

SiC Products LIRR



Sinosteel Luoyang Institute of Refractories Research Co., Ltd

LIRR Profile

- Established in 1963;
- The sole comprehensive research institute for refractories in china.
- 1999, Joined Sinosteel Corporation;
- Refractories Capacity: 80,000 ton/year



1963



LIRR headquarter

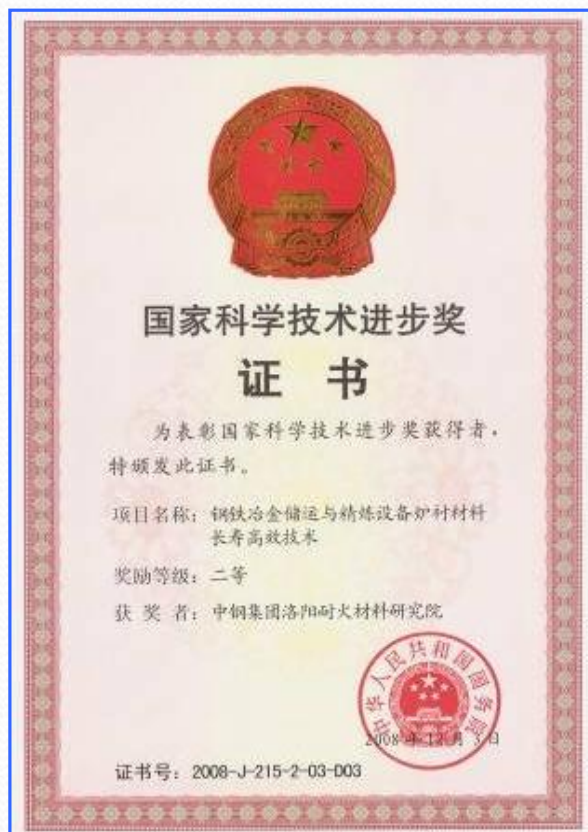
Now

State Key Laboratory of Advanced Refractories & Refractory National Monitor/inspection Center

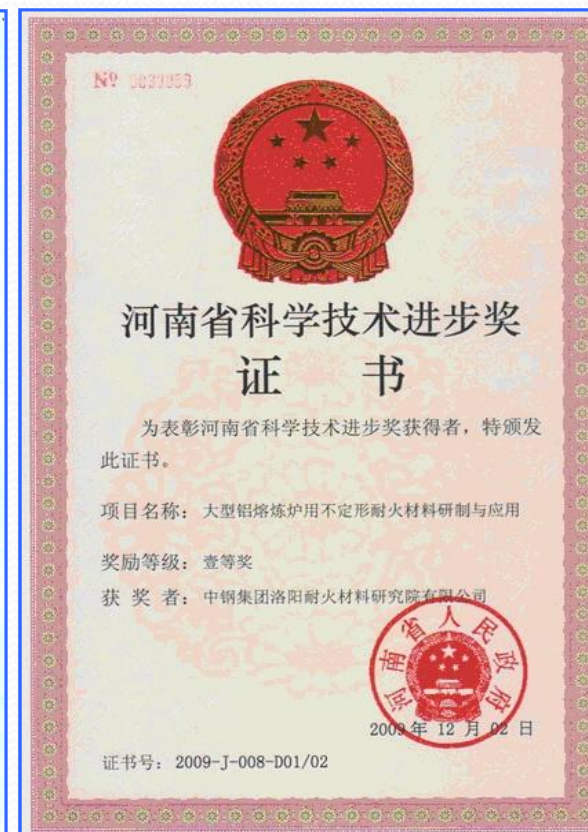
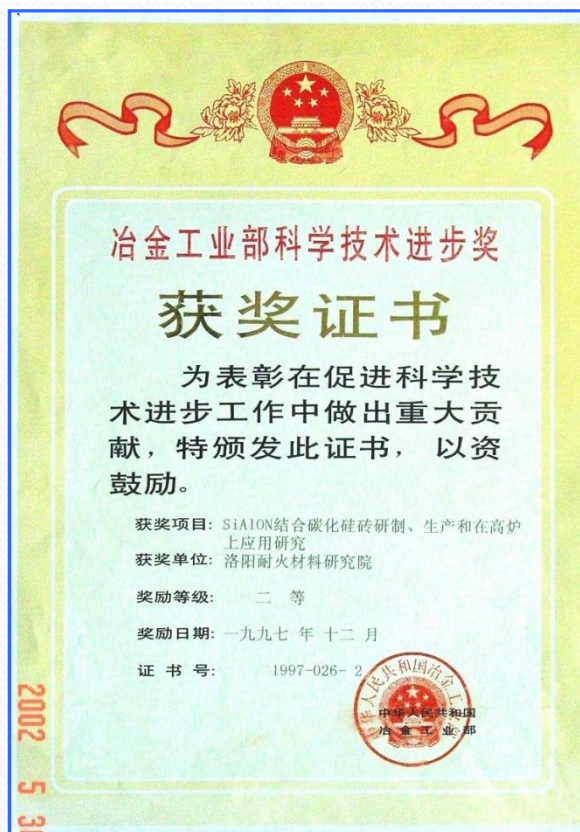
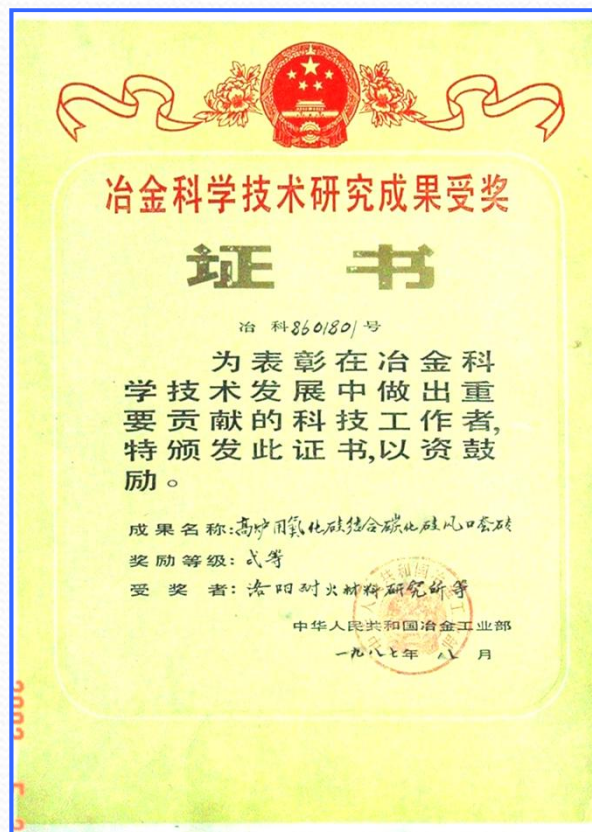


- The most sophisticated lab for refractory research in China;
- Equipped with over 500 sets of research and test devices
- More than 50 national Scientific research projects since 2001;
- More than 200 patents;





Various awards from central government.



Various awards from local government.



