



# High Thermal Insulating Ceramic Materials

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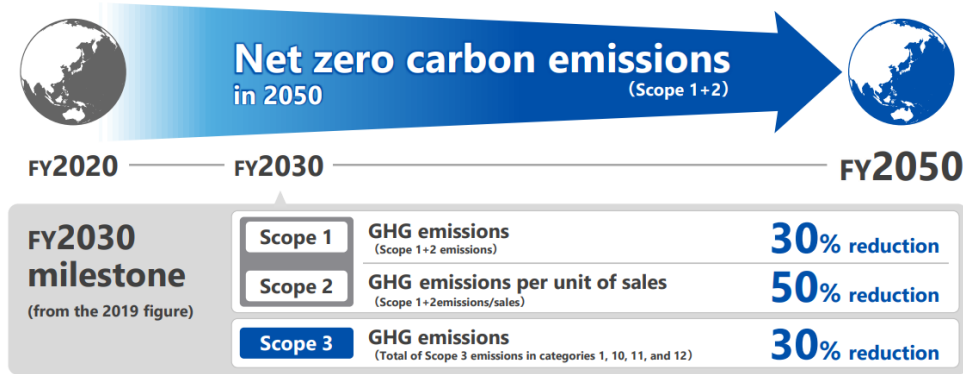
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1. GHG emissions reduction targets of AGC Group
2. Concept of High Thermal Insulating Ceramic Materials
3. Development history of TMT-Series
4. Properties of TMT-Series
5. Application for high temperature industry
6. Application for Glass furnace
7. Conclusion

# 1. GHG emissions reduction targets of AGC Group

## ▲ Risks Net Zero Carbon Target (FY2050)

- Mid- to long-term GHG emissions reduction targets was set in 2021, making steady progress



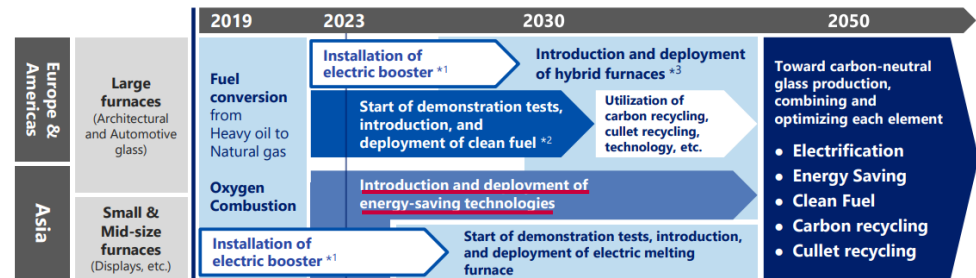
\*The electricity CO<sub>2</sub> emissions factor for 2030 is based on the figures set based on the Sustainable Development Scenarios (SDS) published by the IEA.

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- Expected to achieve the CO<sub>2</sub> reduction target set in 2021
- Aim to achieve net zero carbon in 2050

## ▲ Risks Technology Roadmap for Reducing GHG Emissions in Float Glass Melting Process

- By 2023** : Progress in fuel conversion, electric booster installation, clean fuel demonstration, carbon recycling, and cullet recycling development
- By 2030** : Implement priority measures in line with regional characteristics (Europe & Americas: electrification, Asia: energy saving)
- By 2050** : Combining multiple technologies focusing on electrification



\*1: Energized auxiliary heating \*2: Ammonia, Hydrogen etc. \*3: Energy sources are provided by a combination of electricity and fuel

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- High Thermal Insulating Ceramic Materials has been developed as one of energy-saving technologies.

