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TO: KOBE STEEL (KOBELCO)

Forge Plant, Molding Department

Test Report of Enhanced Heat Insulation on The Electric Furnace.

June, 2012

Hitachi Plant Services CO., Ltd

1. Test Overview

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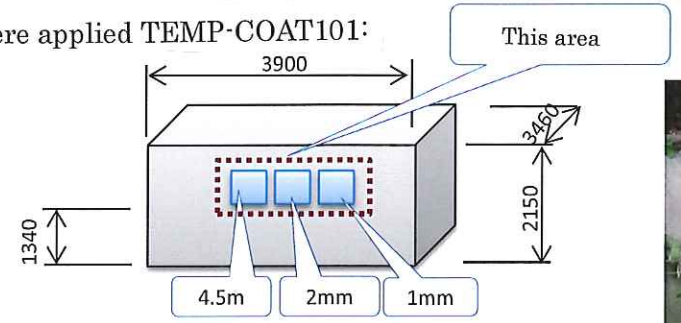
1) PLACE: Takasago city, Hyougo-pref., Japan
2) DATE: June 13 & 14, 2012 10:30AM – 17:00PM
3) TEST CONDITION: Temperature: 27～28℃ Weather: Sunny day
4) WORK PLACE: Forge Plant
5) AREA where applied TEMP-COAT101:



6) Observer: Mr. Takeuchi from KOBE STEEL
7) People who spray TEMP-COAT 101: Mr. Oue from Hitachi Plant
Mr. Aihara from Ace International Trade
Mr. Yamamoto from Hashimoto

8) TEST METHOD: a) Apply TEMP-COAT101 to the area sized 62cm x 60 ～ 85cm of the outer wall of the electric furnace.
Three types of thickness: 1, 2, and 4.5mm. It was done by Airless sprayer.
b) On TEMP-COAT101, top coating (Thermo resin SV300) was applied by brush.
c) Compare the temperature using thermocouple thermometer

2. Test procedure and the result mesured.

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1. Purpose:

To study the reduction of surface temperature and the reduction rate of the amount of heat loss by comparing three different thicknesses of heat insulator on the wall of the electric furnace.

For the three areas/thicknesses, the heat insulator (TEMP-COAT101) and the other heat insulator (Thermo resin SV300) were used.

2. Test:

The wall of furnace was boxed off as shown in the table 1 and the picture.

The test was done by measuring and comparing the thermocouple.

In order to see the effect of the heat insulator, the center of each area was left unapplied.

Table 1.

	A	B	C
Heat insulator	TEMP-COAT101	TEMP-COAT101	TEMP-COAT101
Top coating	Thermo resin SV300	Thermo resin SV300	Thermo resin SV300
Thickness (mm)	4.5	2.0	1.0
temperature (℃)	86.6 / 62.8	83.9 / 68.4	83.0 / 73.4

3. Condition to calculate:

Thermocouple data was taken for this study.

If radiation thermometer was used, infrared emission in the surrounded air also could be measured. The emissivity of the surface of heat insulator is 0.4 and the electric furnace is 0.75.

< The electric furnace >

< Measurement >

3. Caluculation of heat discharge

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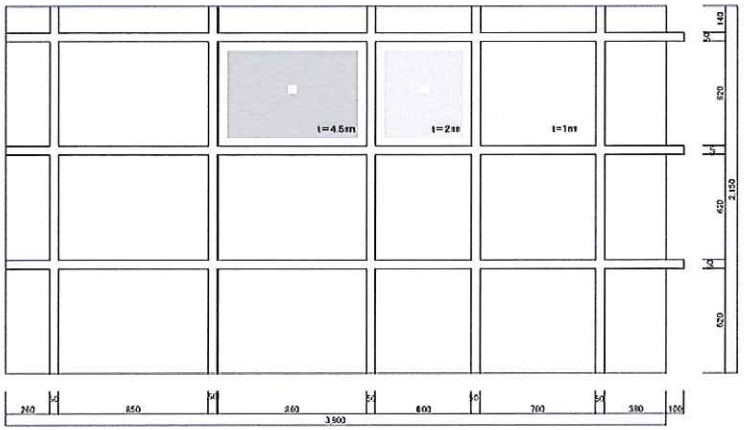
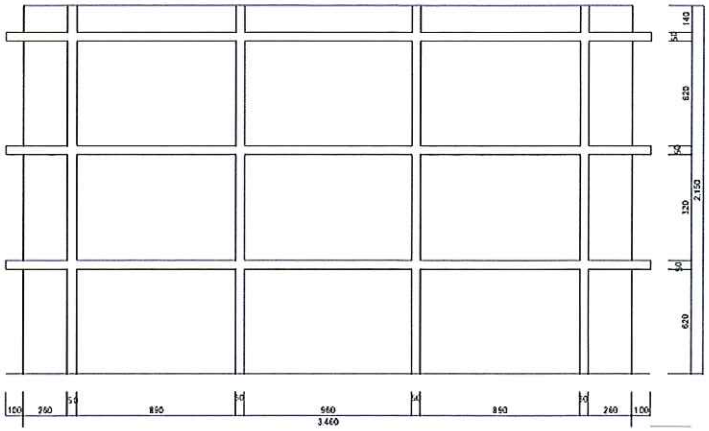
1) The size of the electric furnace.