**The 2nd prize of
“National Sci and Tech Development” 2004**



**LIRR won the 2nd Prize of
“National Sci & Tech. Invention” 2016,
Following the 2nd Prize 2014**



Designing & Engineering



Refractories R&D



Refractory Products



Intern. Collaboration



Quality Inspection



Education



Publications & Info. Service



Instruments & Apparatus

Main Products



**Series SiC
refractories**



**High purity
oxides**



Monolithics



Functional



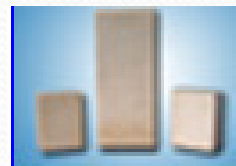
**Testing
machines**



Dental apparatus



**Fibres & the
products**



**Fine
ceramics**

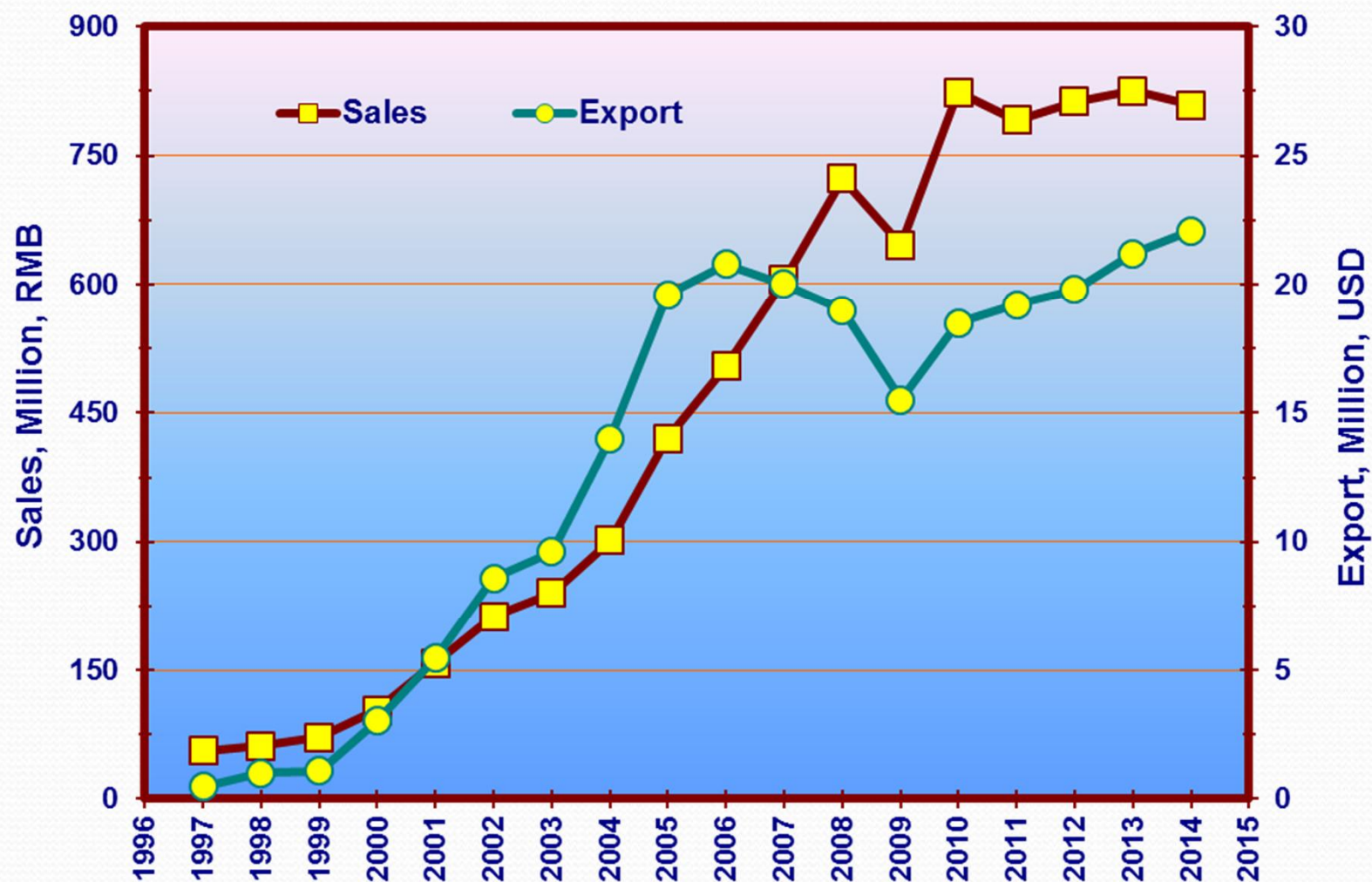


**Cutting &
grinding tools**




Kiln furniture

Sales since 1997



Follow international management system, prioritize environmental protection and safety of employees, and ensure qualified products.




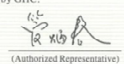


ENVIRONMENT MANAGEMENT SYSTEM CERTIFICATE
Audit and Confirm by Beijing Grand Honour Management System Certification Co., Ltd.
Sinosteel Luoyang Institute of Refractories Research Co., Ltd.
Organization code: 87109493-8
Has established and implemented an environment management system in conformity with
GB/T 24001-2004—ISO14001:2004 standard.

The scope covered by this management system:
Products and activities:
Design, production, selling, engineering service, supporting service and associated management activities for shaped and monolithic refractories, related testing apparatus and packing materials, heating element, dental lab apparatus and diamond finishing tools.
Physical locations:
No.43 Xiyuan Road, Jianxi District, Luoyang City, Henan Province; Production Area A & Area B, Luoxin Industrial Zone, Xin'an County, Luoyang City, Henan Province; No.14 Binhenan Road, Taisha Industrial Zone, Pingluo County, Shizuishan City, Ningxia Hui Autonomous Region.

Certificate registration:02214f2069R3M Issuing date:Dec.25,2014 Effective date:From Dec.25,2014to Dec.24,2017

The certified organization should accept the annual surveillance audit before the following date. This certificate shall be used in conjunction with annually surveillance audit stamp issued by GHC.

MANAGEMENT SYSTEM
CNAS C022-E

GHC Add: Fuhai Center, Building No. 3, Room 307,
Daluoshu Road, Haidian District, Beijing, China.

The validity of this certificate can be verified from the following website www.cncea.gov.cn & www.cmiqc.com



**OCCUPATIONAL HEALTH AND SAFETY
MANAGEMENT SYSTEM CERTIFICATE**
Audit and Confirm by Beijing Grand Honour Management System Certification Co., Ltd.
Sinosteel Luoyang Institute of Refractories Research Co., Ltd.
Organization code: 69922773-4
Has established and implemented an occupational health and safety management system in conformity with
GB/T28001-2011—OHSAS18001:2007 standard.

The scope covered by this management system:
Products and activities:
Design, production, selling, engineering service, supporting service and associated management activities for shaped and monolithic refractories, related testing apparatus and packing materials, heating element, dental lab apparatus and diamond finishing tools.
Physical locations:
No.43 Xiyuan Road, Jianxi District, Luoyang City, Henan Province; Production Area A & Area B, Luoxin Industrial Zone, Xin'an County, Luoyang City, Henan Province; No.14 Binhenan Road, Taisha Industrial Zone, Pingluo County, Shizuishan City, Ningxia Hui Autonomous Region.

Certificate registration:02214S2068R3M Issuing date:Dec.25,2014 Effective date:From Dec.25,2014 to Dec.24,2017

The certified organization should accept the annual surveillance audit before the following date. This certificate shall be used in conjunction with annually surveillance audit stamp issued by GHC.





MANAGEMENT SYSTEM
CNAS C022-S

GHC Add: Fuhai Center, Building No. 3, Room 307,
Daluoshu Road, Haidian District, Beijing, China.

The validity of this certificate can be verified from the following website www.cncea.gov.cn & www.cmiqc.com



QUALITY MANAGEMENT SYSTEM CERTIFICATE
Audit and Confirm by Beijing Grand Honour Management System Certification Co., Ltd.
Sinosteel Luoyang Institute of Refractories Research Co., Ltd.
Organization code: 87109493-8
Has established and implemented a quality management system in conformity with
GB/T 19001-2008—ISO 9001: 2008 standard.

The scope covered by this management system:
Products and activities:
Design, development, production and services of advanced oxides based refractories; nitride bonded silicon carbide series; purging plug series for metallurgical processes; metering nozzle series; refractory fibers and their products; monolithic refractories; submerged nozzle, shroud and stopper for continuous casting; mullite-cordierite based kiln furnitures; refractories for glass fiber tank; packing materials; heating element, diamond finishing tools; testing apparatus series for refractories; dental lab apparatus; and trading of refractory raw materials.
Physical locations:
No.43 Xiyuan Road, Jianxi District, Luoyang City, Henan Province; Production Area A & Area B, Luoxin Industrial Zone, Xin'an County, Luoyang City, Henan Province; No.14 Binhenan Road, Taisha Industrial Zone, Pingluo County, Shizuishan City, Ningxia Hui Autonomous Region.

Note: The products covered in this scope shall be conformed to the requirement of associated licensed document or qualified certificate.

