2008 Prize of the Chairman of ECCJ

Activities to Reduce Use of Energy and Emission of CO_2 by Improving Production Efficiency

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Gets Group

◎ **Keywords: Rationalization of heating, cooling and heat transfer (Heating equipment, etc.)**

◎ Outline of Theme

We will the reduce energy loss happening at our plant and improve our production capacity, to make better products with less energy, to reduce the use of electricity and to mitigate the emission of CO_2.

◎ Implementation Period for the Said Example

May 2007 – March 2008

● Project Planning Period	May 2007	Total of 1 month
● Measures Implementation Period	June 2007 – August 2007	Total of 3 months
● Measures Effect Verification Period	September 2007 – March 2008	Total of 7 months

◎ Outline of the Business Establishment

- Items Produced: Automobile parts (Transmission gears, bevel gears)
- Employees: 250
- Type 1 designated energy management factory
  Building area of Akemi Plant #2, Die Casting Department 12,496 m^2
  Our energy conservation activities covered all of the energy used in this factory.

Photo 1

- Forging 17 lines
- Machining 32 units
- Heat treatment 2 lines

◎ Target Facility

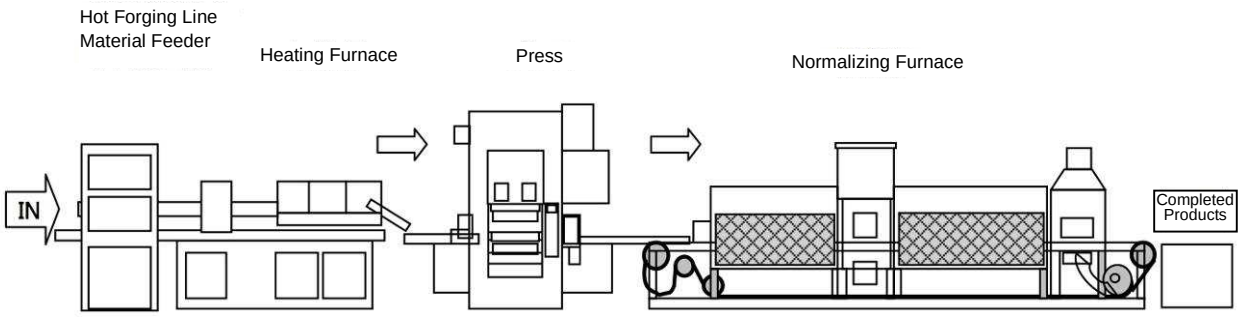


Fig. 1

1. Reasons for Theme Selection

We, Die Casting Department, are trying to reduce the use of energy based on the policy of our company.

By enhancing the efficiency of the equipment and the production capacity per hour, we reduce the energy loss, cut the electricity used and mitigate the CO_2 emission.

①Breakdown of CO_2 emission of Akemi Plant #2.

Of the CO_2 emission of Akemi Plant #2, the electricity consumption accounts for approximately 98% and LNG accounts for the remaining 2%. So we focus on the electricity for the said activities.

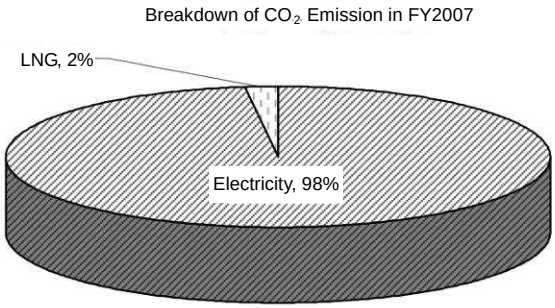


Fig. 2

②Breakdown of electricity consumption of Akemi Plant #2

Of the total electricity consumption, the production equipment accounts for 69%, the compressors account for 14% and the lights account for 9%.

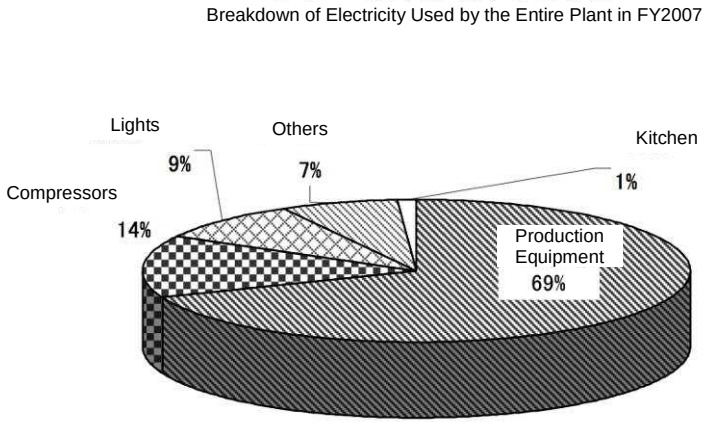


Fig. 3

③Breakdown of electricity used by production equipment

Of the total electricity used, the forging lines account for 80%, the machining and heat treatment account for 13% and others account for 7%.

