。

陶焊的主要优点是它可以在窑炉运行正常期间焊接。没有必要关闭或冷却窑炉。因此，并无生产的损失或是最少的生产损失。对于延长熔炉寿命，高成本的局部重建，陶焊是一种最好的解决方案，

大部份的玻璃制造业者选用陶焊方式来延长熔炉寿命，并无生产上的损失。这些业者含盖平板玻璃，容器玻璃，玻璃玻纤，硅酸钠玻璃及特殊玻璃。

Fuse Tech 提供了两种类型的陶瓷焊接：修复损坏炉内耐火材料（热面焊接）和修复受损的耐火材料炉外（冷面焊接）。Fuse Tech 有能力和经验进行陶焊在玻璃工业（平板，容器，玻纤，硅酸钠玻璃及特殊玻璃）和其他工业中(包括钢铁，炼焦，铝，铜，铸铁，和水泥业)进行陶焊。

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M.E. doghouse arch before
窑炉进料口拱门焊前



M.E. doghouse arch after
窑炉进料口拱门焊后

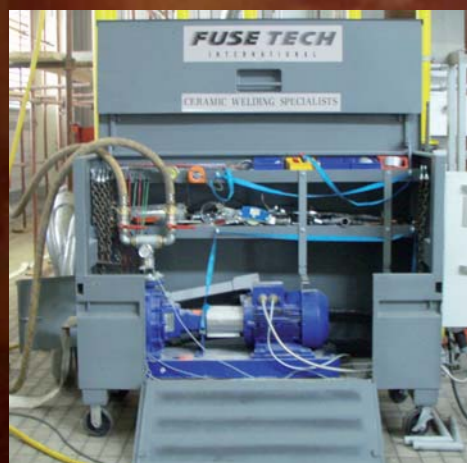
CERAMIC WELDING 陶焊



Welding machine
陶焊機



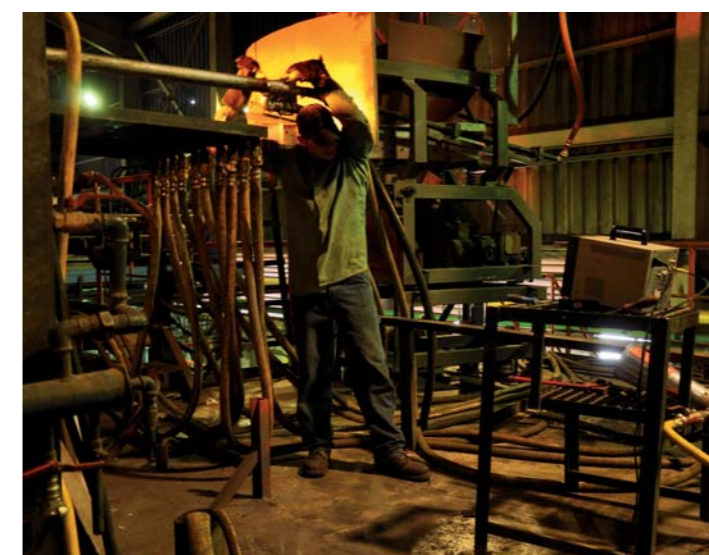
Welding machine and vapourizer
陶焊機和蒸发器



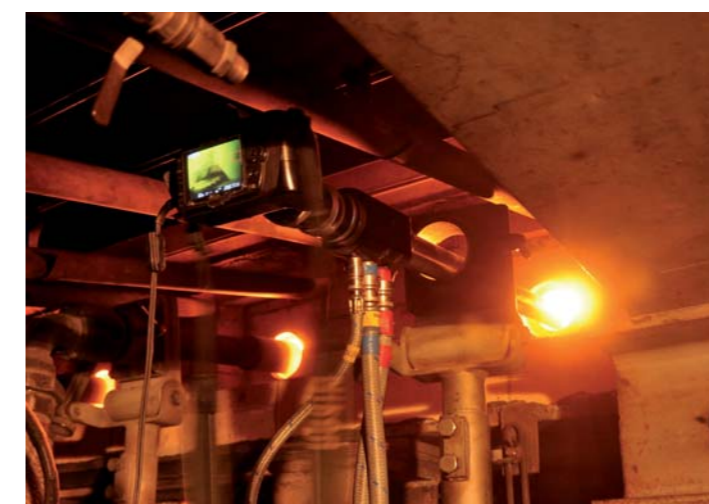
Water pump unit
水泵機組



Welding lance
陶焊噴槍



Welding with a monitor
显示器引导焊接



Supervision with a camera and monitor
照相机显示器引导焊接

HOTFACE WELDING

To carry out ceramic welding during furnace operation a dry mixture (the welding material) is pumped into the furnace.

Many different lance designs and sizes are available which makes it possible to work on damaged areas in the furnace that are normally difficult to reach, such as the crown, port necks, burner arches and doghouse arches. The various welding materials available are described on pages 12 and 13.