Certificate registration:02214Q2136R5M Issuing date:Dec.25,2014 Effective date:From Dec.25,2014to Dec.24,2017

The certified organization should accept the annual surveillance audit before the following date. This certificate shall be used in conjunction with annually surveillance audit stamp issued by GHC.






MANAGEMENT SYSTEM
CNAS C022-Q

GHC Add: Fuhai Center, Building No. 3, Room 307,
Daluoshu Road, Haidian District, Beijing, China.

The validity of this certificate can be verified from the following website www.cncea.gov.cn & www.cmiqc.com

Hydro Audit



Supplier audit

Assessment result

Company information	
Company:	Luoyang Institute of Refractories Research Co. Ltd.
Address:	43 Xiyuan Road, Luoyang 471039
Country:	China
Assessment date	2013-10-23
Assessment no	1
Date last assessment	2009-04-22
Rating	A

Type of assessment	
Supplier pre-qualification	<input type="checkbox"/>
Supplier audit	<input checked="" type="checkbox"/> YES
HSE check at Hydro's site	<input type="checkbox"/>
Norwegian contractor	<input type="checkbox"/>

22nd, April, 2009
Assessment Rate: **A**



Manufacturer	Weighting		Assessment result		
	Contractor	Other	Possible	Achieved	Weighted
Quality Management	20 %	15 %	52	50	14,4 %
Process & Product Quality	5 %	20 %	44	42	19,1 %
Service	5 %	10 %	52	52	10,0 %
HSE	30 %	15 %	136	118	13,0 %
Performance	40 %	40 %	100	92	36,9 %
On time delivery		40 %	100	34 %	85
Quality		40 %	100	40 %	100
Flexibility	10 %	10 %	20	10 %	19
Pricing behaviour	10 %	10 %	16	9 %	14
Total HAL score					93,4 %
CSR	Supplier complies with our overall CSR requirement				

24th, Oct, 2013
Assessment Rate: **A**



Assessment result			
A	Qualified	>	85 %
B	Improvements necessary	70 % -	84 %
C	Upgrade to 'B' or remove from Hydro Supplier list	50 % -	69 %
D	Exclude from Hydro Supplier list	<	50 %



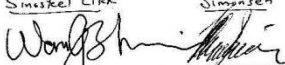

Approved by:	Assessment responsible:
Sverre Emil Enger	Sverre Emil Enger
	Eirik Hagen
	Jun Liang
(signed)	

Dubal Audit

SP/TSK.05.F03

COMMENTS / EVALUATION:

- All documents are in Chinese language. We had to depend on English translation for detailed explanation.
- Process flow is well documented.
- Well maintained plant, maintenance plant available.
- Traceability of previous supply available.
- Simonsen represented Sino Steel LIR due overseas market.
- Production Capacity: Sino Steel - 35,000 t/a, Sino Steel - 12,000 t/a.
- Customer Satisfaction report shows 96%.
- ISO 9001, ISO 14001, ISO 18001 Certified.
- Impressive R&D Centre & Lab facilities.

For the supplier: Sino Steel LIR  Name: Wang Zhennan Designation: V.P. Production Date: 28/2/2014	For DUBAL (Team Leader):  Name: C. Sreenivas Designation: Head of Purchasing Date: 28/2/2014
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- Well documented process
- Well maintained plants
- Traceability available
- 96% customer satisfaction
- ISO Certifications
- Impressive R&D and Lab



LIRR/SIMONSEN

SIMONSEN

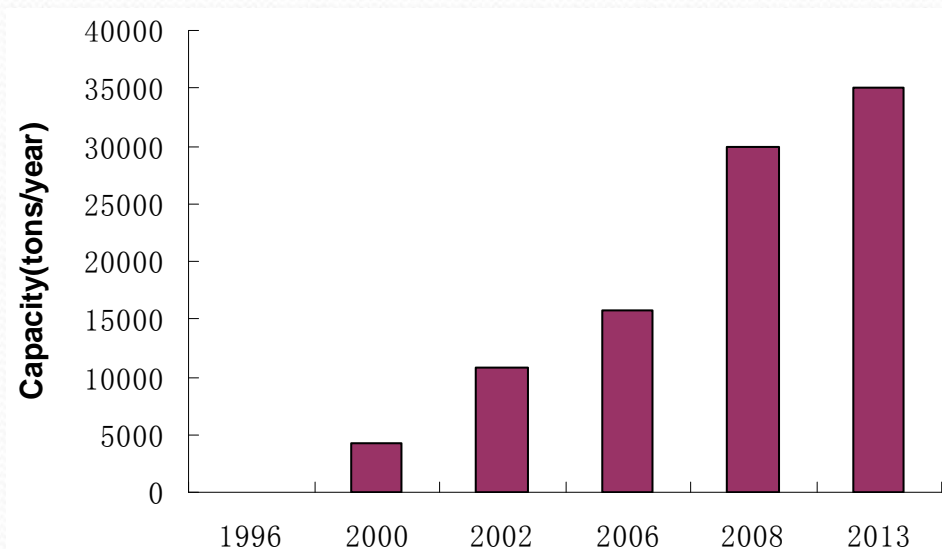
A global refractory supplier

One of the largest supplier of SiC products

LIRR's exclusive business partnership overseas.

Strategic Partner

- 20 years since 1996;
- The biggest manufacture of SiC products





Our SiC products have reached more than 46 countries,
serving for more than 130 companies.



Great Moment to Be Remembered!



Heading for Another 20 Years Success!

