Overview of Kubota's High-performance Centrifugally Cast Tubes For Reformer and Cracking Furnaces

Steel Castings Technology Dept. | Taichi Yamao

TNChE Asia 2026

KUBOTA Corporation

Corporate Data

Corporate name	**KUBOTA Corporation**
Established	1890
Capital	¥84.1 billion
Revenue (consolidated)	¥3,018.9 billion
Employees (consolidated)	52,503
Global expansion	Over 150 areas
Overseas sales	77.3%

Head Office building (Osaka)
Photo by: Grand Green Osaka Developers

Head Office

Grand Green Osaka South Building Park Tower, 5-54
Ofukacho, Kita-ku, Osaka 530-0011, Japan
TEL.(81)-6-6648-2111

Tokyo Head Office

Kyobashi Trust Tower
1-3, Kyobashi, 2-chome,Chuo-ku,
Tokyo 104-8307, Japan
TEL.(81)-3-3245-3111

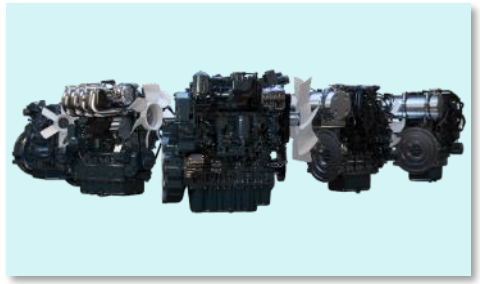
Products

Farm & Industrial Machinery

Agriculture

Construction Machinery

Engines



Weighing & Measuring Control Systems

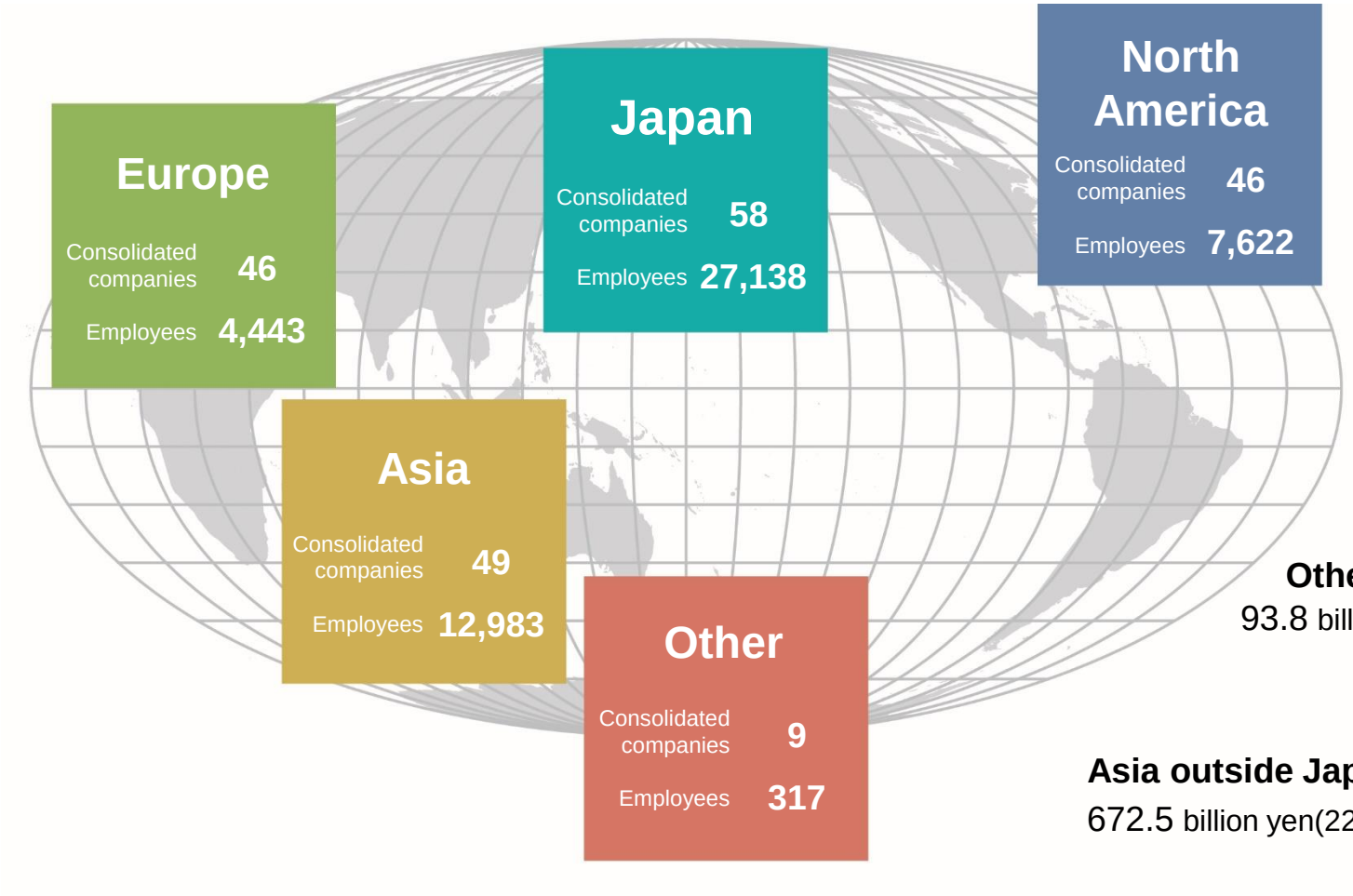
Water & Environment

Ductile Iron Pipes

Environmental Equipment & Plant Engineering

Materials

Global Expansion



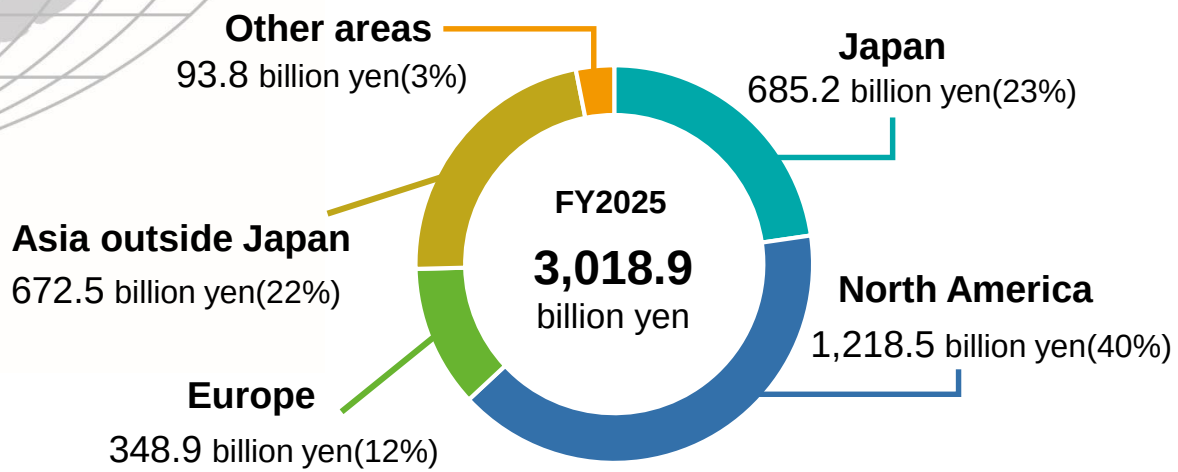
Total number of consolidated companies

208

Total number of employees

52,503

<Revenue by region>



Overseas revenue ratio 77.3%

What you will get today

- ✓ **Overview of Kubota's Reformer tube technologies and their key benefits**
- ✓ **Overview of Kubota's high-performance cracking coil technologies and their key benefits**
- ✓ **Quantification of the economic impact of Kubota's high-performance coils**
- ✓ **Quantification of the environmental impact of Kubota's high-performance coils**