热面焊接

窑爐運行中进行陶瓷焊接的乾燥混合物（焊接材料）被泵送入爐內。

许多不同的设计和大小喷枪，可以伸入一般难以到达的窑炉损坏区工作，如炉顶，烟道颈部，燃烧器拱门和加料口拱门。

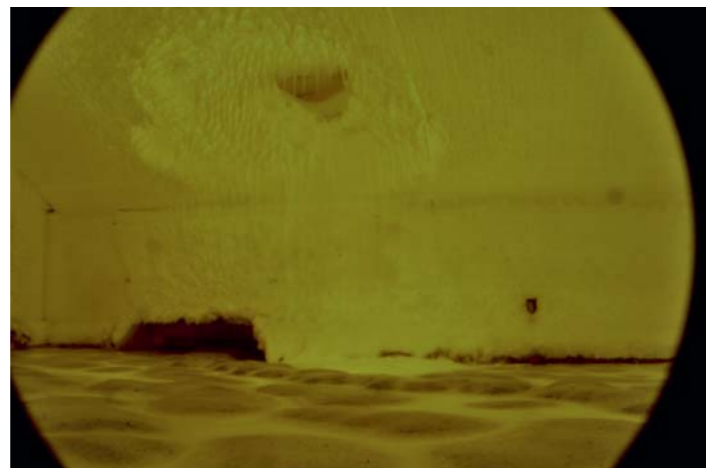
各种焊接材料之介绍请見第12页和第13页。



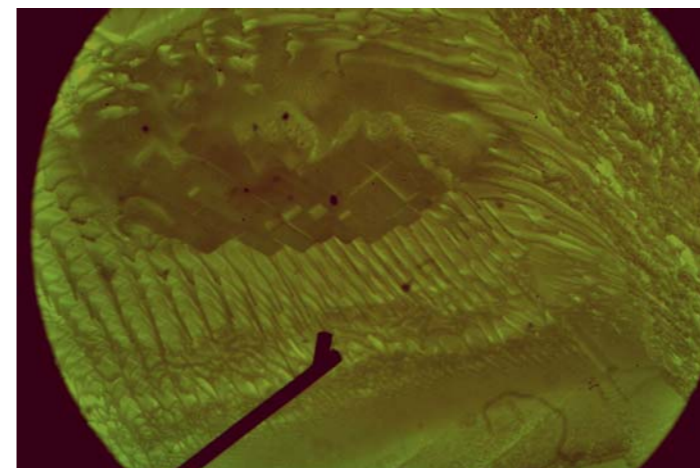
Welding of the crown
炉顶焊接

**Long lasting hot repair
solution for a melting end crown
damage**

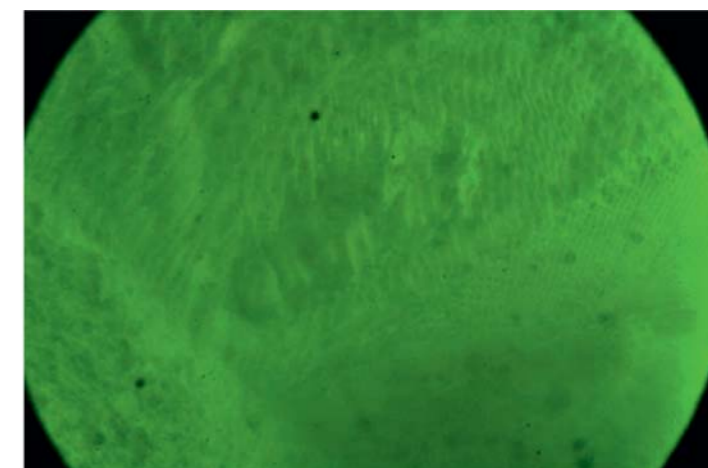
熔炉顶大面积的焊接修复



M.E. damaged crown area
熔炉顶损坏



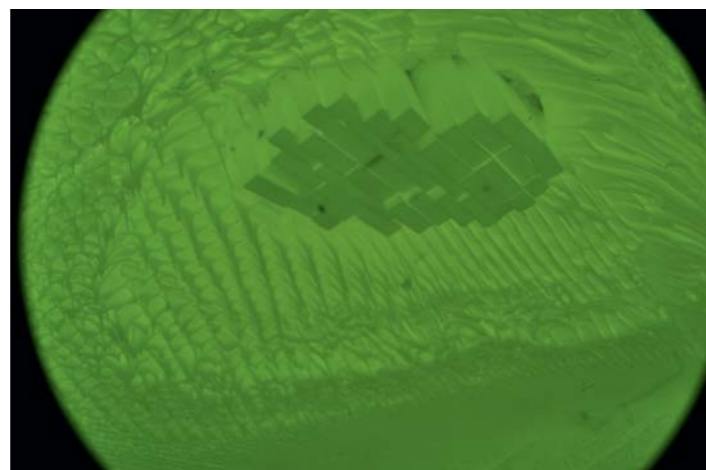
Start welding from inside
焊接内部



After welding from inside
焊接内部后



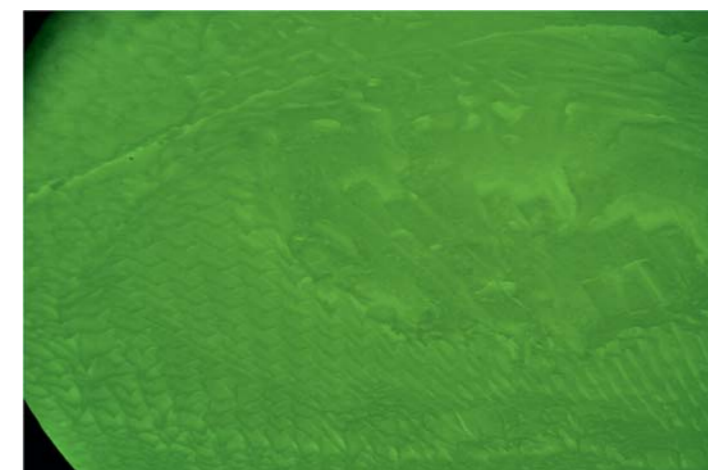
View outside after insert of suspension bricks
悬吊砖放入后外部



View inside after insert of suspension bricks
悬吊砖放入后内部



After welding from outside
焊接外部后



Situation after 22 months
陶焊后22个月



Welding from outside

从外面陶焊



During welding process
焊接作業中

COLDFACE WELDING

There can be used many different lance sizes and combinations in order to reach all expansion joints from outside, even at difficult reachable areas like behind buckstays, between port necks or tank blocks.

