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Title Gas & electricity combination heating for reducing electric demand.

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1. Background

In Japan, natural gas price is higher than other oil fuels.We have been concentrating on developing high efficiency burners and furnaces such as re-generative burners and high efficiency aluminum melting furnaces.We have been changing our customers' fuels from oil to gas by our technologies.Electricity heat type furnaces' installation cost is much lower than gas heat type and their energy consumption amount is very low. So, at small or medium scale furnaces, even if we install the high efficiency furnaces, the pay-back year is longer. Regardless of our effort, there are a lot of electricity heat type furnaces.

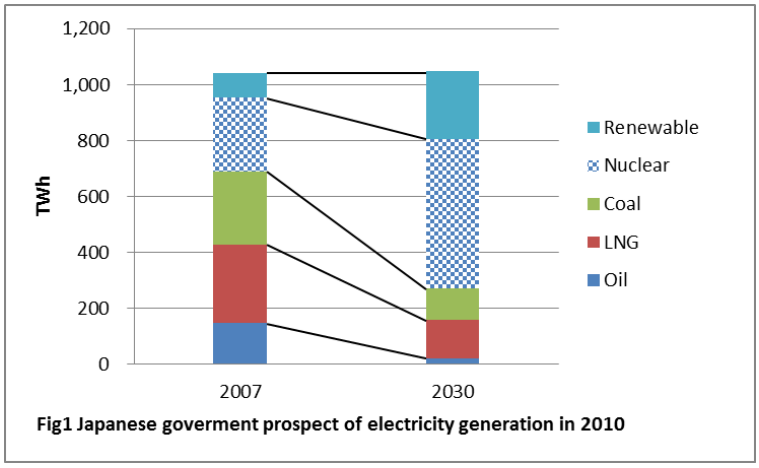

Fig1 Japanese goverment prospect of electricity generation in 2010

After the East Japan great earthquake, most of the nuclear power plants had stopped. To avoid the electric power network failures, we had to reduce the electric power demands.

To reply to these requests, we changed our mind to concentrate not on whole fuel switching but on partial fuel switching, and installed the several gas and electricity combined systems to our customers' sites.

The natural gas price is getting more and more expensive and we have to reduce carbon dioxides emission as much as possible. So we have to improve the gas fired sections' efficiency and reduce the installation cost. In this report, we will show you a successful example.

2. Customer information

Corporation Name　S glass manufacturing
Address　Osaka city
Products　made-to-order glass bottles
Facilities　6 pots type glass melting furnace: gas fired type
Continuous annealing furnace: electricity heater type
Electricity peak demand　168kW
Daily electricity consumption　1,750kWh
Daily gas consumption　820m^3

3. Feature of the annealing furnace

Conveyer	continuous mesh-belt conveyer type
Heater capacity	164kW
Dimension	height：1.75m　width：1.8m　Length：18m
Process temperature	Max 550℃

Fig2 Annealing furnace shape

Fig3 Entrance of the annealing furnace

4. Measurement

To make the remodeling plan, we measured the furnace's inner temperature.