## 2. Concept of High Thermal Insulating Ceramic Materials

### 1. High Thermal Resistance

Applicable over 1,600°C

### 2. High Thermal Insulation properties

Equivalent efficiency to conventional insulation brick

### 3. Low Shrinkage

Linear shrinkage after heating at 1,600°C  
hardly changes

### 4. Easy on-site application

Either Castable or Pre-Cast Block

### 5. Perfect prevention of gas leakage

Reduction of the amount of the fuel used

### 6. Human body-friendly

Free Refractory Ceramic Fiber(RCF)



# 3. Development history of TMT-Series

High Thermal Insulating  
Ceramic Materials  
“TMT series”



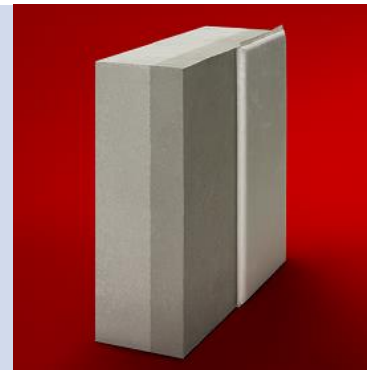
**Design of  
multi-Layer**

## Conventional

- Providing refractory of brick and insulation
- Proposal of design and installation supervise

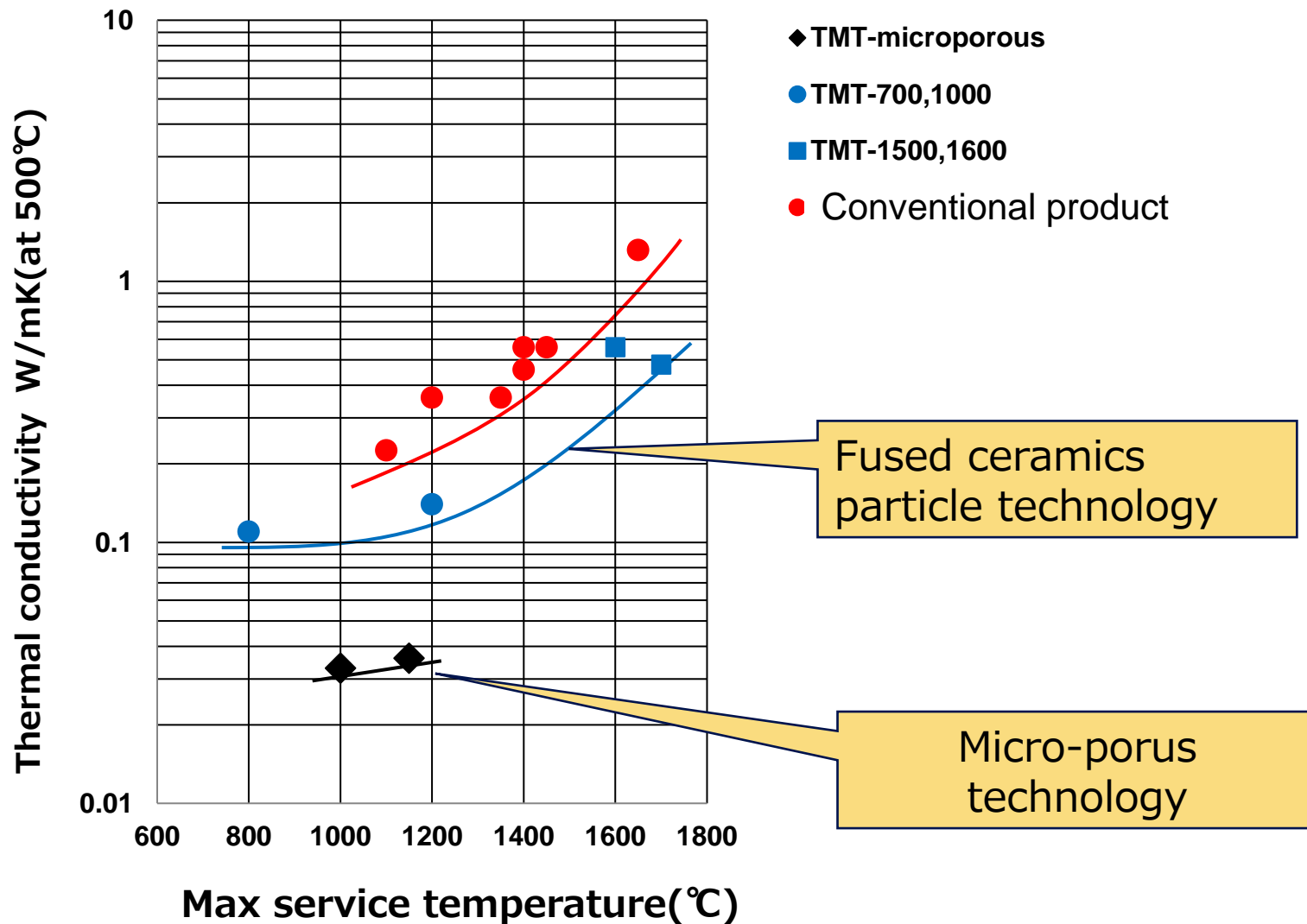


- Providing monolithic refractories and Pre-cast of TMT-Series
- Proposal of saving energy design by simulation analysis and installation supervise
- Verification of effects



Achievement of Energy saving, RCF countermeasures and compactness