High-performance Centrifugally Cast Tubes

For Reforming Furnaces

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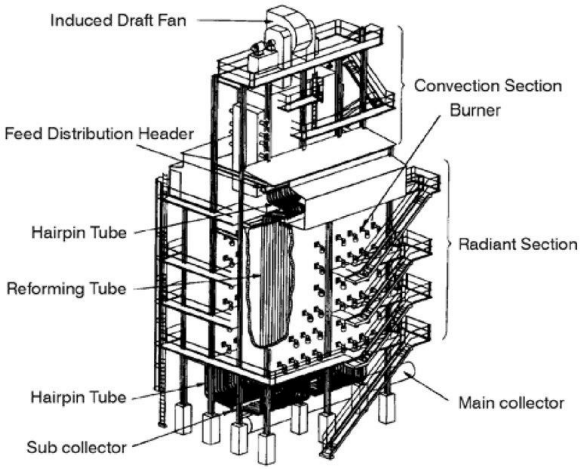
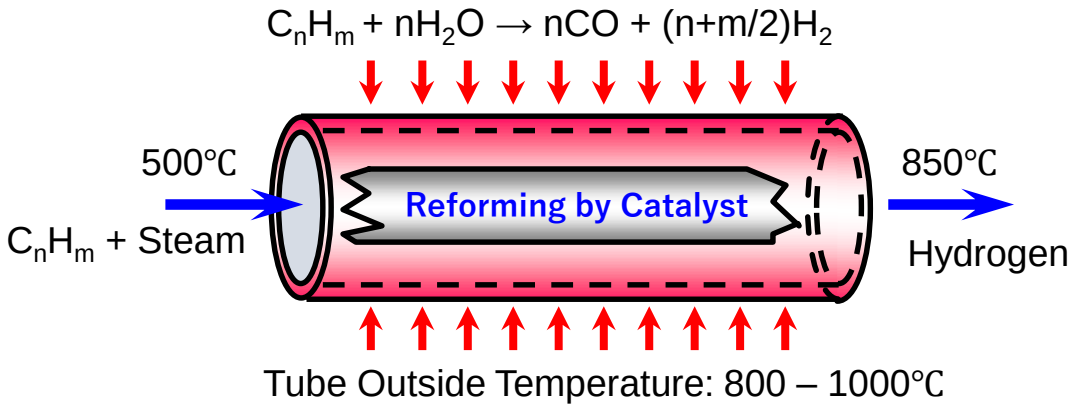
KUBOTA Corporation

Reformer Tubes for Hydrogen Production

Reformer Tubes



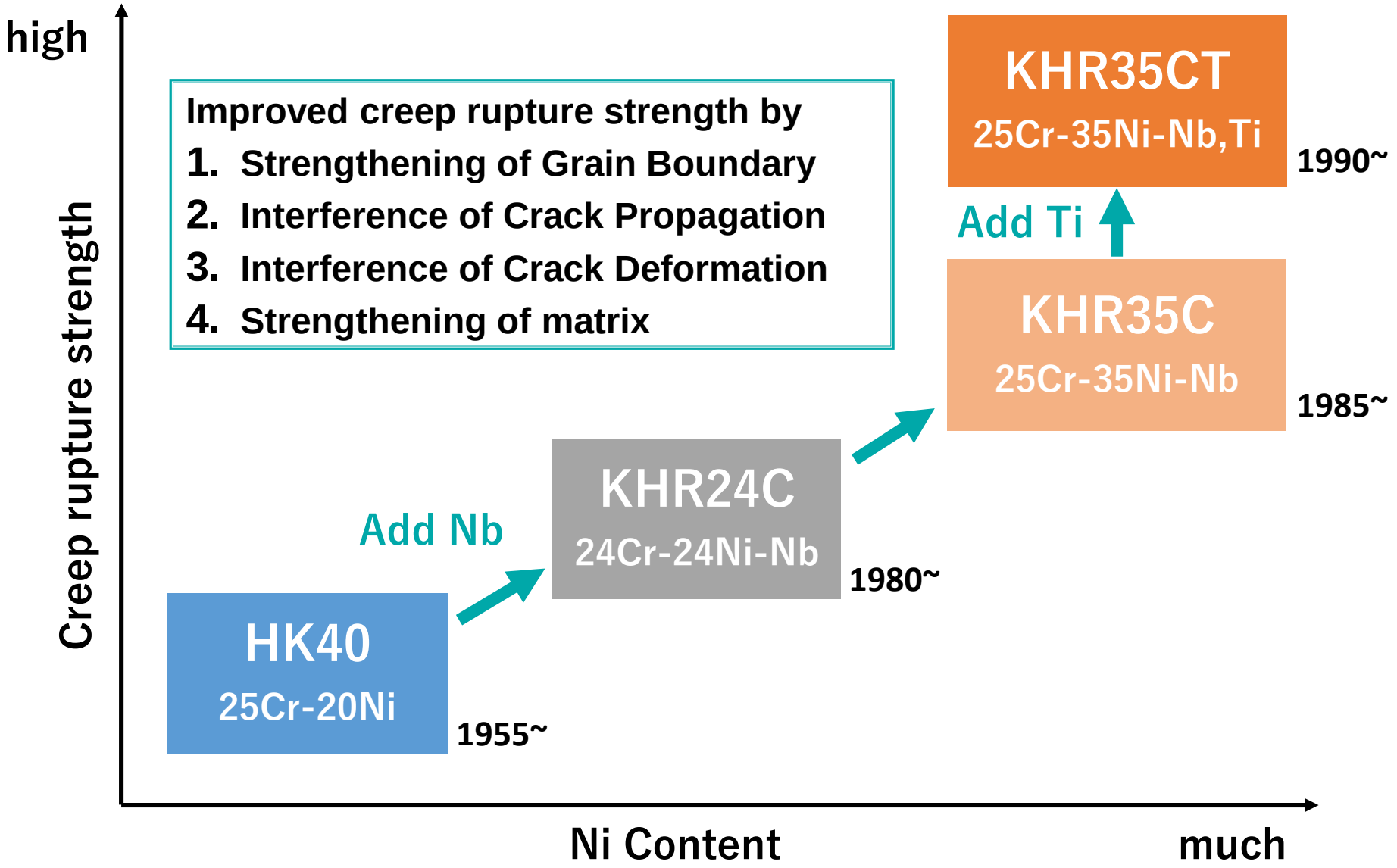


- ✓ **Steam Reforming is currently the most widely used and economically viable method for hydrogen production.**
- ✓ **Used under extremely severe service environments (high temperature: 800–1000℃, high pressure: 2–4MPa etc.)**