The stream of the welding powder enriched with oxygen gets in contact with the refractory surface whilst the metallic contingents are oxidizing during a highly exothermic reaction. The existing heat development (over 2000°C) melts the refractory material with our welding powder which enables to close resp. seal gas tight expansion joints. This reaction results in a long lasting combination between both materials.

冷面焊接

許多不同設計和大小噴槍，可由外部伸入觸及膨脹縫區或損壞區。

富氧的焊接混合物與高溫耐火磚表面接觸，引起混合物里的金屬成份氧化並產生高度放熱反應。

發出的熱量（溫度可達攝氏1600至2200°C）融合了耐火材料與焊接混合物，這種方式可以修復大面積的損壞區。



Skew back joint before welding
焊接前拱座膨脹縫



Cooling down of welding material
焊材冷卻

窑炉受损区域的位置决定陶焊材料的种类（见第8和9页）



During welding process
焊接作業中

Skew back joint over a period of 3 years with Coldface welding

冷面焊接3年间变化



30th Aug. 2009
2009年8月30日



13th July 2011
2011年7月13日



20th Nov. 2013
2013年11月20日



1st Sept. 2010
2010年9月1日



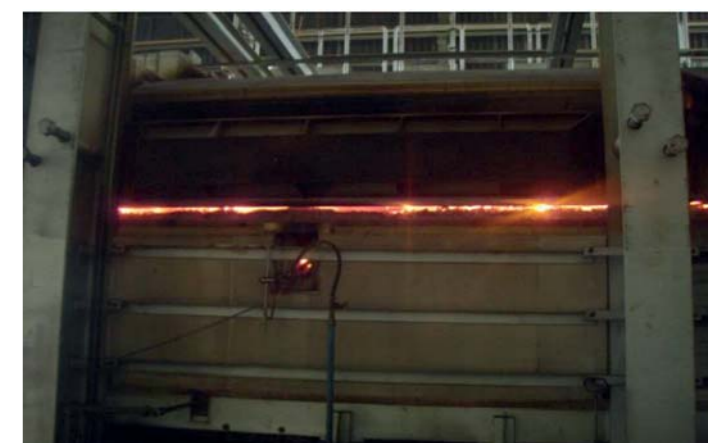
3rd May 2012
2012年5月3日



3rd Feb. 2011
2011年2月3日



6th Dec. 2012
2012年12月6日



A neighbour furnace which is only 6 months older without Coldface Welding

隔壁窑炉没使用冷面焊接，6个月后情况

WELDING MATERIALS AND COMPOSITIONS

The following materials are available for the repair, depending on the part of the furnace to be treated:

HWC-S-1, a silica based material, HWC-AI-1, an alumina based material, HWC-AZS-1, a material based on AZS.

In addition, for the glass industry we also use HWC-S-2, a welding material based on silica and used for the maintenance and repair of silica refractories.

陶焊材料及成份

针对窑炉的不同部位，可以使用下列的焊接材料修补：

HWC-S-1，氧化硅材，
HWC-AI-1，氧化铝材，
HWC-AZS-1，锆电铸砖材。

另外，玻璃业也使用 HWC-S-2 氧化硅材，作为硅砖的维修。

HWC-AL-1 Ceramic welding material based on alumina, mainly used for nose rings in cement furnaces, cyclones and in the glass industry.		HWC-AL-1 氧化铝材陶焊，大多运用在水泥窑的鼻环，旋风处及玻璃工业	
Al ₂ O ₃	approx. 72%	Al ₂ O ₃	approx. 72%
SiO ₂	approx. 27%	SiO ₂	approx. 27%

HWC-AZS-1 Aluminium based AZS ceramic welding material, mostly used for aluminium furnaces and in the glass industry.		HWC-AZS-1 锆电铸砖材陶焊，主要运用在铝窑及玻璃工业	
SiO ₂	approx. 38%	SiO ₂	approx. 38%
Al ₂ O ₃	approx. 37%	Al ₂ O ₃	approx. 37%
ZrO ₂	approx. 20%	ZrO ₂	approx. 20%

HWC-FC-1 Ceramic welding material based on fireclay, used in the coking and glass industries.		HWC-FC-1 耐火黏土材陶焊，运用在炼焦与玻璃工业	
Al ₂ O ₃	approx. 69%	Al ₂ O ₃	approx. 69%
SiO ₂	approx. 27%	SiO ₂	approx. 27%

HWC-S-1 Ceramic welding material based on fused silica, used in the coking and glass industries.		HWC-S-1 熔铸硅材陶焊，运用在炼焦与玻璃工业	
SiO ₂	approx. 94%	SiO ₂	approx. 94%

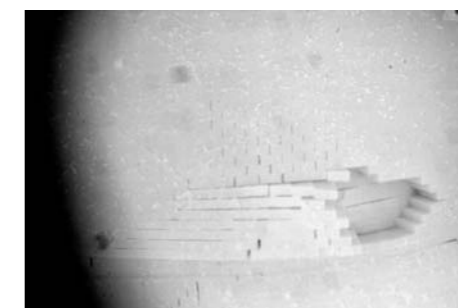
HWC-S-2 Material based on high purity fused silica, mainly used in the coking and glass industries.		HWC-S-2 高纯度熔铸硅材陶焊，主要运用在炼焦与玻璃工业	
SiO ₂	approx. 98%	SiO ₂	approx. 98%