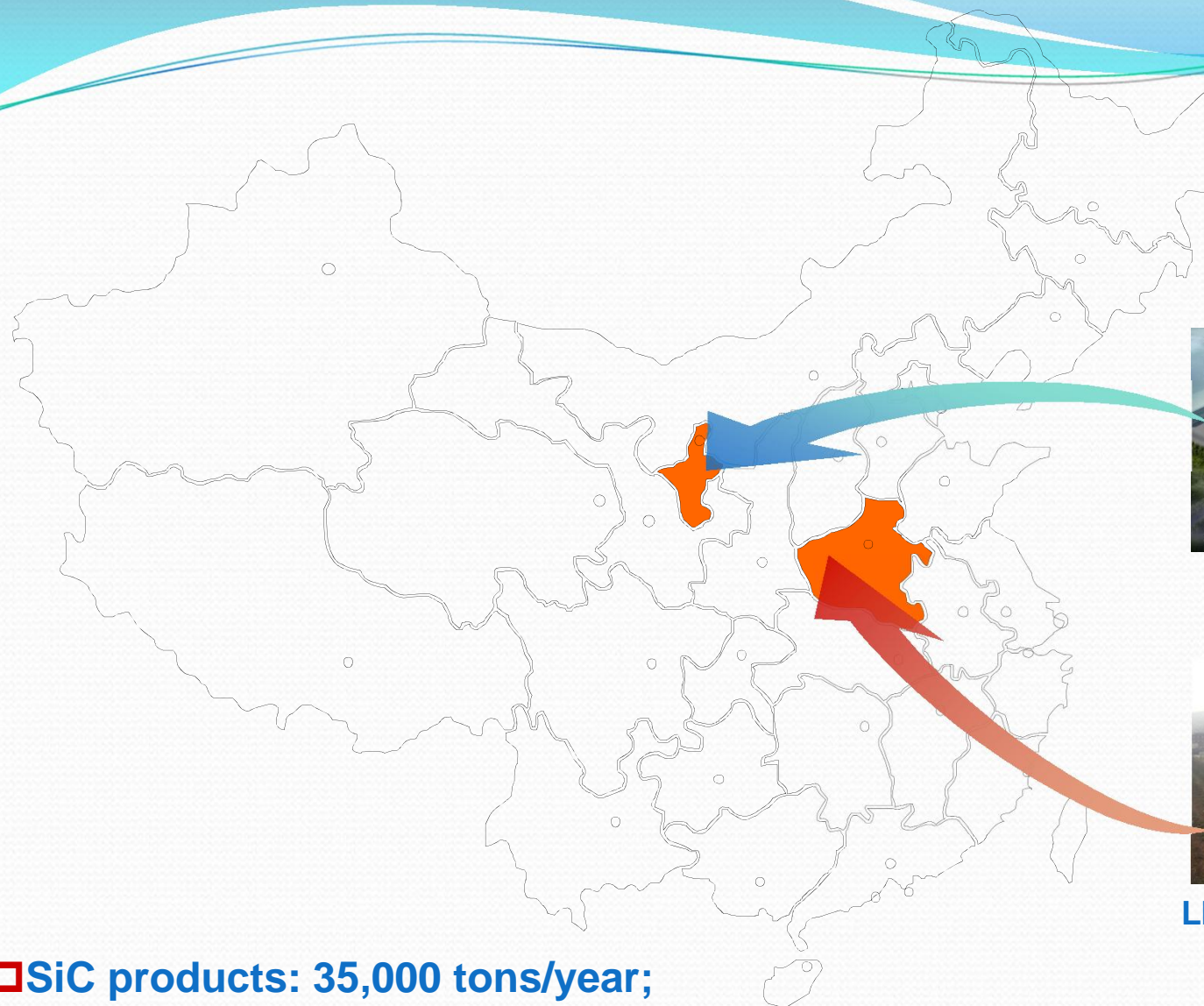
R&D of SiC Materials

The pioneer of refractories, LIRR has been leading the R&D of SiC materials over the years in China .

- 1984~1987, Si_3N_4 -bonded SiC(SICATEC75);
- 1989~1992, Sialon-bonded SiC;
- 1993~1998, $\text{Si}_2\text{N}_2\text{O}$ -bonded SiC;
- 2003~2008, β -SiC-bonded SiC(SICATEC95);
- 2009~2010, Multi-nitride-bonded SiC;
- 2011~2013, α -SiC-bonded SiC(SICATEC98);
- 2012~2016, high oxidation-resistance SiC products (patented).



- LIRR's enormous contribution to the development of SiC Refractories in China.
- Project “**Si₃N₄-SiC Material for Al Electrolysis Cells**” was awarded **the 2nd prize of “National Science and Technology Development”** in 2004



LIRR-Binhe SiC Plant



LIRR-Luoyang SiC Plant

- ▣ SiC products: 35,000 tons/year;
- ▣ The biggest manufacturer of SiC-based products in the world;
- ▣ 30~50% domestic market share.

Plant Facilities



**Automatic
Batching/Mixing**



Pressing



Infrared driers



Firing furnaces



N₂ station



Monolithic line

SiC Products Series



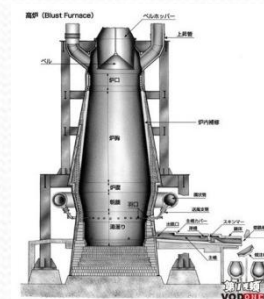
Applications of LIRR SiC products



Kiln Industries



Aluminium
Reduction Cells



Blast Furnaces



WTE



Others...



Chemical Industries

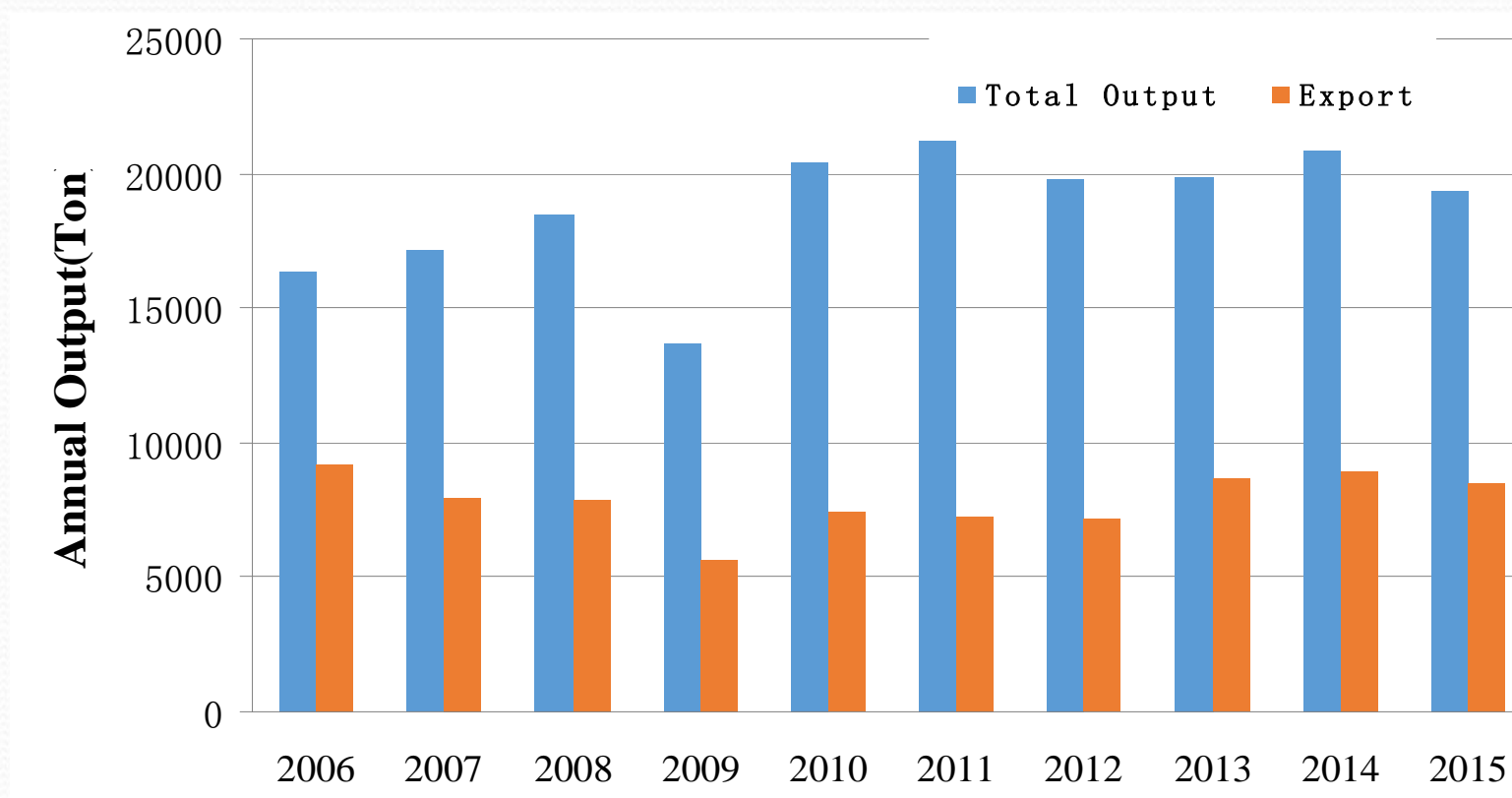


Gasifier

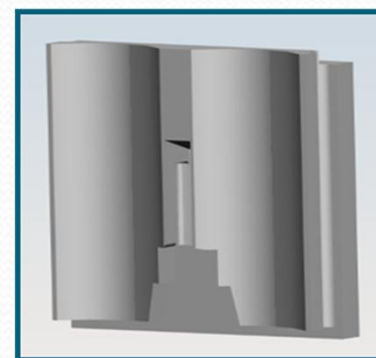
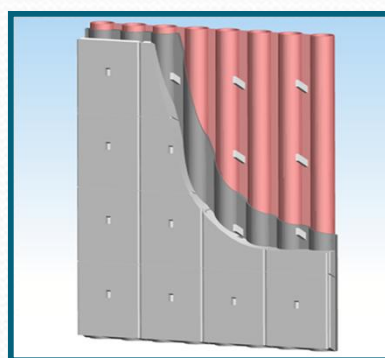
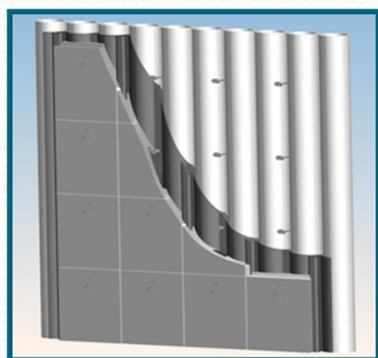