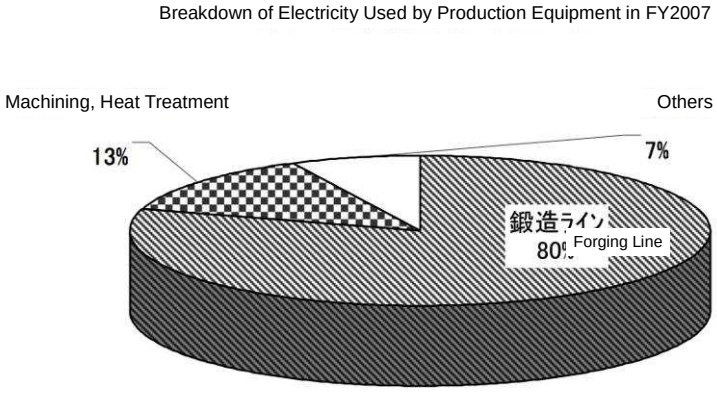


Fig. 4

2. Progress of Activities

(1) Implementation Structure

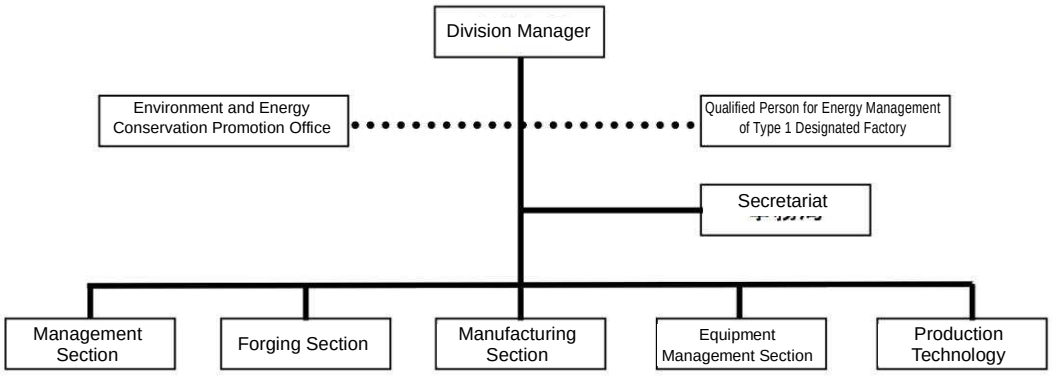


Fig. 5

(2) Understanding of Hot Forging Line's Current Situation

① Transition of production output of hot forging line

The average production output in 5 months from December, FY2006 to April, FY2007 was 602 pieces an hour.

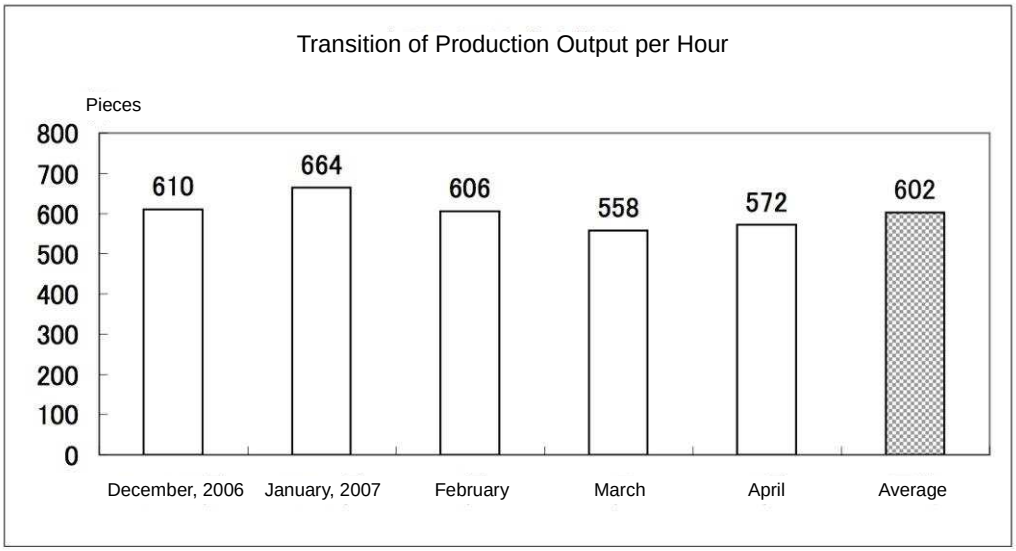


Table 1

② Trend of production (Transition of equipment load)

If the production output continued to be the same, it was supposed that there would be overloaded to the production capacity after September, 2007.