Ceramic Welding Powder
陶焊粉末

REGENERATOR UPPER PART REPAIR

蓄热室上部维修



Inspection of regenerator crown
蓄热室顶检视



Regenerator crown during welding
蓄热室顶焊接中



Inspection of regenerator crown after welding
焊接后的蓄热室顶检视



Regenerator crown after cooling down
冷却后的蓄热室顶



Joints after cooling down
冷却后的砖连结

PORT HOT REPAIR

燃烧器墙热修



Situation before from outside
燃烧器墙焊前



Situation after exchange tuckstones and burner blocks
更换胸墙底砖和燃烧器砖后



Situation during ceramic welding
燃烧器墙焊中



Situation after from outside
完成后外面



ACCESS OPENINGS

Fuse Tech has the necessary equipment and experience to cut openings in the refractory walls or crown. Clean access openings are cut with a water-cooled diamond tipped chain saw at the most convenient locations for the work to be carried out. When the work is finished these openings are closed or configured as additional peep holes. Closing and sealing is achieved by Coldface welding.

开洞作业

Fuse Tech 拥有在耐火砖墙或窑顶开洞的设备及经验。由水冷式钻石链锯在最适当的地方切开洞口，以便工作。当陶焊工作完成后，切口将被封闭或改制为观察口，并以陶焊方式从外部关闭与焊封。



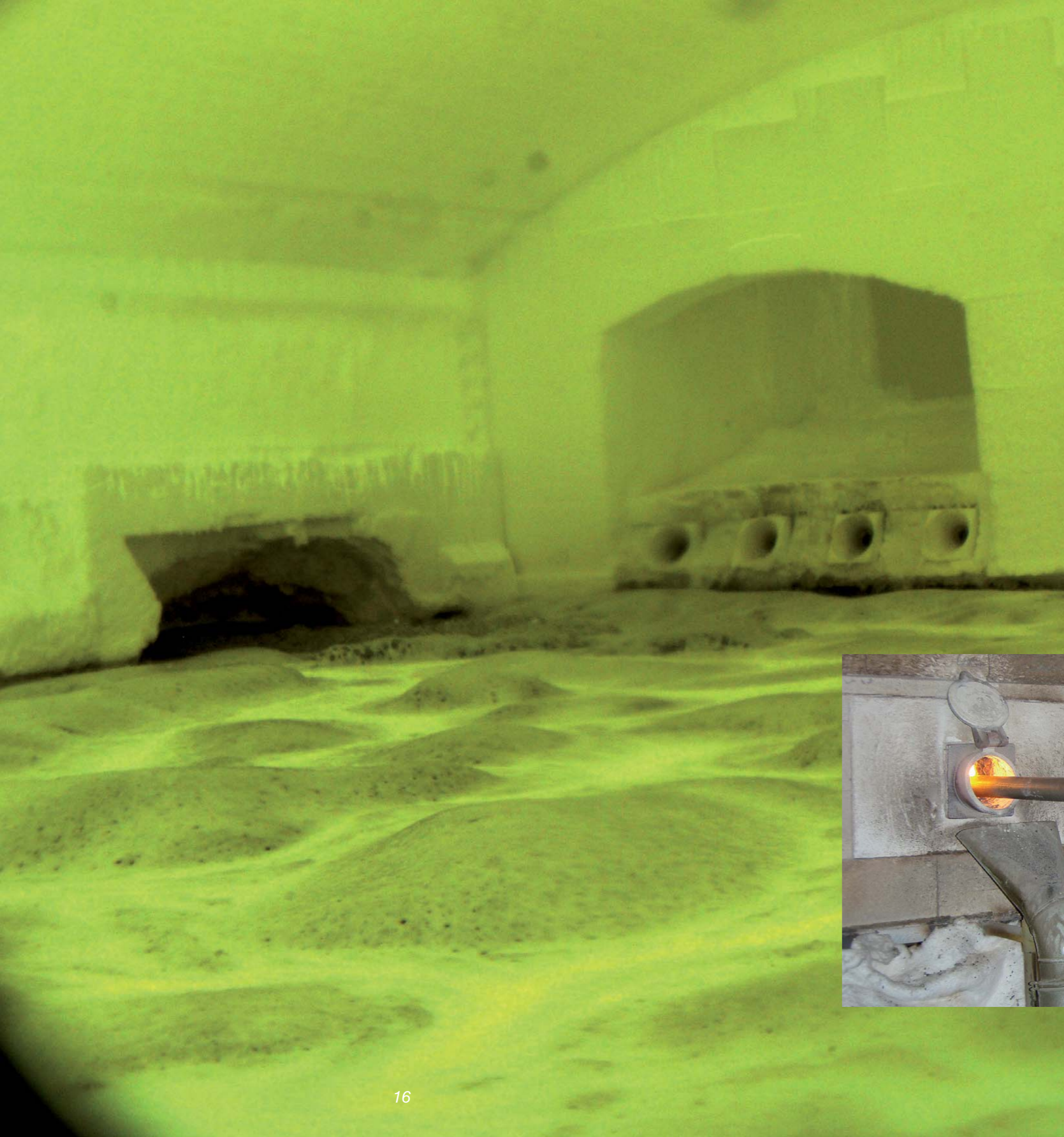
Fuse Tech chain saw
Fuse Tech 钻石链锯

INSPECTION

Before the welding work is begun a furnace periscope is used to determine the extent of the damage so that the exact work needed can be agreed with the customer. The periscope can be used to provide views into difficult corners so that the work can be carried out by reference to the monitor if necessary. After the work is completed it can be used to present the results obtained. Pictures or videos taken at regular intervals can provide the customer management with an appraisal of the furnace condition over the complete life of the furnace.