Coke Dry Quenching

Output of SiC Products in 10 Years (LIRR)



Waste-to-Energy



Waste-to-Energy

Providing local energy from our residual waste

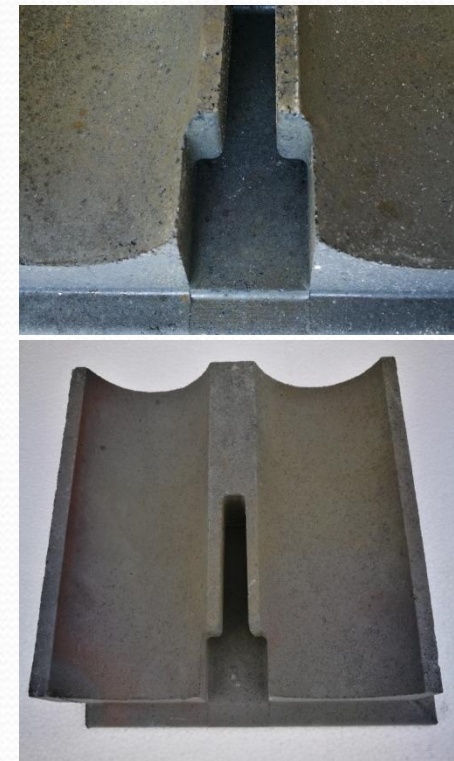
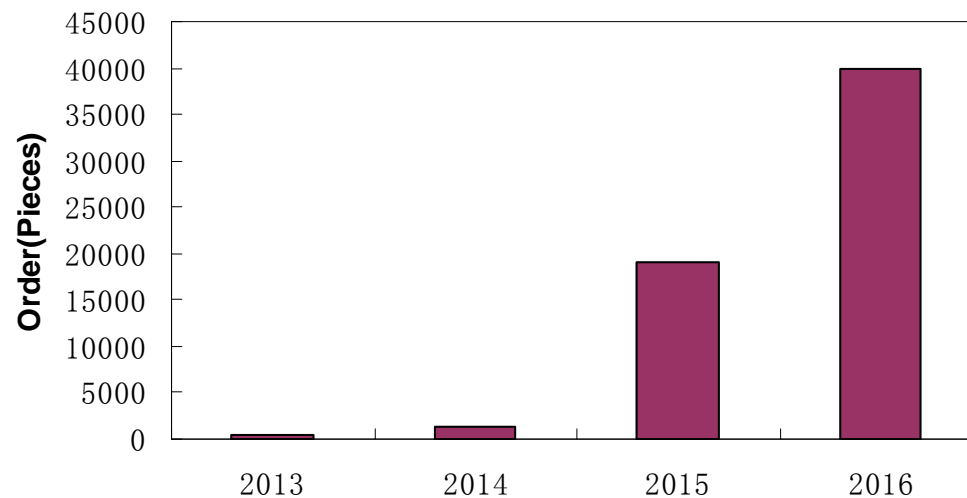
- ❑ Helping to reduce dependence on fossil fuels imports
- ❑ Saving millions of tonnes of CO₂
- ❑ Contributing to security of energy supply
- ❑ Sustainable, local, low carbon, cost-effective and reliable energy
- ❑ While helping to divert waste from landfills

We are making our contributions for greener economy.



How we involved in this business?

- ❑ **2007, started from domestic market;**
 - ✓ most are monolithic materials
 - ✓ Low requirements
- ❑ **2012, first overseas business from COVANTA;**
 - ✓ Special requirement –Oxidation resistance(ASTM C863)
 - ✓ Research Project established
- ❑ **Lab tests by authorities** (Orten in US, DIFK in Germany)
- ❑ **Products gradually recognized.**



What we did?

❑ The oxidation resistance of SiC refractories in steam atmosphere;

- ✓ very few people in China have done research in this field;
- ✓ it is a job deserved to do;
- ✓ wide applications.

❑ Build our own lab device;

- ✓ ASTM C863 Standard;

❑ Develop our own technology;

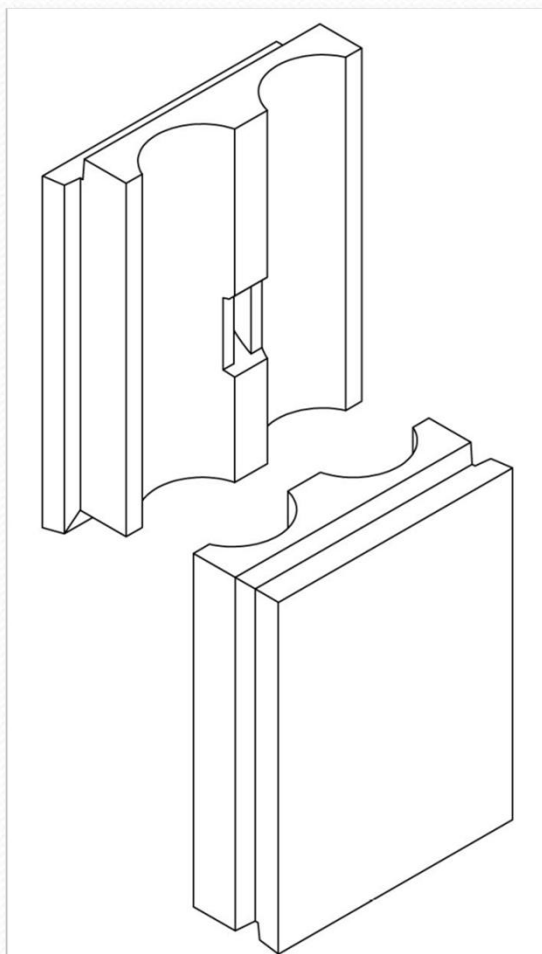
- ✓ Patent pending

❑ Market investigation(WtE unit);

- ✓ almost 100% in USA(90 plants)
- ✓ 91% in Europe (483 plants)
- ✓ 84% in Japan

❑ Communication / technical exchange;

Why SiC tiles?



- ❑ High thermal conductivity;
- ❑ **High oxidation resistance**(our own technology);
- ❑ High mechanical properties and **abrasion resistance**;
- ❑ High thermal shock resistance;
- ❑ Easier assembly and maintenance.



Longer service life

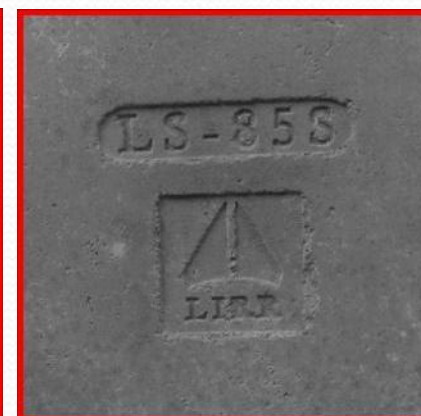
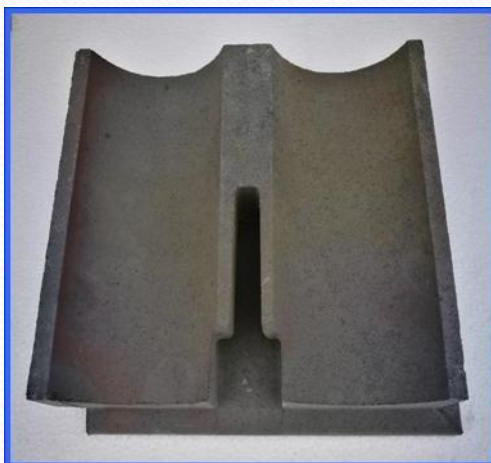
ASTM C863

Standard Test Method for Evaluating Oxidation Resistance of Silicon Carbide Refractories at Elevated Temperatures

- ❑ Key parameter for Tiles in W-T-E Incinerators;
- ❑ Well-established test system in Europe and US;
- ❑ Test system to be optimized in China;
- ❑ Test parameters:
 - ✓ Temperature: 900°C or 1000 °C
 - ✓ Duration: 500 hours
 - ✓ Steam: 32Kg/(h.m³)
 - ✓ **Evaluation: Volume Expansion**