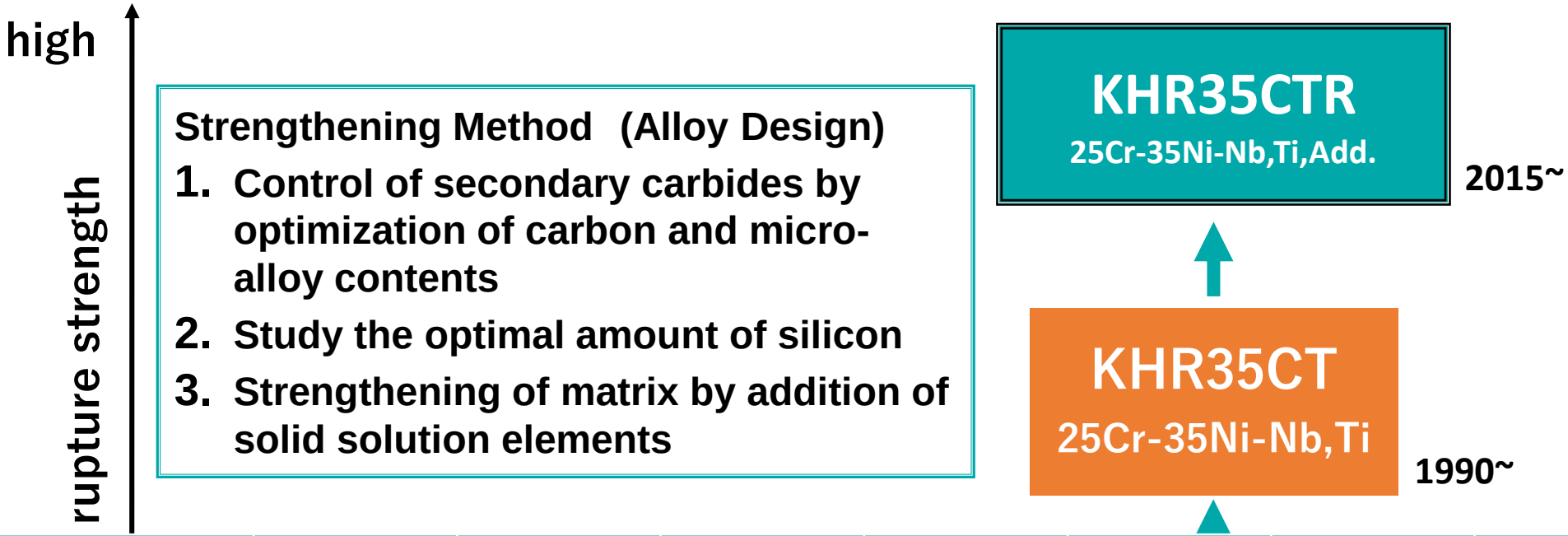
Performance and reliability are highly important.

- ➢ **High Creep rupture strength is required.**

Material Development for Reformer Tubes

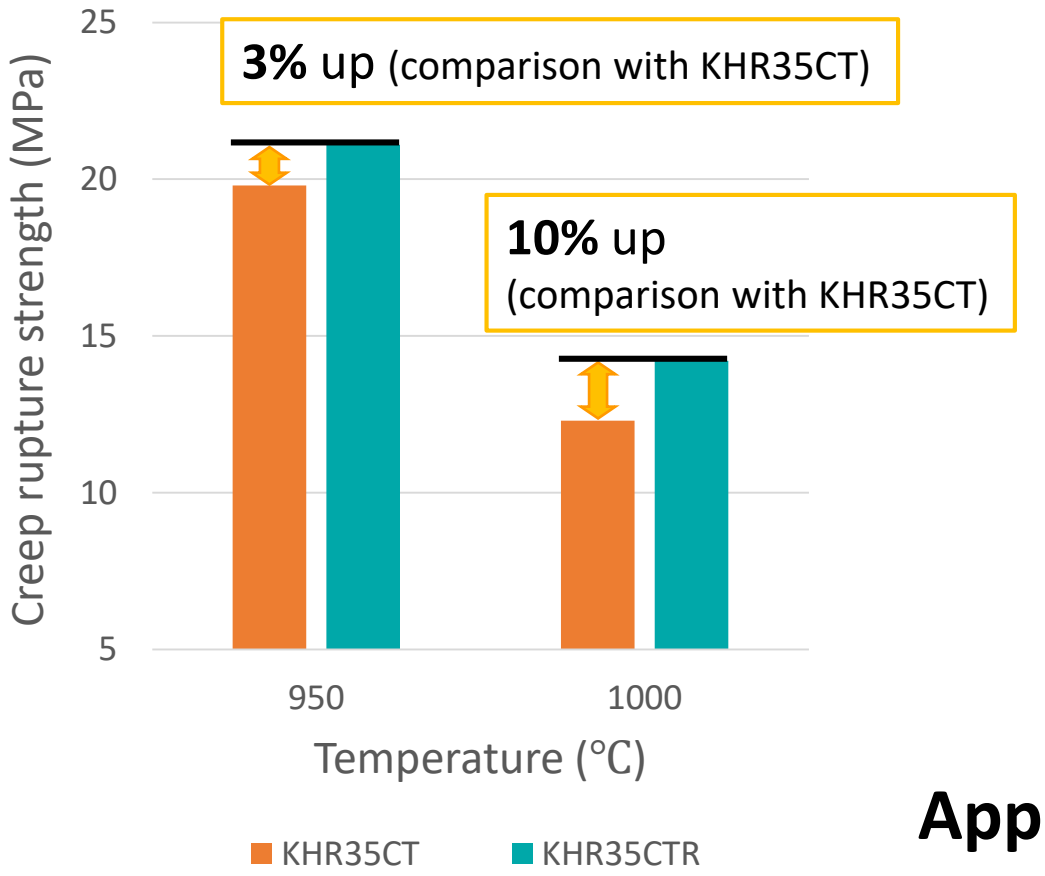


New Material for Reformer Tubes = **KHR35CTR**



Material	C	Si	Cr	Ni	Nb	Ti	Other
KHR35CTR	0.45-0.55	<0.80	24-27	33-37	<1.0	Add.	Add.
KHR35CT	0.45-0.55	<1.50	24-27	33-37	<1.0	Add.	-

Excellent Creep rupture strength of **KHR35CTR**



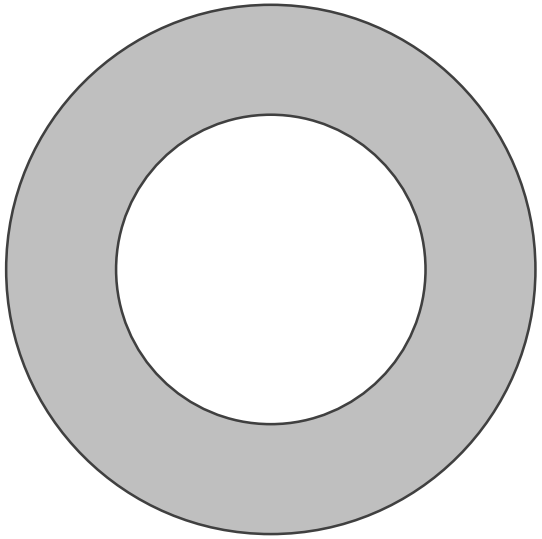
➡ ***Calculation of Wall Thickness According to API 530***

	KHR35CT	KHR35CTR
Design Temp. (℃)	1000	1000
Design Pressure (MPa)	3.68	3.68
Allowable Stress (MPa)	12.3	14.2
Tube Diameter, O.D. (mm)	136.4	136.4
Min. Required Thickness (mm)	17.7	15.6

Approx. 10% reduction in minimum required thickness at 1000℃ design temperature.