检查

陶焊工作进行前，需以窑炉潜视镜检查，可测量损坏区的面积，精准掌握需要进行那些工作。潜视镜可照出死角的视景，在必要时将以监视器引导焊接完成工作，工作完成后它则可用于展示成果。在定期的进行摄影与录像，提供客户管理窑炉的评估，掌握熔炉的使用寿命。



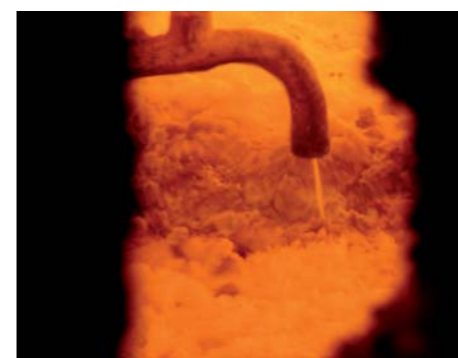
REGENERATOR AND PORT NECK CLEANING (Water blasting)

蓄热室与颈道的清理 (水刀清理)

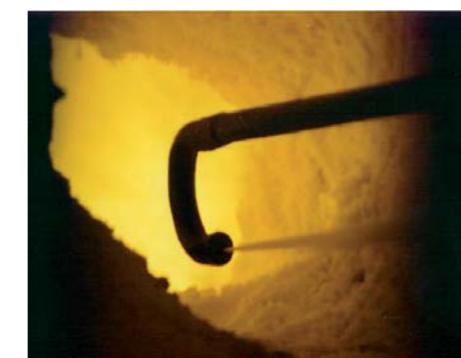
Cleaning is recommended as soon as deposits start to have a negative effect on the combustion system. Deterioration in the combustion air or waste gas distribution can influence the flame development and result in increasing CO or NO_x values and energy consumption.

Our modern, effective cleaning method (water blasting) using our special equipment to melt and remove deposits can significantly improve the efficiency of the combustion system.

沉积物开始对燃烧系统有不良影响时，便建议开始清理工作。燃烧空气下降或废气滞留会影响火焰，产生额外的一氧化碳与多氧化氮，能源的浪费。本公司有特殊设备用以熔化并去除沉积物，以增进燃烧系统的运作效率。