Test Device

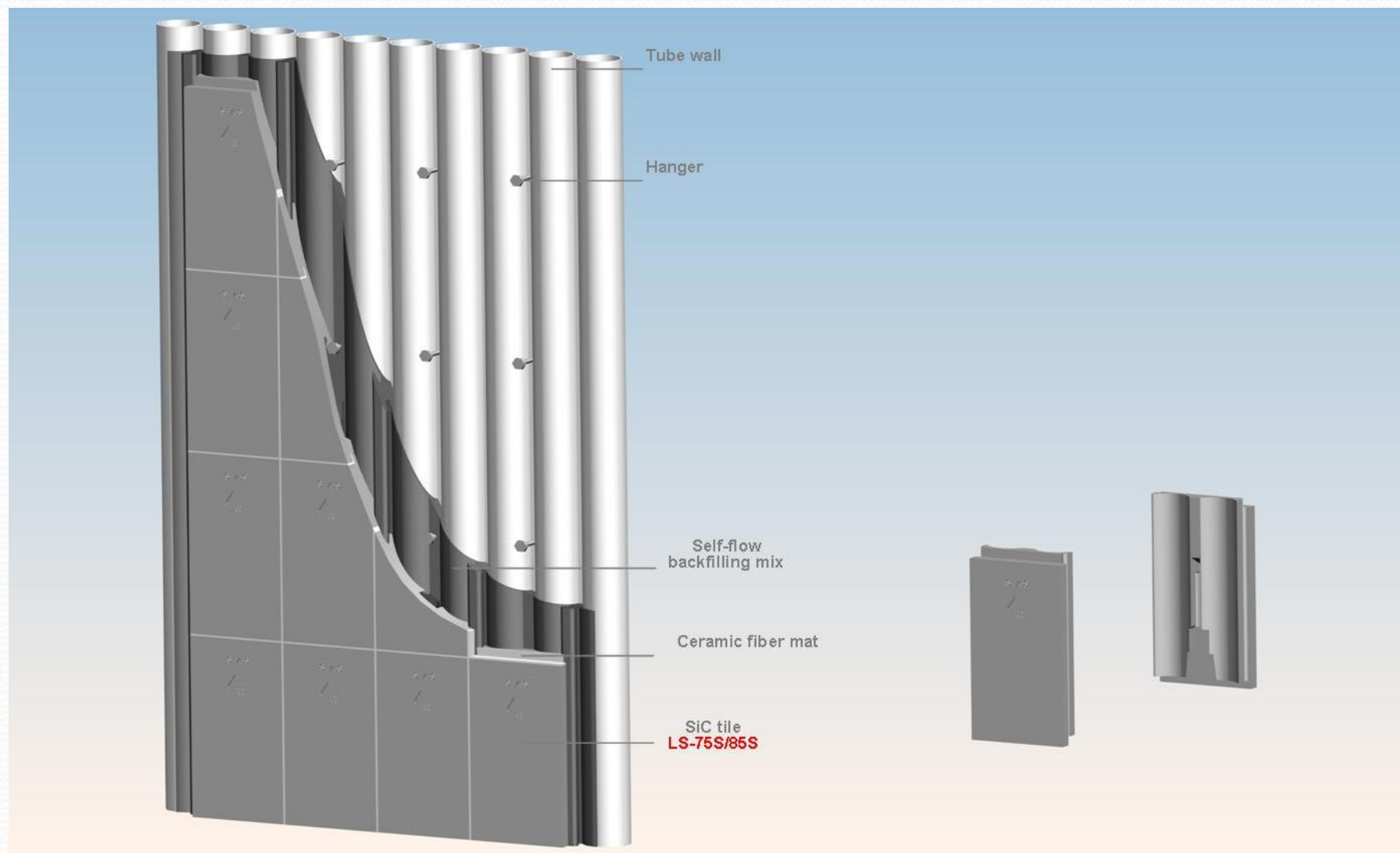


- ❑ Research from 2012;
- ❑ Specially designed for application in highly oxidative environment, especially steam environment;
- ❑ High oxidation resistance(**LS-75S/85S**);
- ❑ Patent protected.

Different Tiles



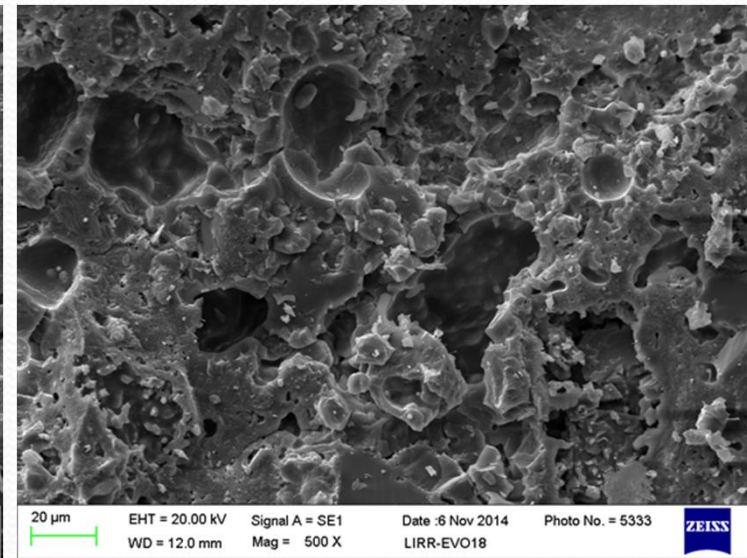
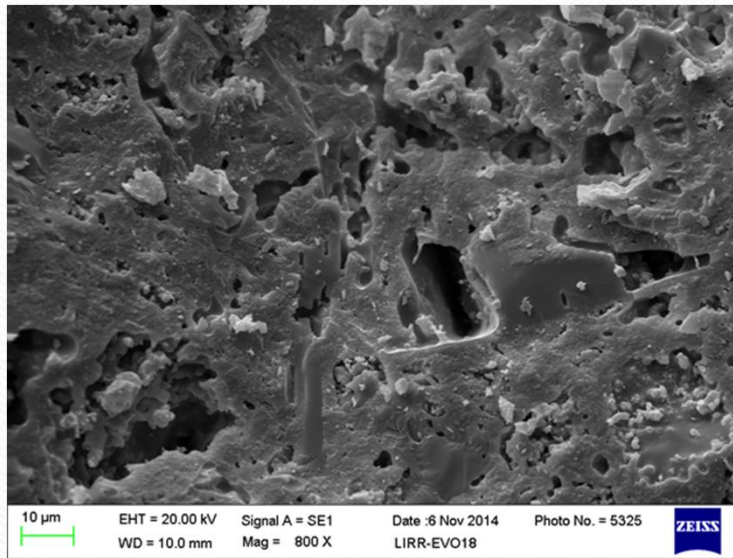
Assembly of SiC Tiles





Glazed Surface

Microstructure



- ❑ Closed pores stop the infiltration of oxygen and reduce the speed of oxidation;
- ❑ Special ingredients slow the crystallization of oxidation product - the cause of volume expansion.