# 4. Properties of TMT series



The above data represents typical values and should not be considered as guaranteed specifications. These typical values can be varied without any notice.

# 5. Application for high temperature industry

## Steel making

Skid Pipe

TMT-1500S  
+TMT-MP10



- ✓New Market
- ✓Global Market
- ✓Non Fiber
- ✓Long Life

Reduce heat flow

**50%**

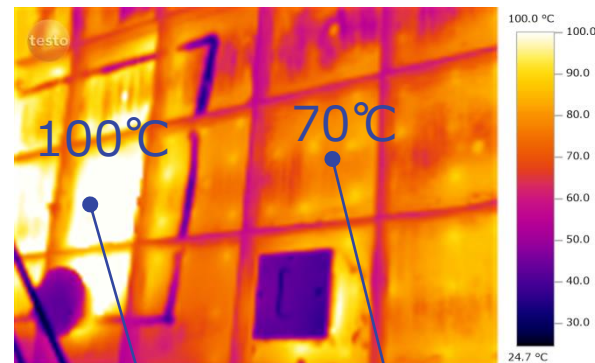
- ✓For Asian Market

Reduce heat flow

**30%**

## Cement making

Pre Heater

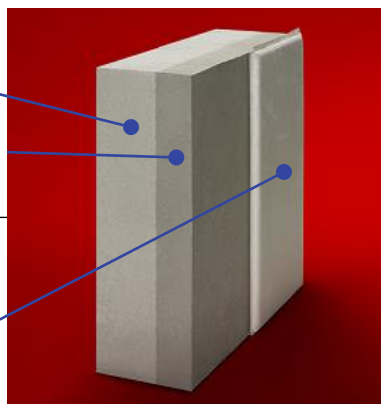


Traditional

TMT-1000

### THERMOTECT WALL

High Thermal Resisting & Thermal Insulating Grade



Super Thermal Insulating Grade

## Aluminum making for Automobile

Ladle



TMT-C1000+TMT-MP10

Reduce heat flow

**50%**

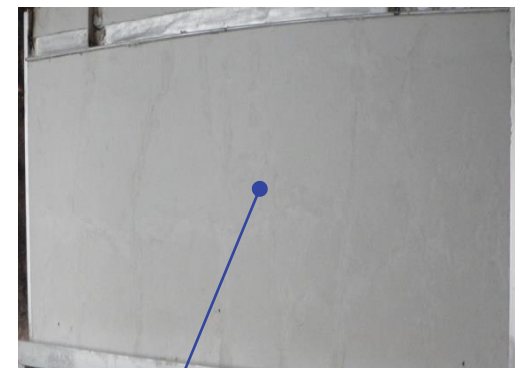
- ✓Global Automobile Market
- ✓Non Fiber
- ✓Long Life

Total Saving Energy **2%**

- ✓Global Market
- ✓Non Fiber
- ✓Long Life

## Glass

High Performance Regenerator



TMT-1000

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# 6.1. Technical information of TMT series