Regenerator checkerwork from above
蓄热室格子砖顶部



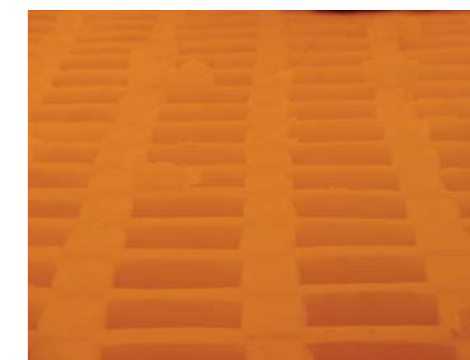
Port neck
颈道



Special lance in use
特殊喷枪

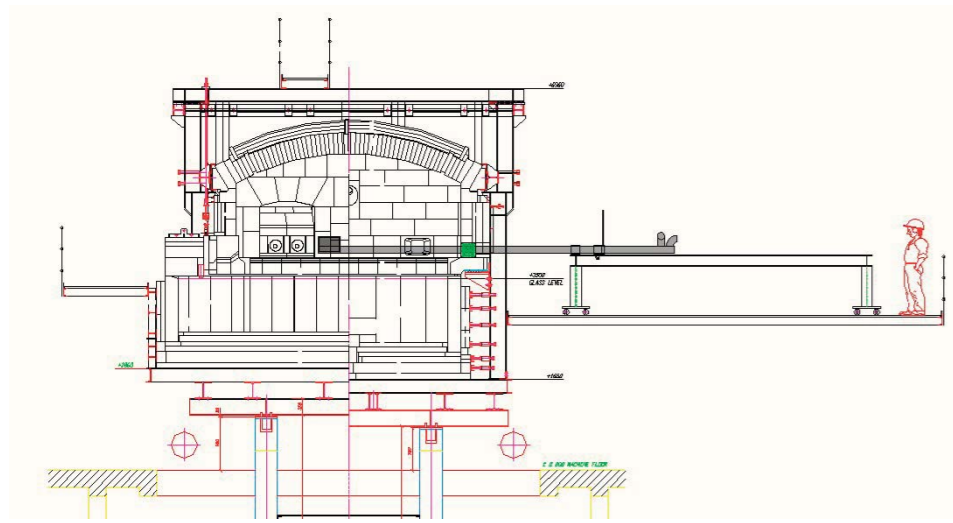


Deposits on the checkerwork
格子砖上的沉积物



Checkerwork after cleaning
清理后的格子砖

Molten deposits from the top of the checkerwork
从格子砖顶部熔化的沉积物



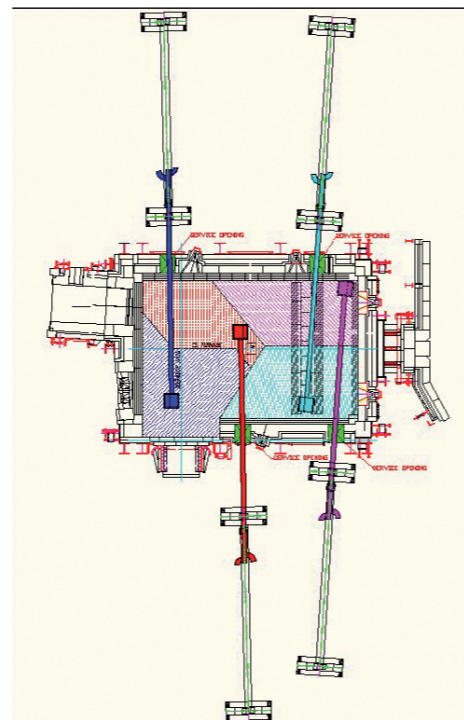
THE USE OF GRANULATE TO REPAIR CORROSION DAMAGE TO THE FURNACE BOTTOM

Early detection of potentially hazardous locations in the furnace bottom (low remaining refractory thickness) is still difficult. Test drillings are made in the bottom to determine the remaining thickness of the refractory. Problem areas are most frequently found near boosting and bubbling systems. Depending on the furnace type, fused cast or chrome based material is inserted into the furnace chamber by our special water-cooled carriage. As a result of our experience we can

judge the amount and distribution of the granulate required and place it in the damaged area.

We always try to disturb the production as little as possible. In certain cases different procedures may be required, and these are always discussed in detail and agreed with the customer.

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



使用粒状耐火材料修补熔炉底部损蚀

早期探测出窑炉底部的问题(窑底砖厚度)仍属不易,在底部钻出探测孔以测定耐火砖的剩余厚度,而有问题的区域经常发现在靠近电极与吹泡系统处。

按照窑炉的不同型式,我们使用特制水冷式承载器将熔铸砖或铬砖倒入熔炉室中。

由于过去的经验我们可以判断粒状耐火材料在损坏区的需要量以及如何配置。

一般过程中我们尽可能不影响生产,若需要使用不同的程序则将与客户详细讨论后决定。若想以相对低廉的价钱延长窑炉的使用寿命,运用这套修补方式是极佳的选择。



BURNING-OUT OF WASTE GAS CHANNELS IN RECUPERATIVE SYSTEMS

Using our thermal separation (oxygen lancing) procedure we are able to melt out solidified slag to make it fluid for draining. During thermal separation oxygen is used to burn the core lance tip. The resulting chemical reaction releases intense heat (temperatures up to 2500°C), which is used to cut through various materials such as iron, steel alloy, refractory bricks, mortar and stone.

The core lance must exhibit optimum burning characteristics for each particular application in order to achieve the required results effectively and economically.

Our lances are noted for:

- concentrated flame bundling which provides controlled energy release
- long burning period and burning capacity per lance
- low oxygen consumption
- high safety standard for the operator
- high flame stability, which allows precise positioning
- low vibration and low noise level during use.

金属热交换器废气道的烧出

使用我们的热分离(纯氧喷枪)的程序,能够将凝结变硬的炉渣熔解后排出。

在热分解中需加入氧气让束枪末端燃烧,化学反应的结果将释放出高热(高达摄氏2500°C),用以切割铁、合成钢片、耐火砖与各种岩石。

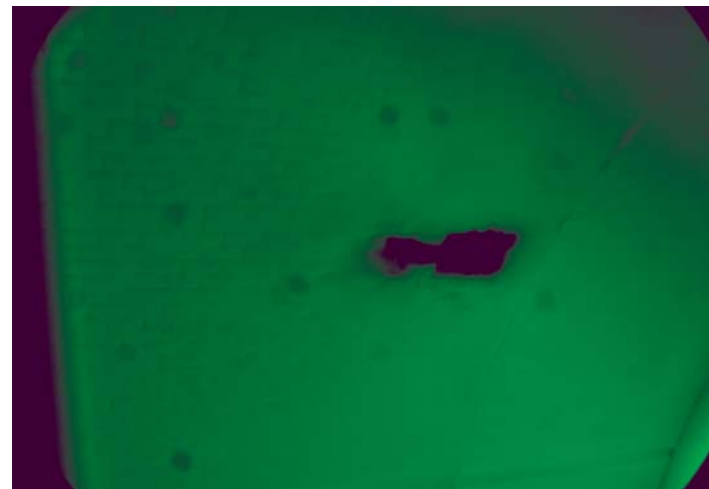
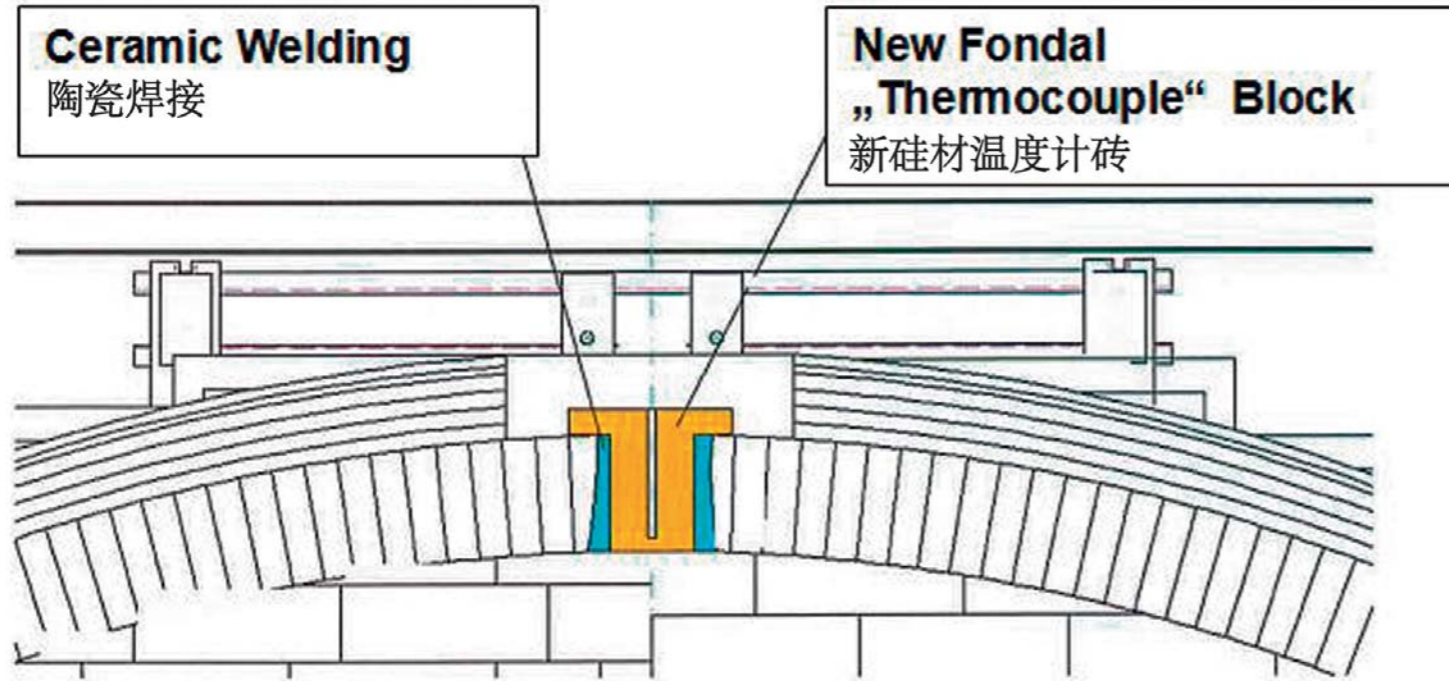
为了有效且经济的使用这个系统,束枪必须依照需要提供充分的最佳燃烧特质。