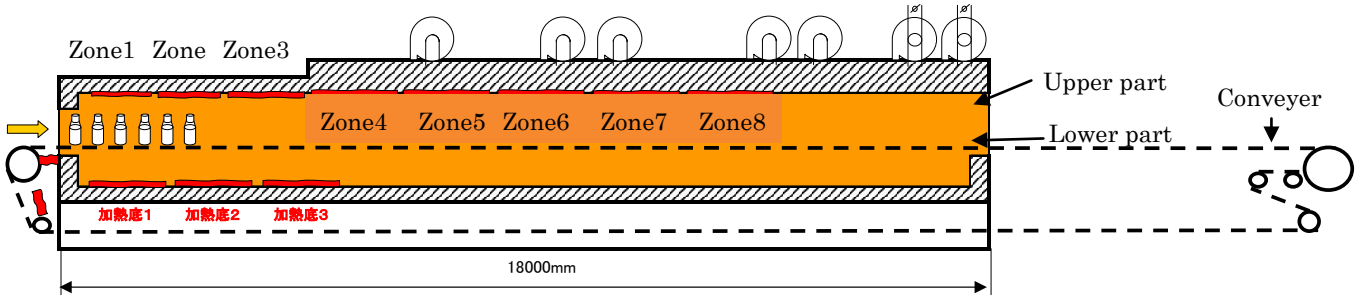

Fig4 inner structure of the annealing furnace

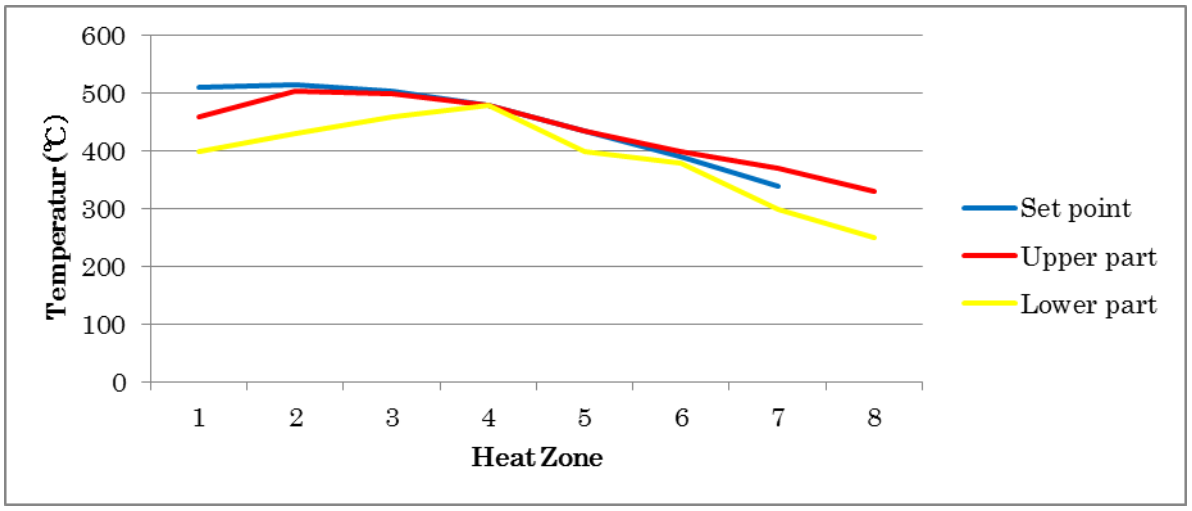

Fig5　inner temperature

As fig5 shows, the upper part temperatures are almost same as the Set points. But the lower part temperatures are below each set point. And processing materials are usually placed at Lower parts as fig3 shows. The annealing furnace does not have enough heating capacity. If we add another heat mechanism to this furnace, we can improve its performance.

5. Remodeling plan

Before measuring, we were going to replace some electric heaters with gas burners. But we know that this furnace does not have enough capacity, so we decided to add another heating zone to this furnace.

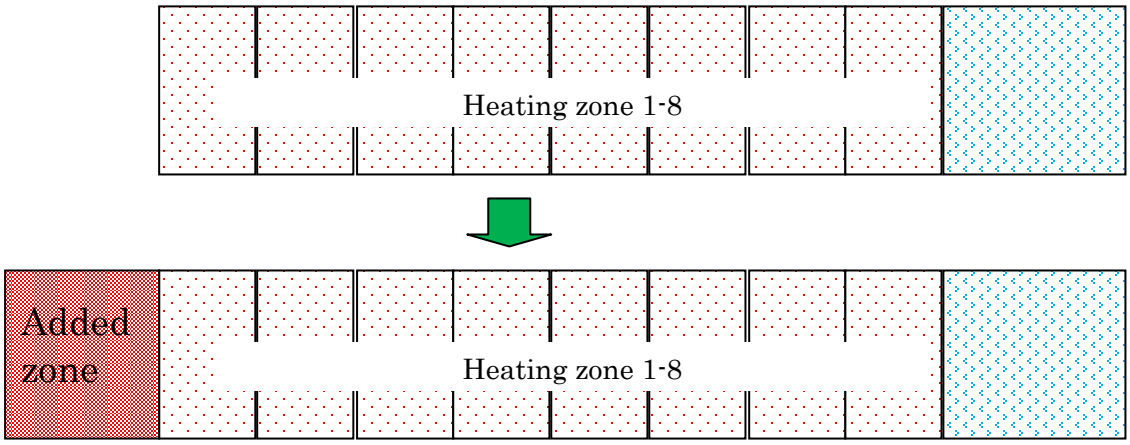

Fig6 remodeling plan

6. Burner selection

We compared several burners each other and adopted D-mat burner for this remodeling.