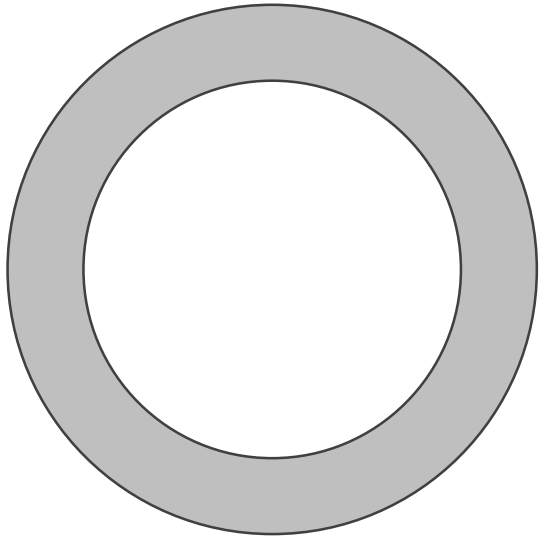
Advantages of **KHR35CTR**

Case of **KHR35CT**



>10% Thickness Reduction

Case of **KHR35CTR**



Excellent Creep rupture strength enables Thinner Wall Thickness

- ✓ **Lower Thermal stress**
- ✓ **Longer Tube life**
- ✓ **Higher reforming efficiency**
- ✓ **Increased Capacity – larger I.D.**
- ✓ **Lower Fuel consumption – Smaller O.D.**
- ✓ **Material & Cost reduction**

High-performance Centrifugally Cast Tubes

For Cracking Furnaces

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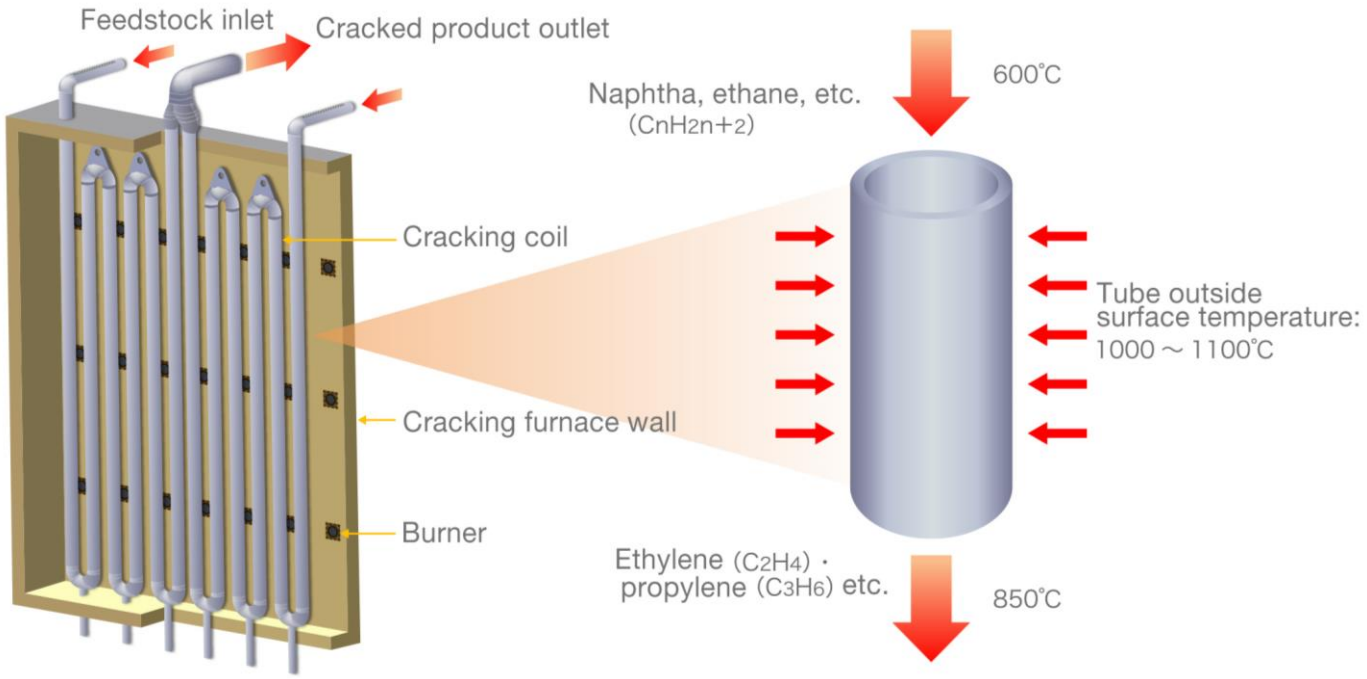
Steam Cracking Coils for Ethylene Production

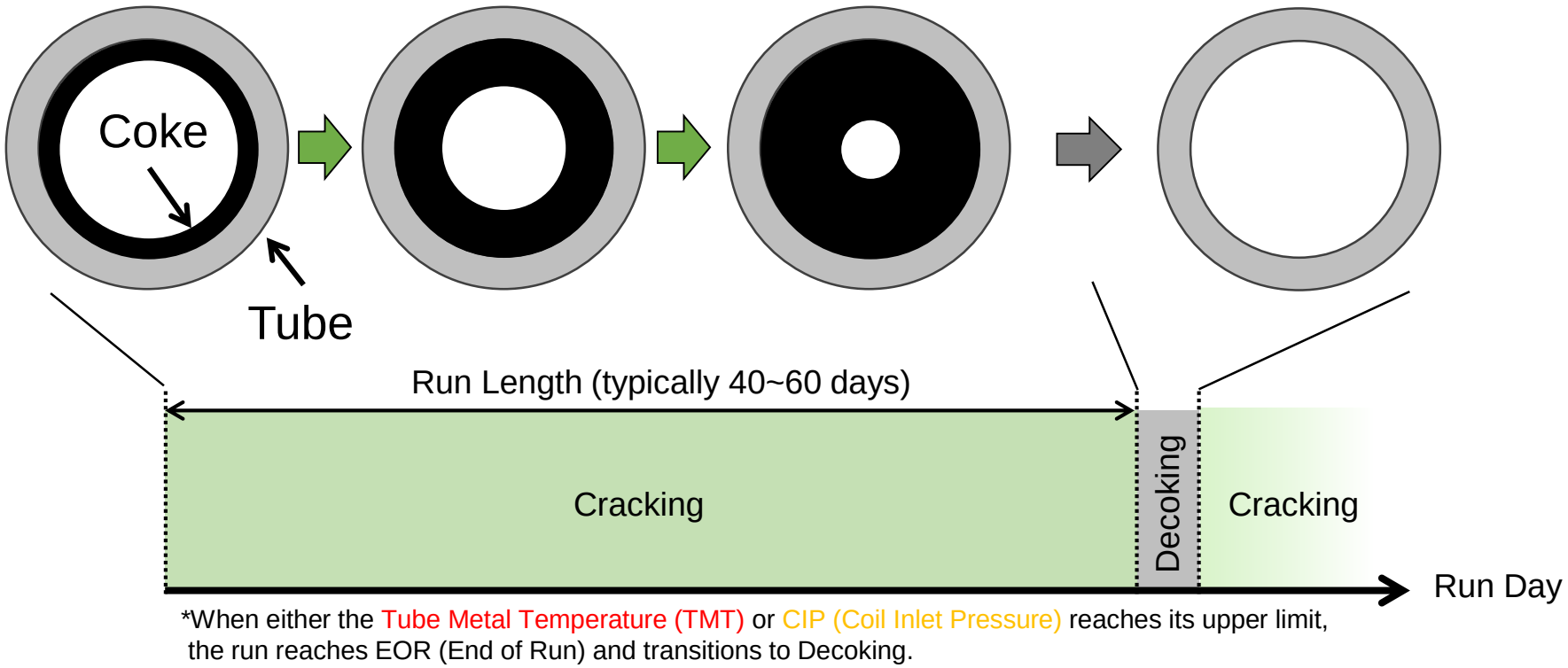
Cracking Coils



- ✓ **The most important and fundamental equipment in a petrochemical complex**
- ✓ **Used under extremely severe service environment (high temperature, high pressure, carburization, corrosion, erosion etc.)**