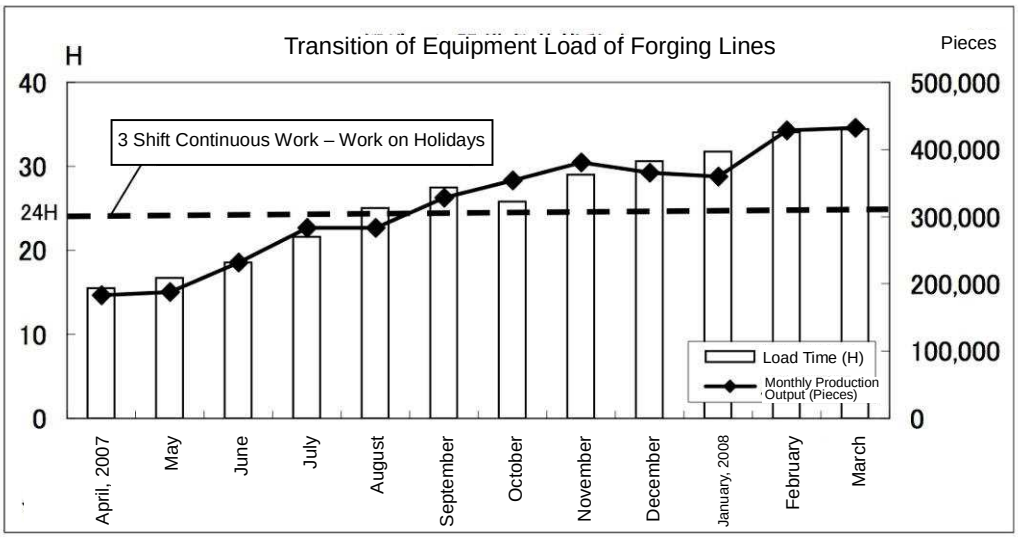


Table 2

(3) Target Settings

Business division, business plan policy: To achieve CO_2 reduction.

CO_2 reduction	0.47 kwh	⇒	0.33 kwh	(30% reduction)
Production output per hour	602 pieces/hour	⇒	783 pieces/hour	(30% increased)

(4) Problem Points and Improvement Proposal

Problems for the increase of production output per hour and CO_2 reduction

No	Type	Problems	Improvement Proposal	Validity of Effect		
				CO_2	Output	Electricity Cost
1	Machining Defect	Machining defects are many. (Profile too thin, bad appearance)	To improve the die material and lubricant by reviewing the forging conditions and machining conditions so that the product profile does not become too thin.	◎	◎	◎
2	Die Life Cycle	The surface of the die is worn.	To make optimal dies by reviewing the operational conditions. To put priority on the toughness instead of on the surface hardness. Not to do the surface treatment.	○	○	◎
3	Energy Loss	The heating furnace and the material do not match.	To use material which matches with the heating furnace. To make the heating furnace smaller according to the material diameter.	◎	—	◎
4	Operation Rate	The continuous forging is frequently stopped.	The cause is the falling of the product at the press feeder. So prevent the product from falling.	○	◎	○
5	Heat Efficiency	The product temperature comes down before the product enters the normalizing furnace.	To change the press outlet and the inlet shoot of the normalizing furnace and put the product in the furnace before the temperature comes down.	◎	○	◎

Table 3

◎：Very Effective
○：Effective

(5) Contents of Improvement

1) Improvement of inferior machining (Review of forging and machining conditions)

By repeating the continuous machining trials with the die material and machining conditions, we could set the optimal conditions.
Result: The machining defects became decreased.