In this case, there were three important points below.

1 low installation cost : especially air-fuel ratio controller is critical

2 high efficiency : we had to reduce exhaust gas loss, so low exes air ratio was important

3 safety : inner temperature was over 500℃, so we had to avoid back fire.

Table 1 burners selection

	Nozzle mixing	Pre-mixing with ceramic	Pre-mixing with metal knit	Pre-mixing with D-mat
Installation cost	×	△	○	◎
Low exes air	×	○	◎	◎
Back fire	◎	△	○	○
shape				

7. Added zone's features

We could not get the present furnace data such as insulation design, so we had to design this added zone by ourselves.

At the remodeling, most anxious thing was the conveyer belt control. If it moved in a zigzag direction, it would have taken much time to fix this failure.

Fortunately, the conveyer belt moved in a straight direction and we successfully accomplished this remodeling.

The added zone's features are below

Heat capacity　50kW (Low Heat Value)　4 burners

each burner's capacity is 12.5kW and minimum combustion rate is 4kW.

Dimensions　height : 1.75m　width : 1.8m　Length : 1.5m

Electricity consumption　Max 1.0kW

Fig7 added zone's shape

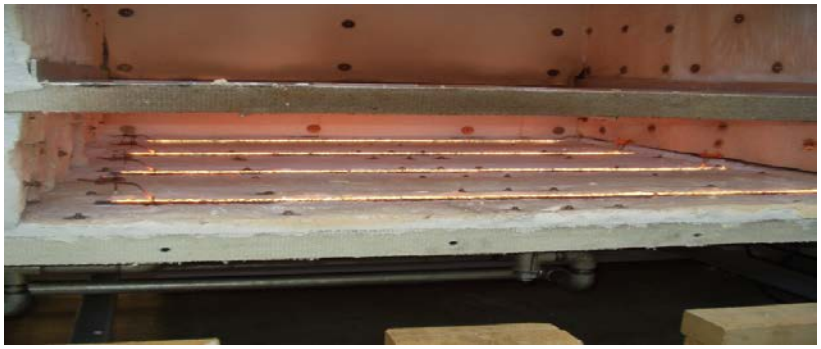

Fig8 4 burners

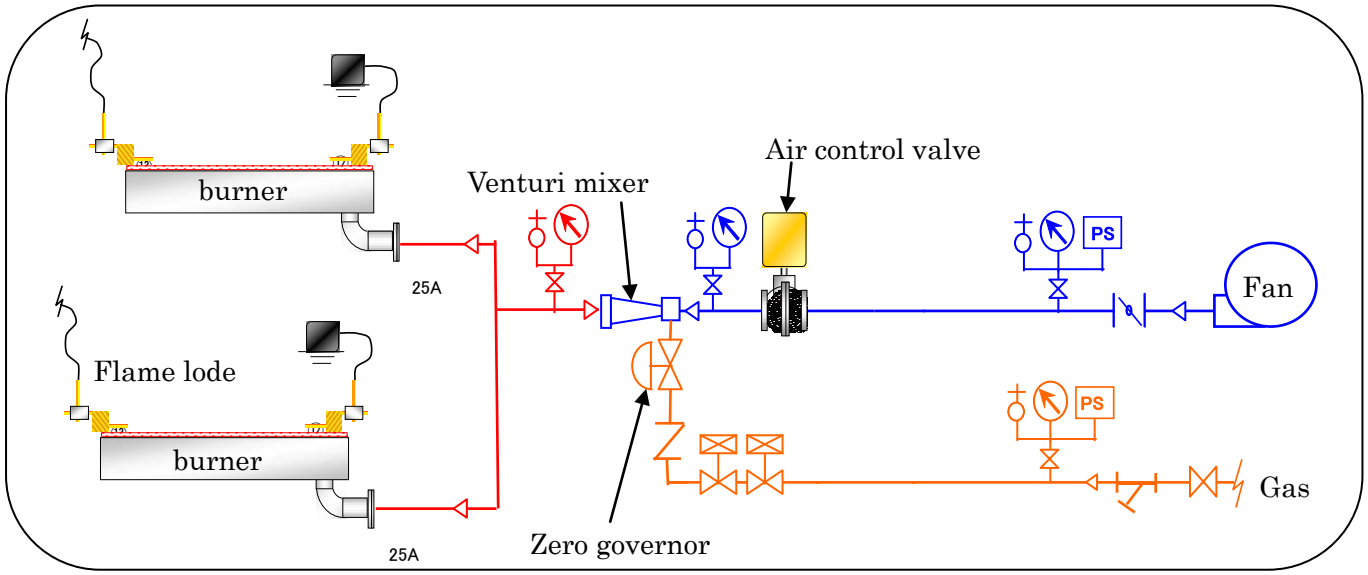

Fig9 air and gas flow

8. Results of this remodeling

The added zone is working from May 2013 and we had gotten some data. We successfully decreased the electricity consumption by 38% and increased the gas consumption by 6%.Our customer reduced its energy cost by 20%.The pay-back year is approximately 4 years