	LS-75	LS-75S	LS-85S	LSO (oxide-SiC)	standard
Volume expansion, %	≤ 3.0	≤ 1.0	≤ 1.0	≤ 6	ASTM C863
Bulk density, g/cm ³	≥ 2.65	≥ 2.65	≥ 2.65	≥ 2.65	ISO5017
Porosity, %	≤ 16.5	≤ 15	≤ 15	≤ 16	ISO5017
CCS, MPa	≥ 150	≥ 150	≥ 150	≥ 140	ISO10059
Modulus of Rupture(RT), MPa	≥ 40	≥ 40	≥ 40	≥ 35	ISO 5014
Abrasion resistance, cm ³	≤ 5	≤ 5	≤ 5	≤ 8	ASTM C704
Thermal conductivity(1000°C), w/(m.K)	≥ 15	≥ 15	≥ 17	≥ 12	Laser flash
SiC, wt%	≥ 72	≥ 70	≥ 78	≥ 85	ISO 21068
Si₃N₄+Si₂N₂O, wt%	≥ 18	≥ 15	≥ 8	--	ISO 21068

Lab Test(orten)



**Materials Testing
and
Research Center**

6991 Old 3C Highway
Westerville, OH 43082, USA
Phone: 800-999-5442 x1323
Fax: 614-895-5610

**ASTM C863 Oxidation Resistance of Silicon Carbide Refractories
Using ASTM C20 to Determine Volume Change**

Material: Refractory
Preparation: Diamond Cut

Customer: Sinosteel Luoyang Institute
Customer PO: E. Zhang
Date: February 18, 2016

Sample ID

	I	II	III
Oven Dried: 110C			
Dried Length (in)	6.202	9.045	8.149
Dried Weight (g)	1483.3	2090.4	1805.3
Suspended Weight (g)	1003.9	1404.8	1227.3
Saturated Weight (g)	1537.6	2173.7	1874.4
Volume (cm ³)	533.7	788.9	647.1
Porosity (%)	10.2	10.8	10.7
Bulk Density (pcf)	173.5	189.7	174.2

Steam Exposure: 1000C (500 Hours)

Dried Length (in)	6.202	9.072	8.181
Dried Weight (g)	1497.4	2138.3	1880.9
Suspended Weight (g)	990.6	1402.0	1226.5
Saturated Weight (g)	1524.6	2175.7	1880.5
Volume (cm ³)	534.0	773.7	654.0
Porosity (%)	5.1	4.8	3.0
Bulk Density (pcf)	175.1	172.5	177.6
Length Change (%)	0.0	0.3	0.4
Weight Change (%)	1.0	2.3	3.1
Volume Change (%)	0.1	0.6	1.1



Sample

I

II

III

Volume expansion, %

0.1

0.6

1.1

Lab Test_(DIFK)

Volume Expansion, % 1.00 0.98 0.82 1.05

Sample	Bulk density (start)	Bulk density (500hrs.)	Weight (start)	Weight (500hrs.)	Weight expansion (start-500hrs.)	Volume (start)	Volume (500hrs.)	Volume expansion (start-500hrs.)	Linear expansion (start-500hrs.)	visual inspection
	[kg/dm³]	[kg/dm³]	[g]	[g]	%	[cm³]	[cm³]	%	%	
LUPUSIC 85 N - 1	2,737	2,753	215,06	218,47	1,59	78,58	79,36	1,00	0,33	no complaint
LUPUSIC 85 N - 2	2,735	2,753	217,22	220,79	1,64	79,42	80,20	0,98	0,33	no complaint
LUPUSIC 85 N - 3	2,717	2,742	219,65	223,48	1,74	80,84	81,50	0,82	0,27	no complaint
LUPUSIC 85 N - 4	2,730	2,748	221,16	224,95	1,71	81,01	81,86	1,05	0,35	no complaint



Our products are designed to meet the every single requirement of on-site installation and application.

🌐 Quick and precise installation

precise mould designing

formula control

🌐 Best Protection

Against thermal stress

Against oxidation (volume expansion))

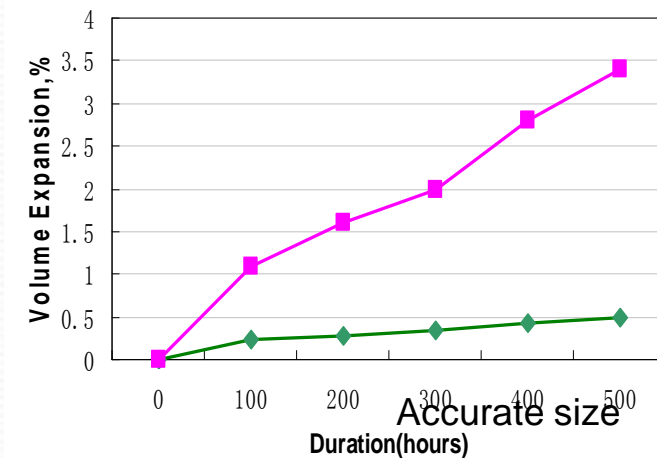
Against chemical erosion

🌐 Reduced thermal tension

Enhance homogeneity

🌐 Excellent thermal conductivity

🌐 Best Price-performance ratio





Chinese Market

常州绿色动力环保热电有限公司

永嘉绿色动力再生能源有限公司

桐城市垃圾焚烧发电有限公司

武汉绿色动力再生能源有限公司

乳山绿色动力再生能源有限公司

泰州绿色动力再生能源有限公司

惠州绿色动力环保有限公司

爱益思维工程技术（北京）有限公司

天津绿色动力再生能源有限公司

句容绿色动力再生能源有限公司

安顺绿色动力再生能源有限公司

平阳绿色动力再生能源有限公司

...