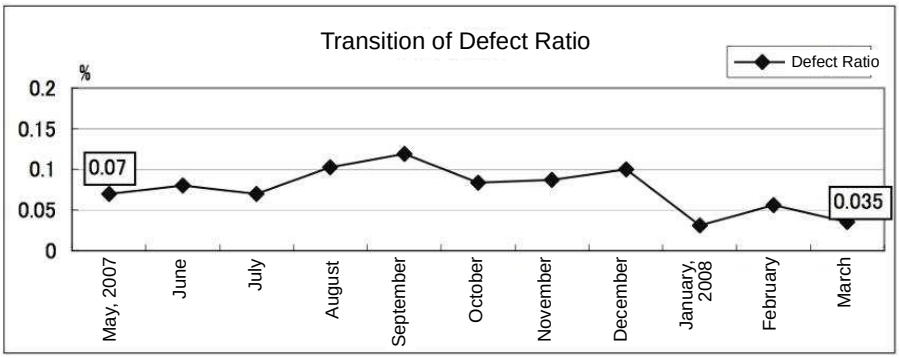


Table 4

2) Improvement of die's service life

We had been doing the forging processing by continuous processing, but it used to cause the die to break and worsen the service life of the die, leading to the frequent change of the dies. So we analyzed the cause of the die damage and changed our priority from hardness to toughness.

Result: We had been making the hardness by doing surface treatment, but we stopped doing it. As a result, there is no die damage.

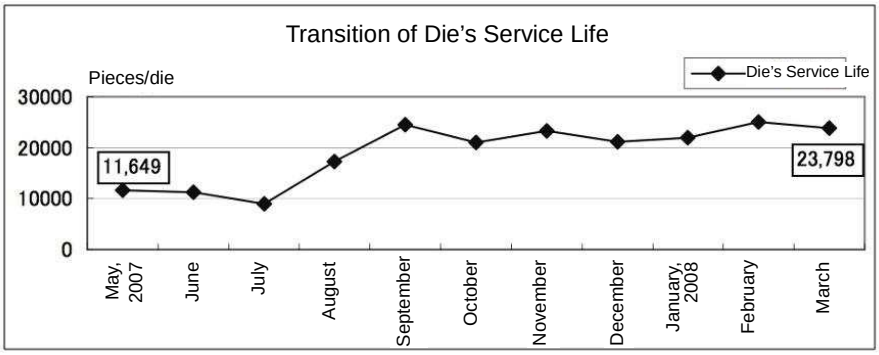


Table 5

3) Improvement of energy efficiency

The setting of the material's diameter and the heating furnace's diameter had been wrong so the energy efficiency had been lowered.

(1) The big difference between the induction heating furnace's inner diameter and the material's diameter had been leading to energy loss. The energy efficiency of the induction heating used to change in proportion to the distance.

(2) We reviewed the specifications of the equipment and the distribution of the material's diameter.

Before Improvement

Heating Furnace Diameter	Material Diameter		
	ϕ28	ϕ34	ϕ44
ϕ44◎	◆	◎	◎
	◆	◎	◎
	◆	◎	◎
ϕ30○	◆	◎	◎
	◆	◎	◎
	◆	◎	◎

Table 6

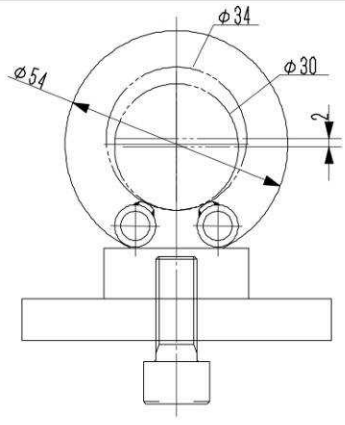
After Improvement

Heating Furnace Diameter	Material Diameter		
	ϕ28	ϕ34	ϕ44
ϕ44◎	◆	◎	◎
	◆	◎	◎
	◆	◎	◎
ϕ30○	◆	◆	◎
	◆	◆	◎
	◆	◆	◎

Table 7

Result: We could maintain the heating efficiency by changing the furnace's diameter from Φ44 to Φ30.

If the coil's inner diameter is closer to the billet's outer diameter, the heating efficiency becomes better. ----- Base



"For Φ30" means that if Φ30 billet is put through, the center comes to the coil's center.

The electricity amount of Φ34 steel material was measured by the difference of the coil's inner diameters.

Heating Conditions and Electricity Amount

	For Coil Φ44	For Coil Φ30
Heating Voltage	590V	481V
Feeding Speed	13.3mm/s	13.3mm/s
Electricity Amount	126kw	117kw
		Energy Saving 7.1%

Table 8

If the distance is up to around +10mm against the applicable diameter of the heating furnace, the material goes through the furnace and is sufficiently heated.

Fig. 6

4) Improvement of operation rate

The pusher used to stop frequently when going from the heating furnace's exit to the press's entrance.