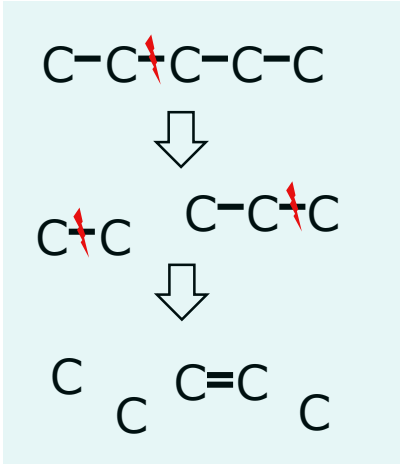
Performance and reliability are crucial.

Cracking Furnace Operation Overview



*When either the Tube Metal Temperature (TMT) or CIP (Coil Inlet Pressure) reaches its upper limit, the run reaches EOR (End of Run) and transitions to Decoking.

Coking:

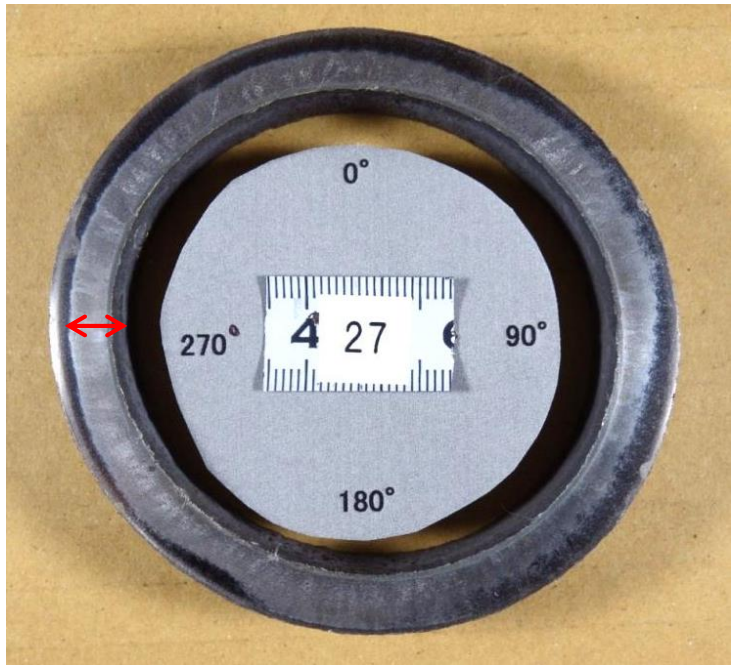


Decoking:
Air and steam are passed through the coil to heat and burn off/remove deposited coke. Requires 1–2 days.

Required performance for Cracking coils:

- **Longer Run length (Anti-Coking, Lower TMT)**

Failure mode of Cracking tubes



Carburization

Coking

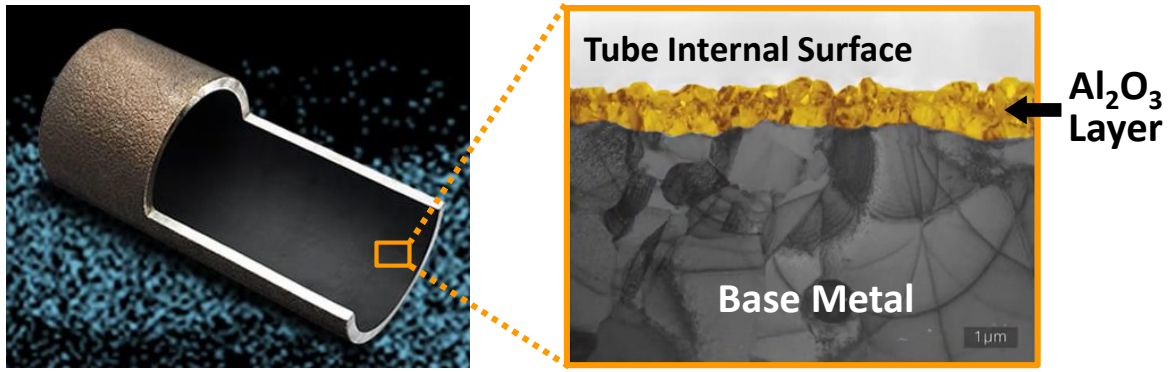
Bulging & Crack

Required performance for Cracking coils:

- **Longer Tube life (Anti-Carburization)**

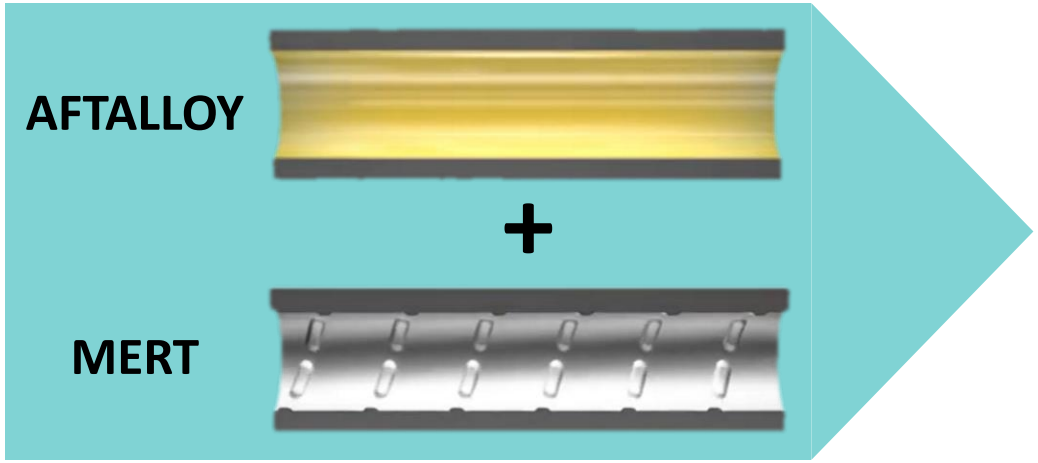
Kubota's High-performance Cracking Coil Technologies