Front surface



Back surface



2) Calculating formula

Wastage of heat transfer ⟶ $=\varepsilon \times \sigma \times ((273.15+T)^4-(273.15+T_0)^4)\cdots(1)$

Wastage of convection heat transfer $=hm \times ((273.15+T)-(273.15+T_0))^{4/3}\cdots(2)$

Wastage of total heat ⟶ =式(1) + 式(2)

T: surface temperature or mean temperature

To: Ambient temperature

ε : Emissivity

σ Boltzmann constant

hm: Convection constant = 2.01

3) **Test Result**

(No.1 Only Temp-Coat101 was applied)
Test Date: June 14, 2012 9:05AM

	4.5mm厚	2mm厚	1mm厚
W/O heat insulator	82.6℃	81.6℃	80.1℃
W/ heat insulator	62.5℃	65.9℃	71.9℃
GAP	20.1℃	15.7℃	8.2℃
Adiabatic rate	24.3	19.2	10.2

(No.2 Temp-Coat101 & SV300 were applied) Test Date: June 14, 2012 9:55AM

	4.5mm厚	2mm厚	1mm厚
W/O heat insulator	86.6℃	83.9℃	83.0℃
W/ heat insulator	62.8℃	68.4℃	73.4℃
GAP	23.8℃	15.5℃	9.6℃
Adiabatic rate	27.5	18.5	11.6

4) Result of the amount of radiant heat

ε :Emissivity is 0.2 but it considered as 0.4 due to aged dirt on the furnace.

		A	B	C
BEFORE	Emissivity	0.6	0.6	0.6
	Surface temperature (℃)	86.6	83.9	83
	Wastage of heat discharge(W/㎡)	29	273	268
	Wastage of convection heat (W/㎡)	458	430	420
	Wastage of total heat(W/㎡)	748	703	688
AFTER	Emissivity	0.4	0.4	0.4
	Surface temperature (℃)	62.8	68.4	73.4
	Wastage of heat discharge(W/㎡)	102	122	141
	Wastage of convection heat (W/㎡)	228	279	326
	Wastage of total heat(W/㎡)	331	401	466
	Reduction rate (%)	56	43	32

4. COST

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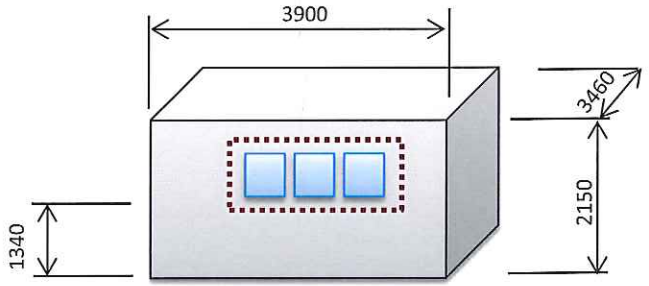
1) The dimension of electric furnace (1 set)

Top side	Cannot be applied the insulator.							
Side (left and right)	3.9	x	2.15	x	2	=	16.77	㎡
Front surface	Cannot be applied the insulator.							
Back surface	3.46	x	2.15	x	2	=	14.88	㎡
							31.65	㎡



2) Condition for Performance

Running time	280	days	x	24	hours	=	6,720 Hr
Electricity cost							11.5 yen/kWh

3) The amount of heat discharge

	㎡			kW		kW			Hr	〈Reduction heat quantity〉		〈Reduction electricity cost〉	yen/KW	〈The amount to be collected〉	
T=4.5 mm	31.65	x	(	0.748	-	0.331	)	x	6,720	= 88,640	kW	76,230 KW/year x	11.5	= 876,650	yen/year
T=2 mm	31.65	x	(	0.703	-	0.401	)	x	6,720	= 64,221	kW	55,230 KW/year x	11.5	= 635,141	yen/year
T=1 mm	31.65	x	(	0.688	-	0.466	)	x	6,720	= 47,179	kW	40,574 KW/year x	11.5	= 466,603	yen/year