Brand	Max service Temp. (°C)	Chemical composition(%)			Bulk density	CCS (MPa)	Thermal conductivity (W/mK)				Construction method
		SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	ZrO <sub>2</sub>			After 110°C×24hr	400°C	500°C	600°C	
<b>High thermal resistant grade</b>											
TMT-1600	1700	-	83	6	1.00	2.5	-	0.48	-	0.54	Casting
	1700	-	83	6	1.20	5.0	-	0.71	-	0.73	Trowelling
TMT-1500S	1600	1	83	-	1.35	8.0	-	0.60	-	0.60	Casting
<b>High thermal insulation grade</b>											
TMT-1000	1200	45	34	-	0.37	0.3	-	0.14	-	0.28	Casting
	1200	45	34	-	0.39	0.4	-	0.15	-	0.28	Trowelling
TMT-1000S	1200	39	39	-	0.47	1.1	-	0.16	-	0.31	Casting
	1200	39	39	-	0.60	3.3	-	0.20	-	0.33	Trowelling
<b>Super thermal insulation grade</b>											
TMT-MP10-RHY	1000	63	3	-	0.26	-	0.026	-	0.031	-	Board construction

Muti-Layer design to use each TMT-Series grade has been provided

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## 6.2. Application history of TMT-Series for glass furnace





Application area	2010	2015	2020
Regenerator wall	▼ 2009 Test	▼ 2012 Full scale	
Melter breast wall	▼ 2011 Test	▼ 2013 Full scale	
Crown of Oxygen combustion	▼ 2012 Test	▼ 2014 Full scale	
Crown of Air combustion		▼ 2016 Test	▼ 2018 Full scale

Scope of application for Soda-lime, Water glass and Special glass has been extended by a long period of trial.

## 6.3. Evaluation of glass vapor test

Vaper test of Soda-lime glass for TMT-1600 after heating at 1,500°C for 48hrs

After testing	
Appearance	No change
Chemical/mineral composition	Reactants with glass components are not identified.
Shrinkage	0.1%

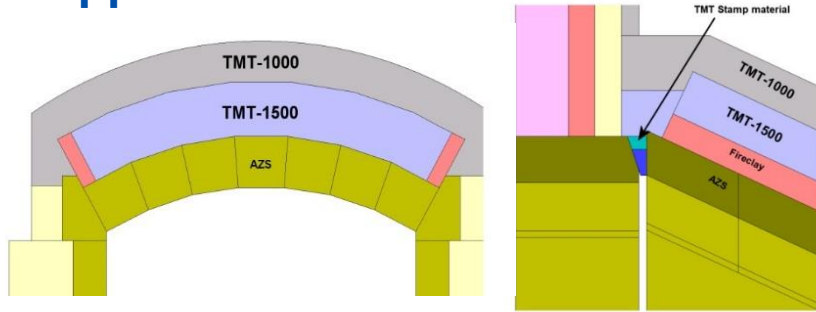
	Before testing	After testing
Reacting surface		
Side surface		

TMT-1600, that have been used for the most severe area, was not confirmed to be reacted with the glass(Same results of used TMT-1600 evaluation).

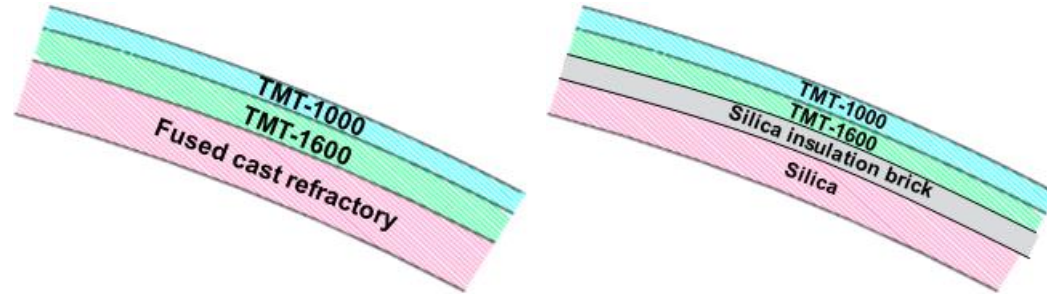
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# 6.4. Application for glass furnace