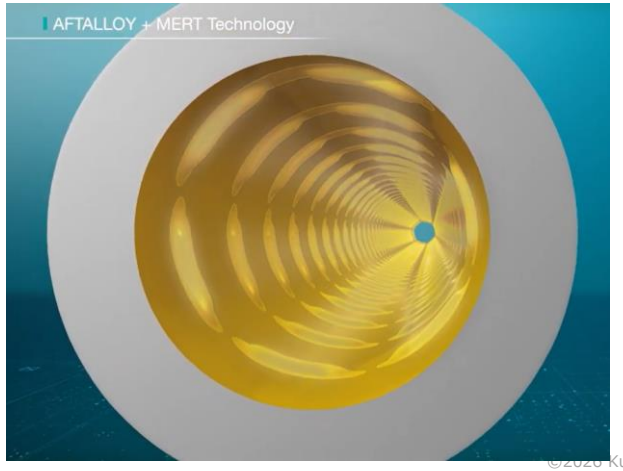
AFTALLOY
(Alumina Forming Tube Alloy)



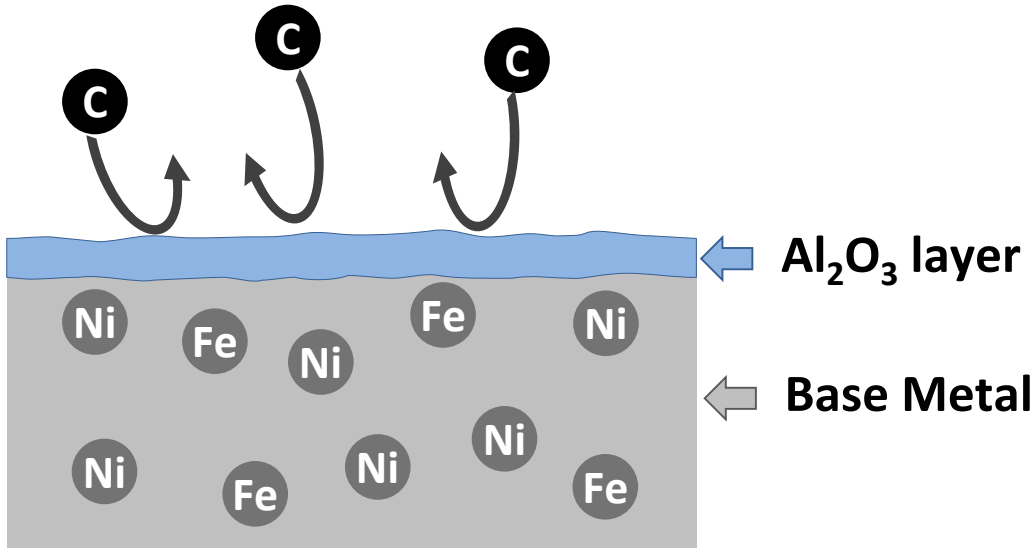
MERT
(Mixing Element Radiant Tube)

AFTALLOY + MERT

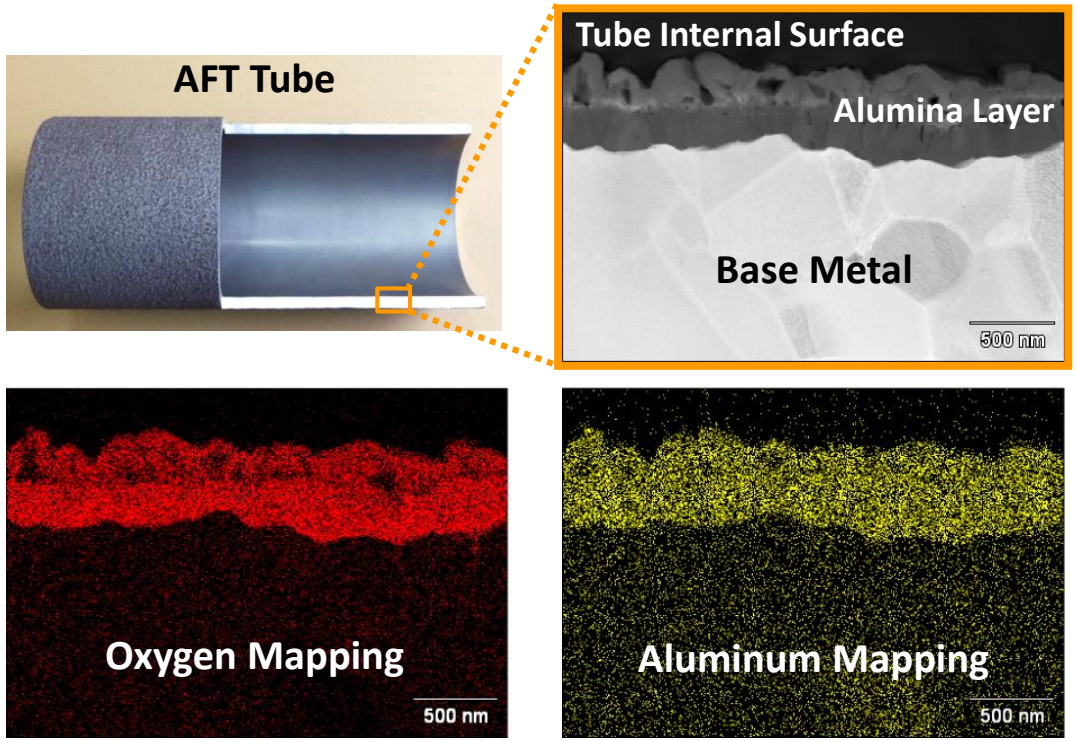




AFTALLOY



Ni and Fe have catalytic activity for coke formation.



Anti-coking

Alumina layer covers over tube surface and passivates catalytic activity of Ni and Fe in base metal.