Table 2 energy consumption

	Before remodeling	After remodeling
Daily electricity consumption	1750kWh	1082kWh
Electricity peak demand	168kW	122kW
Daily gas consumption	820m^3	870m^3

9. Conclusion

In this case, gas burners' efficiencies are more than 90% at Low heat Value base.

We can reduce the electricity peak demand and consumption by small size gas burners.

The added zone's temperature is 500℃. Without any heat recovery system, the heat efficiency can't reach over 90%.

In many case, we can't afford to install the heat recovery system. The heat recovery system is pretty expensive and the pay-back year will get longer and longer.

At this annealing furnace, there are several fans for decreasing the products' temperature. We adjusted these fans to direct the gas burners' exhaust gas toward the exit direction.

By this adjusting, we reduced the exhaust gas temperature without any additional equipment. And the exhaust gas temperature was less than 100℃.

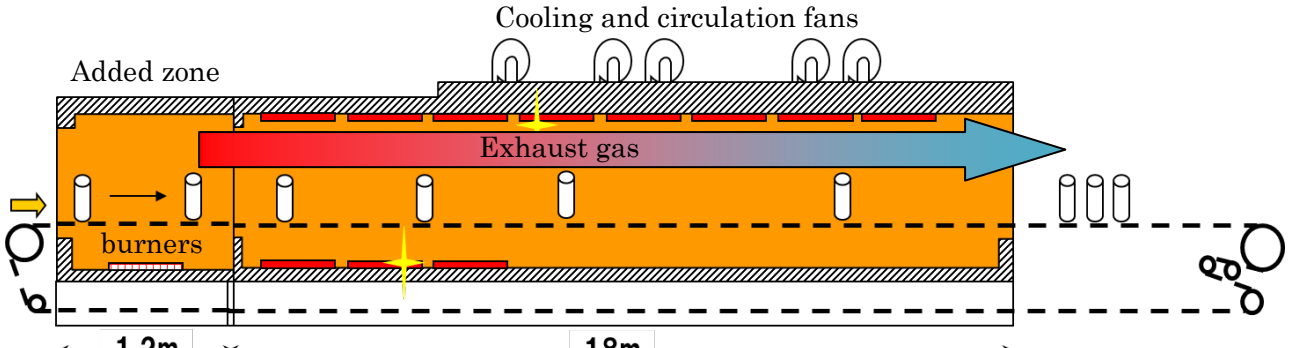

Fig10 exhaust gas flow

The burners' heat efficiencies depend on the exhaust gas flow. But most of the electricity heat furnaces are designed without considering exhaust gas flow.

There are many customers who want to reduce their electricity peak demand and consumption. Electricity companies want to restart their nuclear power plants and Japanese government will help them with their activities. But many people don't trust their nuclear power plants' reliability. We are going to develop remodeling technologies and remodel our customers' facilities.