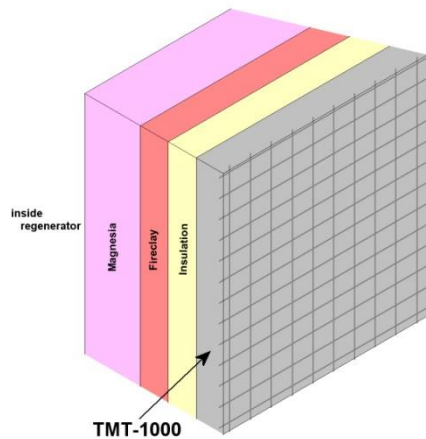
## 1. Application for Port



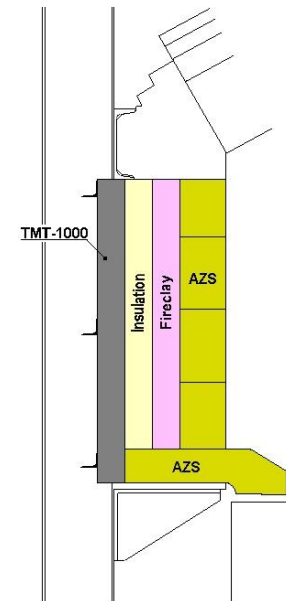
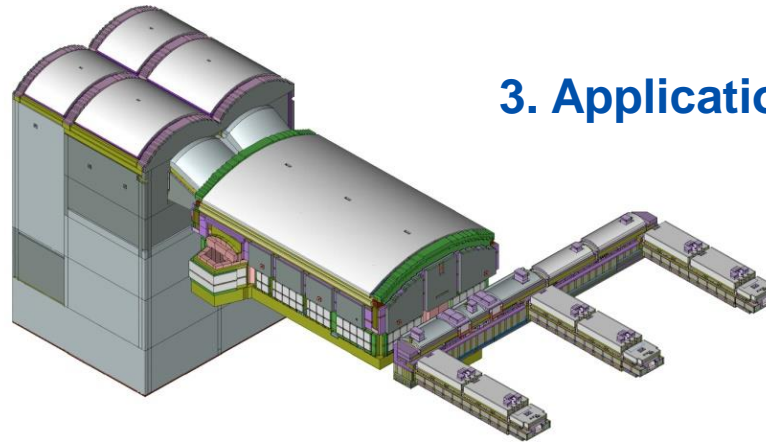
## 4. Application for Crown



## 2. Application for Regenerator wall



## 3. Application for Superstructure



# 6.5. Application for crown of oxygen combustion

	Conventional design		TMT-Series design	
	Material	Thickness(mm)	Material	Thickness(mm)
Linings for crown	AZS fused cast	350	AZS fused cast	350
	Tamping	40	TMT-1600	210
	Bonded	65	TMT-1000	150
	Insulation brick	130		
	Blanket	100		
	Total	685	Total	710
Surface temperature(°C)	109		101	
Heat loss(W/m <sup>2</sup> )	1442		1262 ▲12%	
Weight(kg/m <sup>2</sup> )	438		280 ▲36%	

Calculation conditions:

Furnace internal temperature 1,600°C, ambient temperature 30°C, emissivity outside the furnace 0.94.

## Advantage of TMT series

Energy saving	<ul style="list-style-type: none"> <li>➤ Performance equal to or better than RCF lining</li> <li>➤ Prevention of gas leaks</li> </ul>
Countermeasure of RCF	<ul style="list-style-type: none"> <li>➤ RCF not used.</li> </ul>
Long term stability	<ul style="list-style-type: none"> <li>➤ No long-term deterioration of insulation properties</li> </ul>

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- High Thermal Insulating Ceramics Materials, TMT-Series, have been developed to have high thermal insulation and high heat resistance at up to 1,600°C by using our melting processes and monolithic technologies.
- Fiber insulation, that is conventional insulation, has aging after short time. However, TMT-Series can maintain its insulation performance for more than 10 years.
- Energy savings have been achieved in many parts of glass furnaces by combining TMT-Series, multi-Layer design and our installation supervise.

**AGC**

Your Dreams, Our Challenge

Thank you!