Anti-carburization

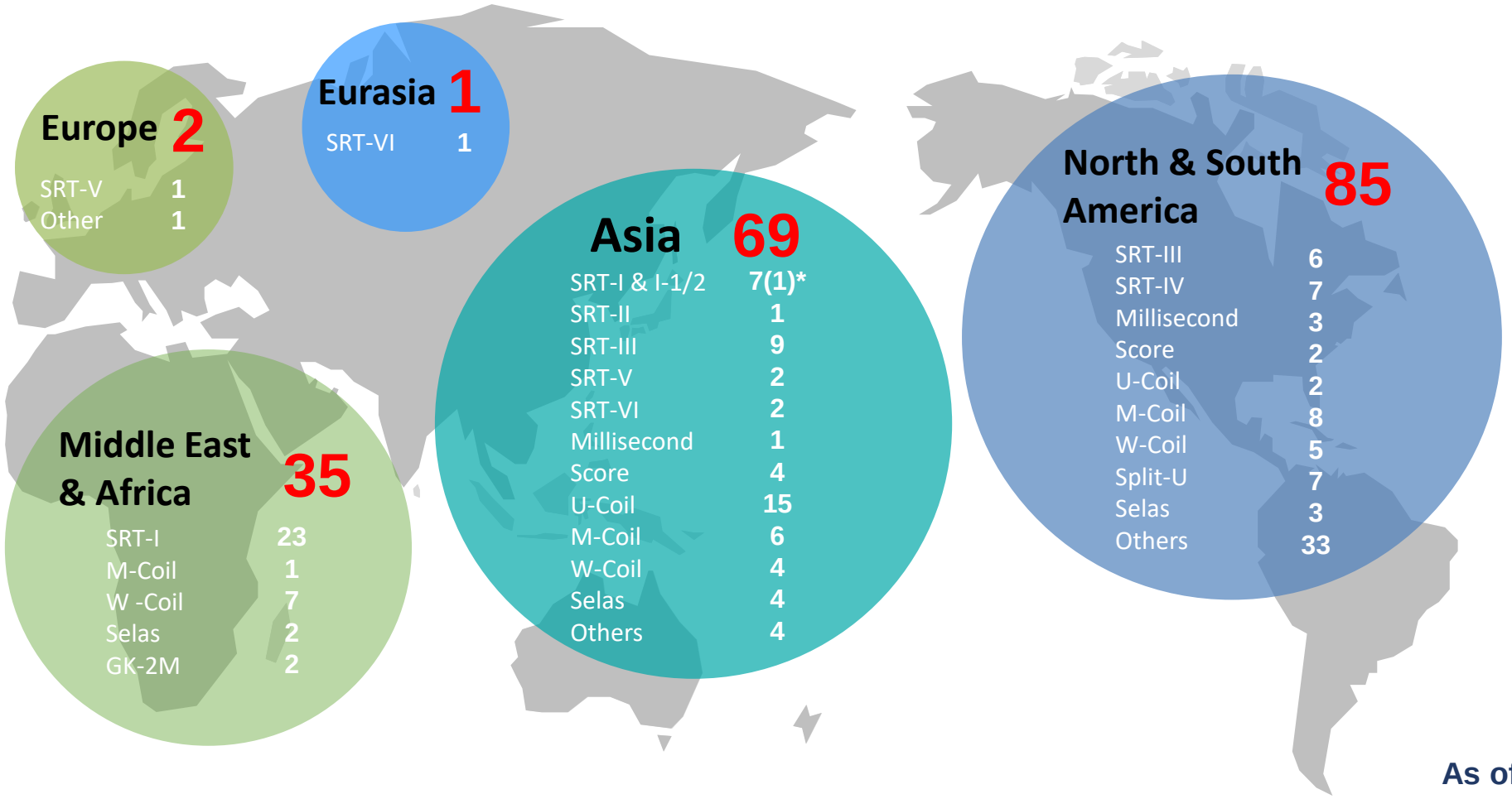
Alumina layer blocks carbon to get into base metal.

AFTALLOY

Kubota

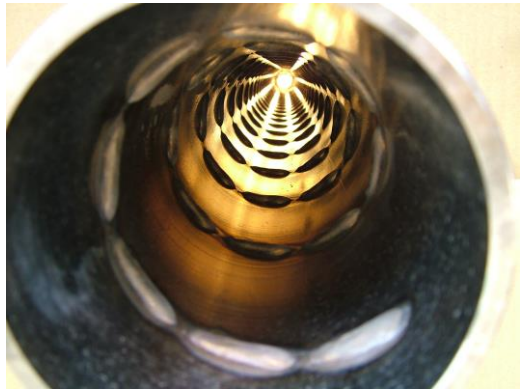
Total supply number

192 Furnaces

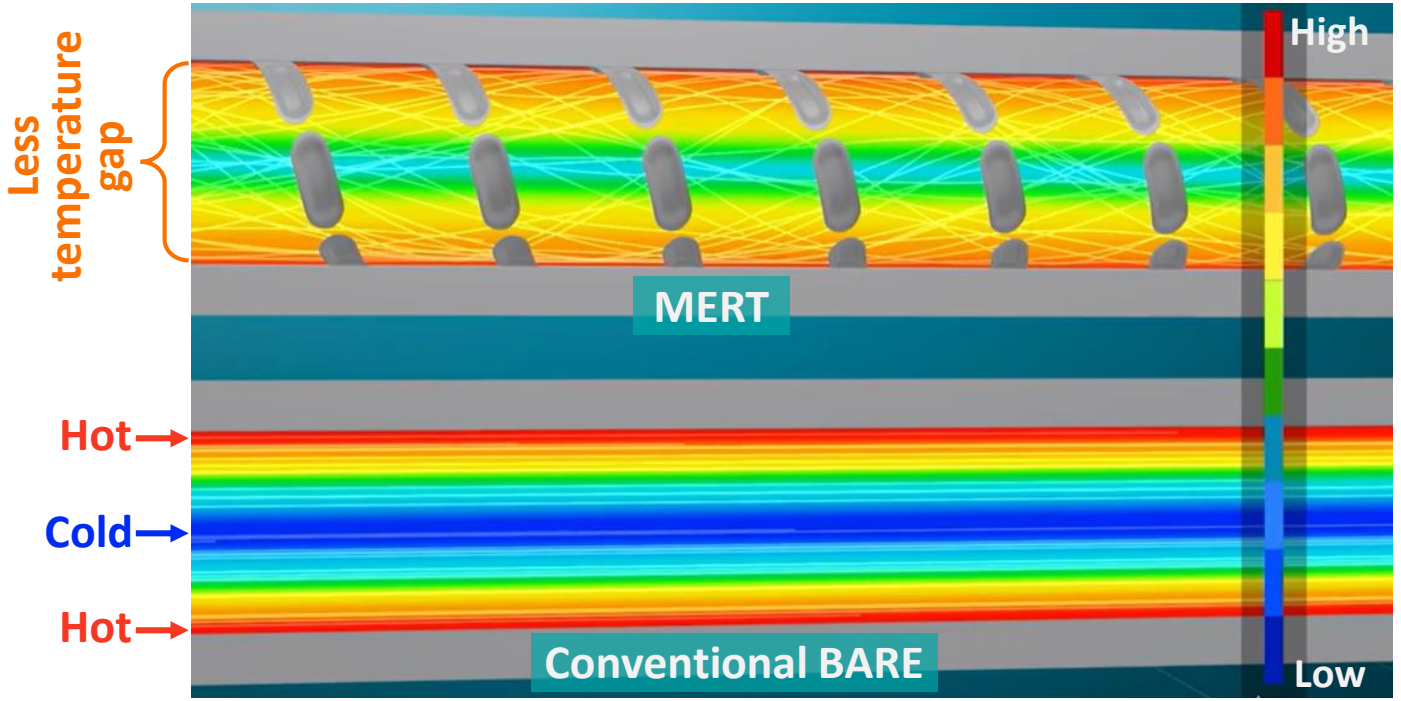


As of Dec. 2025

MERT



- ✓ Enhanced Heat Transfer
- ✓ Lower TMT



MERT

Run length extension

1.5 – 2 times longer run length

because of:

- ✓ **lower TMT from SOR**
- ✓ **reduced coking rate**

Fuel savings

4 – 5 % fuel savings

because of:

- ✓ **enhanced heat transfer**

Olefins production increase

because of:

- ✓ **longer run length (less opportunity loss during decoking)**
- ✓ **possibility of increased load/severity operations maintaining good run length**

Tube life extension

Lower TMT reduces:

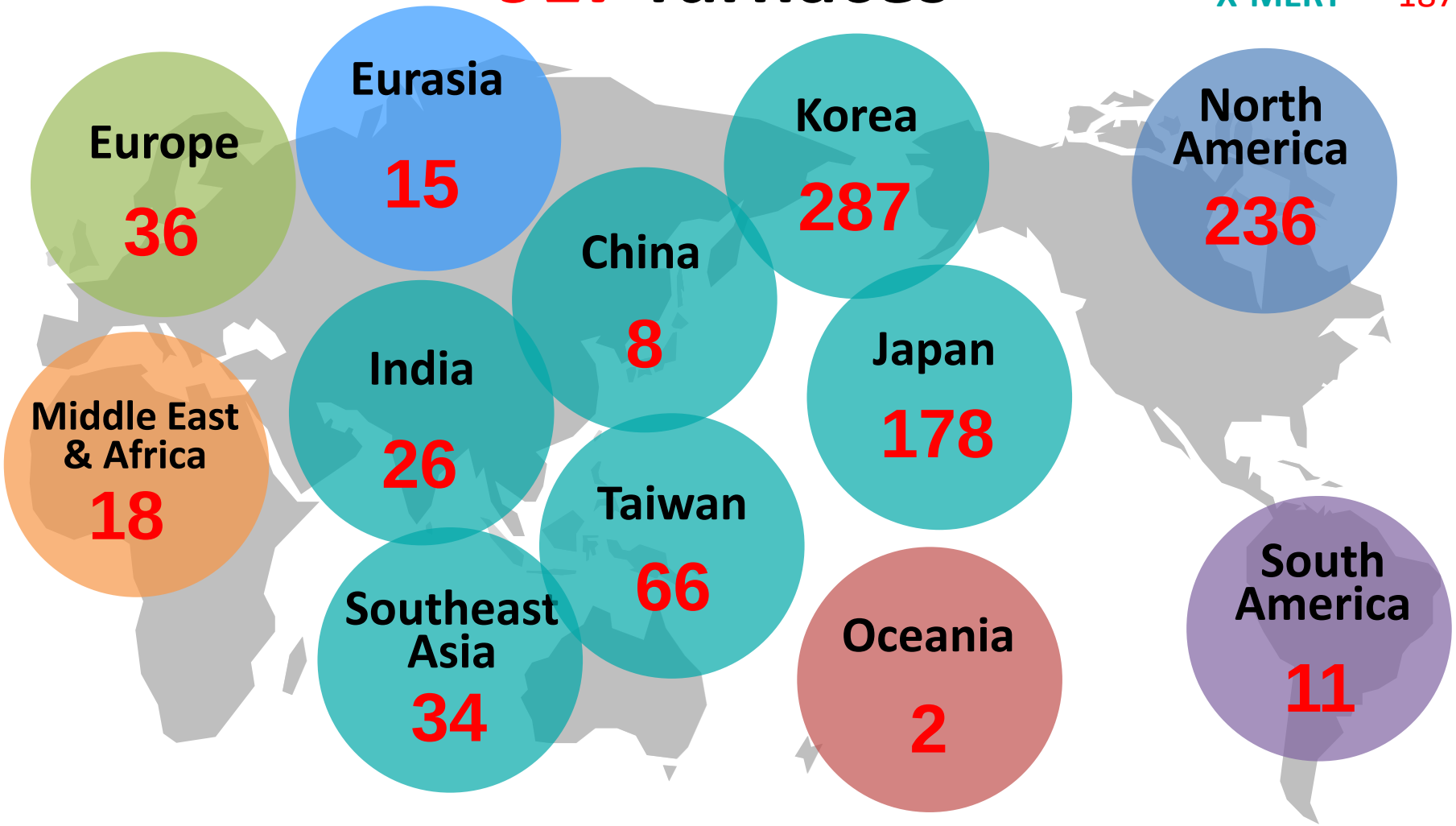
- ✓ **carburization**
- ✓ **creep deformation**

MERT

MERT has been supplied to

917 furnaces

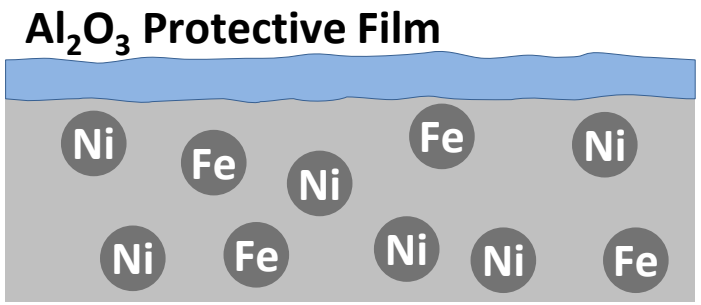
MERT	334 (since 1996)
Slit-MERT	396 (since 2003)
X-MERT	187 (since 2008)



As of Dec. 2025

AFTALLOY + MERT

AFTALLOY



MERT

AFTALLOY+MERT

Quantification of Economic Impact

Benefits of High-performance Coils

✓ **Coil Life Extension**

1.2 – 1.5 times longer than conventional Bare coils because of lower TMT resulting in less carburization

✓ **Run Length Extension**

1.5 – 2.0 times longer run length because of lower TMT and less coking

✓ **Fuel Savings**

3 - 5 % of fuel savings because of improved heat transfer

Successfully demonstrated in actual operations across multiple plants worldwide.

Quantification of Economic Impact

	Conventional Bare		MERT	
Run length	60 days	1.5x	90 days	
Ethylene Production [ton/year]	140,000		141,728	
Margin from Ethylene Production [USD/year]	49,000,000		**49,604,938**	**Margin increase: 604,938 [USD/year]**
Fuel consumption (index to Bare = 100)	100	- 4%	96	
Fuel cost [USD/year]	28,149,120		**27,310,464**	**Cost saving: 838,656 [USD/year]**
Coil life	6 years	1.5x	9 years	
Annual coil replacement cost [USD/year]	600,000		**511,111**	**Cost saving: 88,889 [USD/year]**

(Total economic benefit by MERT) = (Margin increase by MERT) + (Cost saving by MERT)

= 604,938 + 838,656 + 88,889 = 1,532,483 [USD/furnace/year]

Quantification of Environmental Impact

Annual CO_2 emission per ton of ethylene production

Inputs	Unit	Bare	MERT	
Annual CO_2 emission for cracking	ton-CO_2/furnace/year	183,825	**178,650**	**-5,175**
Annual CO_2 emission for decoking	ton-CO_2/furnace/year	1,021	**688**	**-1,728**
Annual ethylene production	ton-C_2H_4/furnace/year	140,000	141,728	

$$\text{(Annual } CO_2 \text{ emission per ton of ethylene production)} = \frac{\text{(Annual } CO_2 \text{ emission for cracking \& decoking)}}{\text{(Annual ethylene production)}}$$

Outputs	Unit	Bare	MERT	
Annual CO_2 emission per ton of ethylene production	ton-CO_2/furnace/year /ton-C_2H_4	1.320	**1.265**	**(- 4.3%)**

Key Takeaways

- ✓ Kubota's KHR35CTR (HP-based alloy for Reformer furnace) enables cost savings, higher capacity, and energy savings through its superior creep rupture strength.
- ✓ Kubota offers tailored high-performance cracking coil solutions (MERT, AFTALLOY, AFTALLOY+MERT) optimized for each furnace, feedstock, and customer needs.
- ✓ High-performance cracking coils deliver 1.5–2x longer run length, 3–5% fuel savings, and 1.3–1.5x longer coil life.
- ✓ MERT delivers 1.5 MUSD/furnace/year economic benefit (based on a 140 KTA ethylene plant, successful case). Run length extension and fuel savings are the key drivers.
- ✓ MERT reduces CO_2 emissions by 4.3% per ton of ethylene in the same case.

Thank you for your attention.

KUBOTA Technology Cracking Tube
on YouTube

www.youtube.com/watch?v=dcRzbpOLDjw