Overseas Market

Covanta

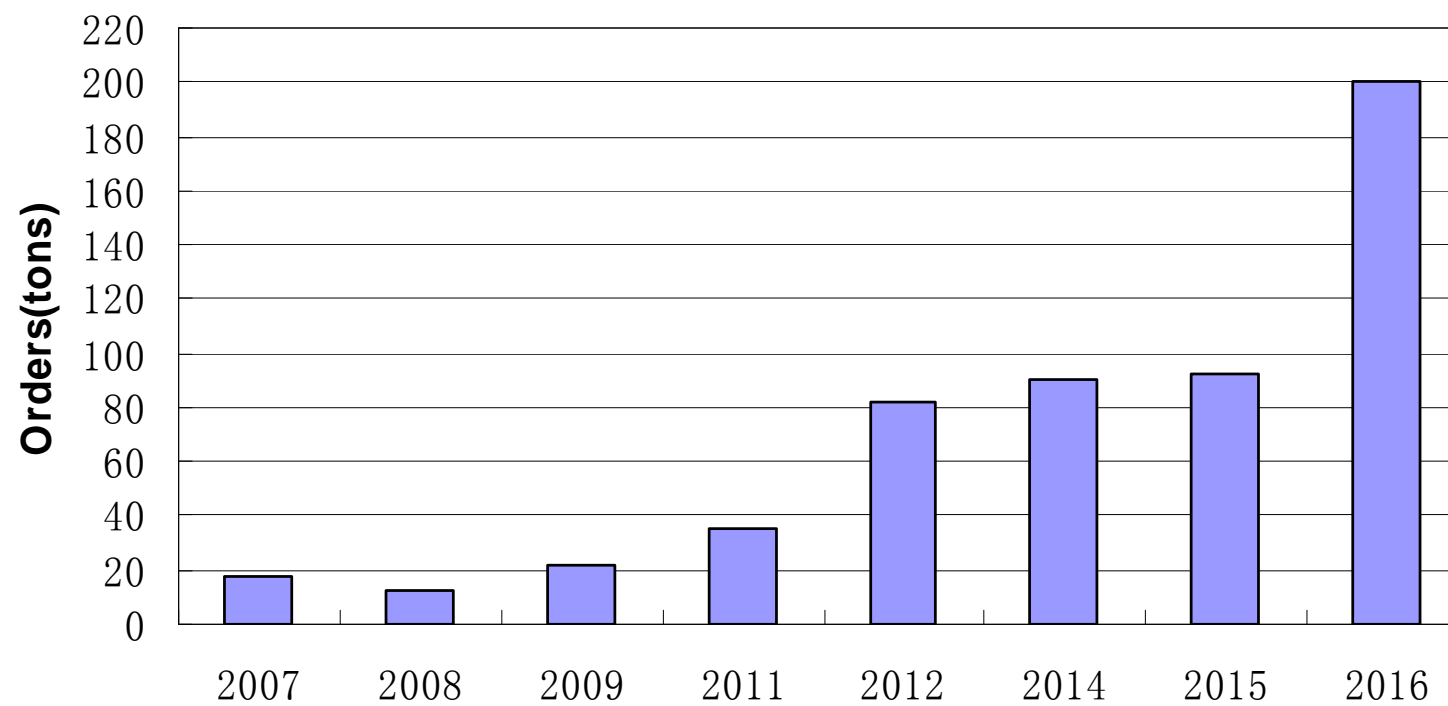
Calderys

ZUBLIN

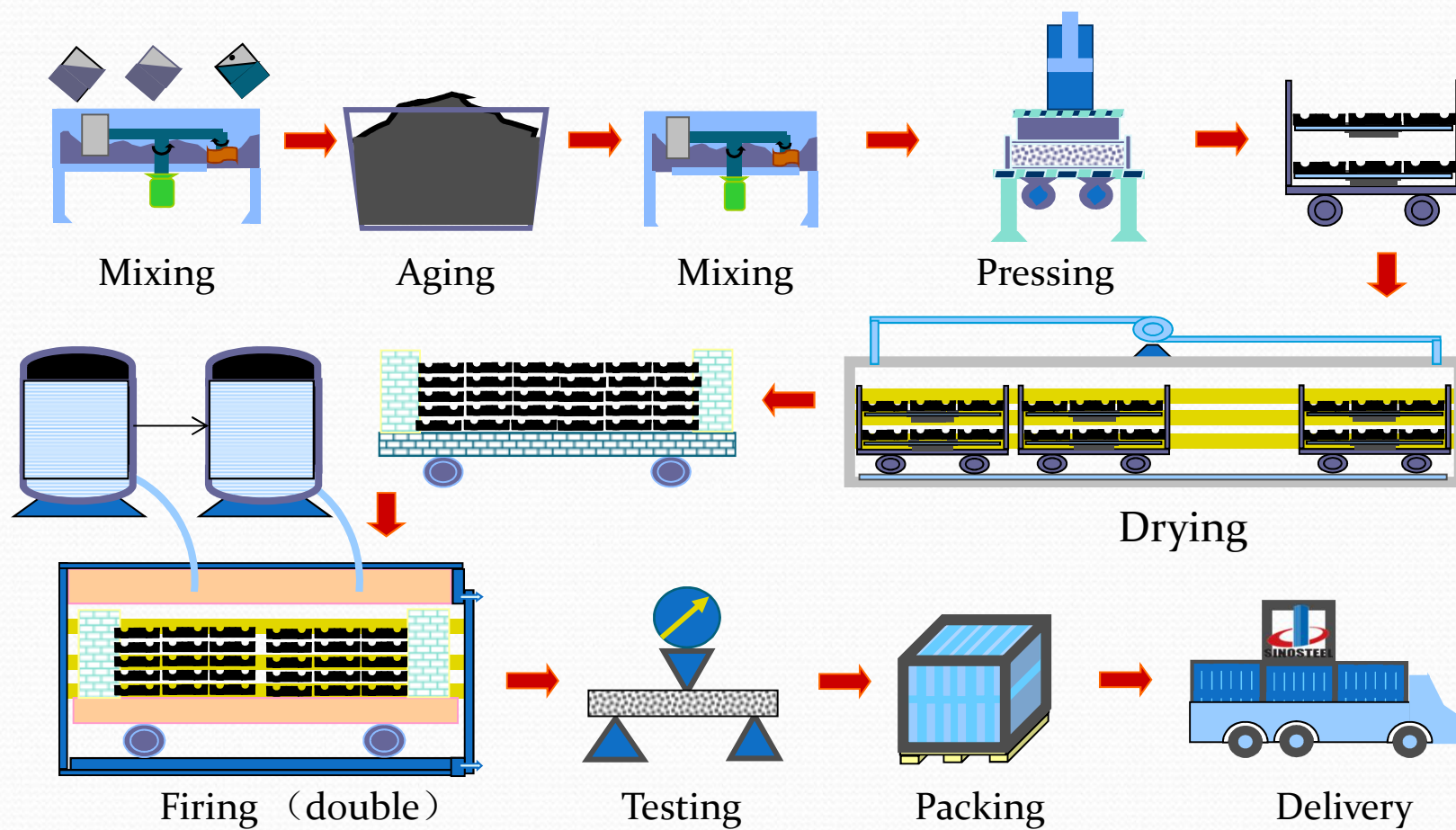
Vanguard

Glauch Systems GmbH

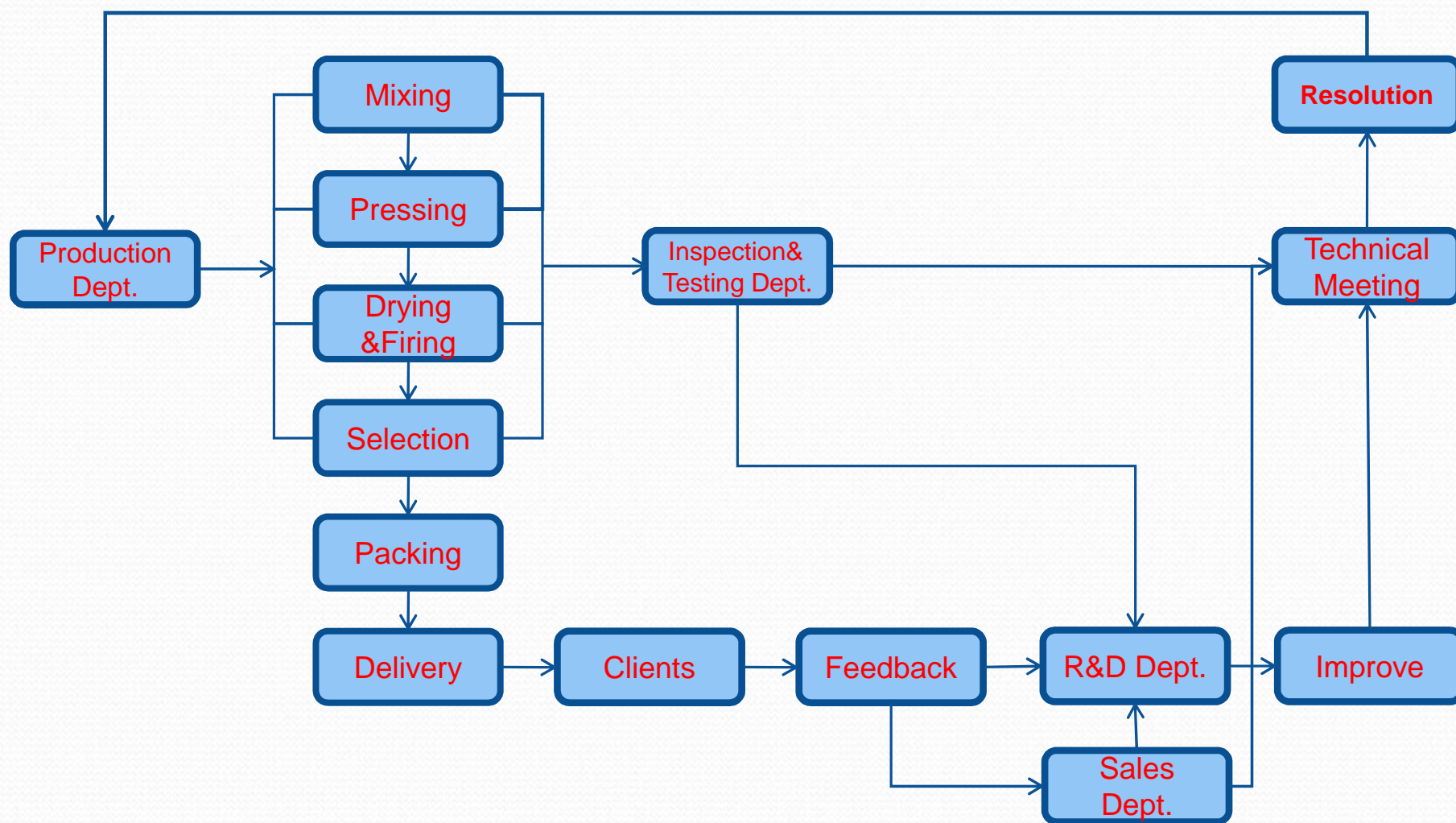
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Production Process



Quality Control Process



Thank You!