我们的喷枪具有以下优势:

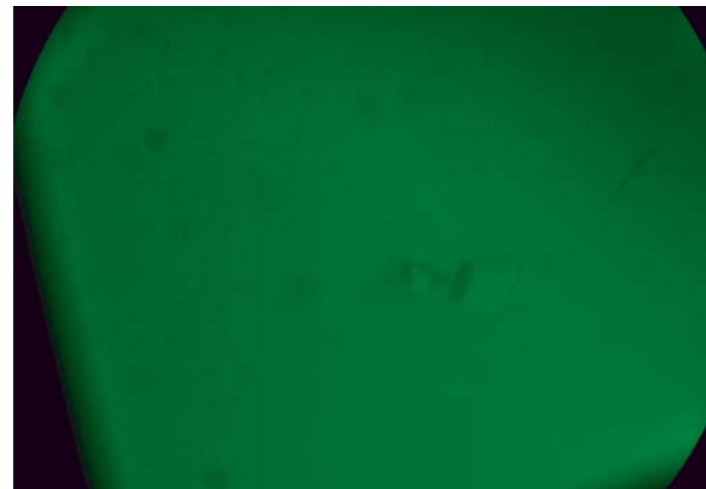
- 火焰集中以提供集中的能量释放
- 枪的燃烧时间长并且容量大
- 耗氧气量低
- 人员安全性高
- 切割焰火的稳定度与精确性高
- 使用时震动与噪音量皆低

LATEST BEST SOLUTION TO REPAIR RAT HOLES AT THERMOCOUPLES

熔炉顶老鼠洞的修复



M.E. crown damage before
熔炉顶陶焊前



M.E. crown damage after
熔炉顶陶焊后

The Company 公司简介



Company location in Lohr am Main, Germany
公司位於德國 Lohr am Main

Fuse Tech was founded in 1993, and in the following year received contracts from customers in the glass and coking industries. These jobs were completed in February 1995.

Our current employees now possess well over 100 years combined experience of ceramic welding.

The ABILITY, ADAPTABILITY and EXPERIENCE of these employees have been major factors behind our past achievements and are guarantees for our future successes.

Safety has a high priority within our organization and we continually train our employees, and upgrade and monitor our safety programme. Up until 2008 Fuse Tech was only active in the North American market. Fuse Tech International now offers ceramic welding services worldwide.

Fuse Tech 成立于1993年，在1994年11月开始第一个玻璃窑炉维修工作，1994年12月开始第一个炼焦炉维修工作，一直至1995年2月止。

目前本公司的工作人员总共合计已有超过100年的陶焊经验，我们过去与未来的成功来自于员工的能力、质量与经验。

本公司一向强调安全性，并持续训练，提升与监控我们的安全系统。直至2008年以前，本公司的业务范围仅于北美，而现在我们将提供全世界性的服务。

REFERENCES

实绩



Customer 客户	Location 位置	Welding carried out 实绩
AGC Flat Glass, Netherlands	Thiel	Port neck cleaning
AGI Glass, Thailand	Ayutthaya	Coldface welding of skew backs, expansion joints crown after heating up, endoscope inspection
Ardagh Glass, Germany	Germersheim Nienburg Bad Münden	Endoscope Inspection of superstructure of furnace H Emergency - repair furnace 3 Ceramic welding regenerator entrance left/right, welding of the sting outs
Bangkok Glass Industry Co., Ltd	Bangkok	Delivery of ZAC stoppers and diamond drills, Coldface welding of skew backs, expansion joints crown after heating up
BCC Glass, Thailand	Bangkok	Endoscope inspection
Bucha Glassworks, Ukraine	Bucha	Visual inspection of furnace Exchange of the side wall regenerator right side as well as ceramic welding of the open gap in this area from inside
Consol Glass Ltd., South Africa	Bellville Clayville Wadeville	Coldface welding of skew backs, expansion joints crown after heating up, Hotface and Coldface welding Endoscope inspections of 2 furnaces Coldface welding of skew back line left/right
DBW Advanced Fiber Technologies, Germany	Bovenden	Endoscope inspection of 2 furnaces
Drujba Glassworks, S.A. Bulgaria	Sofia Plovdiv	Exchange of burner blocks, welding of both dog-house arches, regenerator entrance and skewback regenerator both sides, visual inspection and periscope inspection Visual inspection and endoscope inspection
GE Lighting, Hungary	Vac	Melting end skewback joint over complete length (from inside)
Gerresheimer, Belgium	Momignies	Suspended bricks of rotating crown (from inside)
Gerresheimer, Germany	Essen Lohr	Port neck transition blocks (from outside) Endoscope inspection
Glaswerk Ernstthal, Germany	Ernstthal	Coldface welding of skew backs, expansion joints crown after heating up
Gulf Glass, Manufacturing Co., Kuwait	Kuwait City	Hot repair works by meaning of ceramic welding and shotcreting, Inspection of the furnace by endoscope

Customer 客户	Location 位置	Welding carried out 实绩
Interpane Glass SAS, France via Karrena Glas	Seingbouse	Regenerator and port neck cleaning
Lanxess N.V., Belgium, via Karrena Glas	Antwerpen	Waste gas flue wall
Lauscha Fiber, Germany	Lauscha	Around the burner blocks, waste gas flue transition, thermal cleaning of waste gas channels and of the deposits, tuck stones (from inside) drilling for and insertion of ceramic tubes in stack bottom, welding of worn tuckstones, welding of fire sting-outs at recuperator expansion joint
Kumbi Corporation, Korea	Seoul	Hot repair works after draining and ceramic welding of the doghouse skew back
Khon Kaen Glass Industry Co. Ltd., Thailand	Khon Kaen	Cleaning of top layer of checkerwork of 2 furnaces, Ceramic welding of expansion joint front wall and burner wall
MGM, Egypt	Cairo	Regenerator crown
MEG Glass, Egypt	Cairo	Endoscope inspections
Nampak Glass, South Africa	Gauteng Leondale	Endoscope inspections, Coldface welding of skew backs, expansion joints crown after heating up Endoscope inspections of 2 furnaces
O-I Glasspack, Germany	Achern	Exchange suspension bricks, ceramic welding doghouse protection arch, ceramic welding sting-outs batch wall, ceramic welding expansion joints, Coldface welding expansion joints port necks
PQ Potters Europe, Germany	Wurzen	Burner wall
Prachinburi Glass Industry Co. Ltd., Thailand	Prachinburi	Checker cleaning via water-cooled lances and compressed air
Quinn Glass Ltd., UK	Elton	Ceramic welding of the expansion joints in the crown left/right side in chamber sections LHS/RHS port 1 to 10 from inside, as well as demolition of the middle wall to a certain level to do shotcasting Endoscope inspections of 2 furnaces
Quinn Glass Ltd., Northern Ireland	Derrylin	Ceramic welding of the expansion joints tank doghouse arches, burner wall after exchange of tuckstones, burner blocks etc. Endoscope inspections of 2 furnaces
Rayong Glass Industry Co., Ltd., Thailand	Rayong	Cleaning of top layer of checkerwork via water-cooled lances and compressed air

Customer 客户	Location 位置	Welding carried out 实绩
Saint-Gobain, Germany	Bad Wurzach	Endoscope Inspection
	Essen	Inspection of furnace 1 – 3
	Mannheim	Doghouse arch, transition block above burner Coldface welding (from outside)
	Neuburg	Welding of fire sting-out at crown
	Ladenburg	Both doghouse arches (from inside), welding left doghouse arch
	Lübz	Exchange of burner blocks and welding after wards (from inside)
Steklarna Hrastnik, Slovenia	Hrastnik	Regenerator crown, port neck joint Coldface welding (from outside)
Stirom S.A., Romania	Bucuresti	Ceramic welding works melting end Welding doghouse arch Furnace 3
Stölzle-Oberglas, Austria	Köflach	Welding of tuck stones at furnaces 2 + 4
Sevam, Morocco	Roches Noires	Endoscope Inspection
Thai Malaya Glass Co., Ltd., Thailand	Saraburi	Endoscope inspection and sidewall heating repair at forehearths
Vidrala, Portugal	Marinha Grande	Melting end crown and tuckstones around melting end burner blocks regenerator middle wall
Vidrierias Masip S.A., Spain	Cornellà de Llobregat	Delivery of HWC-AZS material for overcoating work at doghouse corner
Vidrul, Angola	Luanda	Paving of the burner wall, exchange of tuck stones below the burner blocks of the intermediate wall, welding of the joints at burner wall after insert of the new material as well as welding of the skewbacks M.E. left/right
Wiegand Glas, Germany	Großbreitenbach	Melting end skewback joint doghouse cover, Coldface welding (from outside), Coldface welding skew back brick doghouse arch Cleaning of top layer of checkerwork Welding of skew back block doghouse arch left side
	Steinbach	Removal of the ramming mix at skew backs M.E. afterwards Coldface welding (from outside), ceramic welding of expansion joints burner and front wall (from inside) Coldface welding of fire sting-outs at melting end crown
Yioula Glassworks S.A., Greece	Athens	Welding of the joints at regenerators left/right (from inside)



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