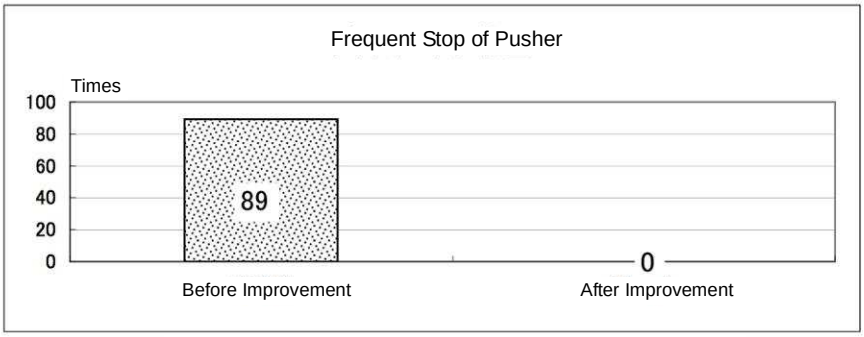
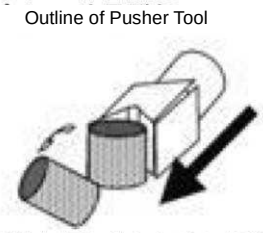


Table 9

Result: By changing the shape of the pusher tool, the pusher was made not to stop.



The material fell when it was pushed out.

Fig. 7

By making the shape of the pusher cylindrical, the material was made not to fall.

Fig. 8

5) Heating efficiency

After hot forging, the product used to travel a long distance to enter the normalizing furnace, using extra heating electricity.

Result: By extending the press's exit and the shoot of the normalizing furnace, it became possible to put the product in the normalizing furnace before its temperature comes down.

Before Improvement

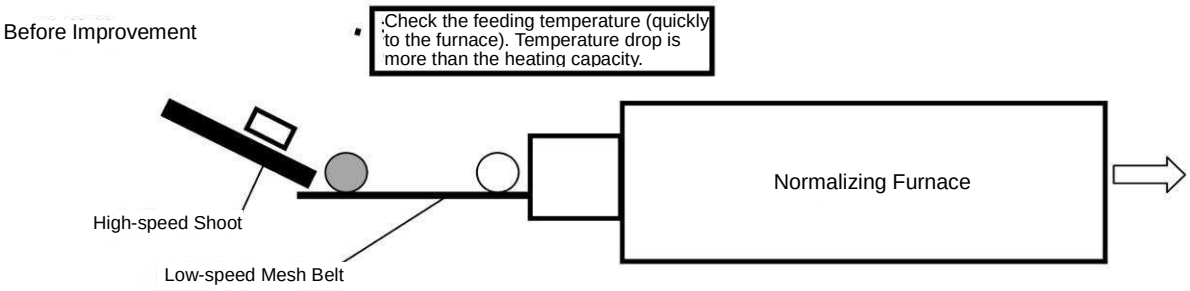


Fig. 9

Result of Radiation Temperature Measurement

Measurement Location	Temperature (℃)
●	760
○	560

Heating Temperature Drop
Heating Loss

*The temperature drops after the product falls onto the mesh belt and before it enters the normalizing furnace.
*After the product enters the furnace it is heated again and this is to create the heating loss.

Table 10

After Improvement

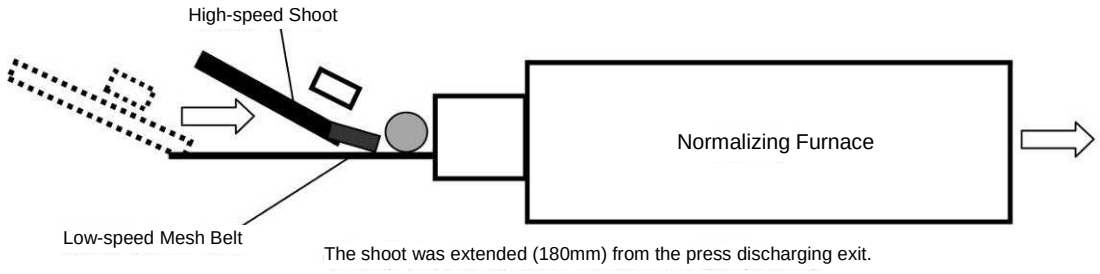


Fig. 10

(6) Effects Achieved after Improvement

Verification of the effect achieved after implementing each measure (CO_2 reduction, production output per hour, electricity amount)

1) CO_2 graph

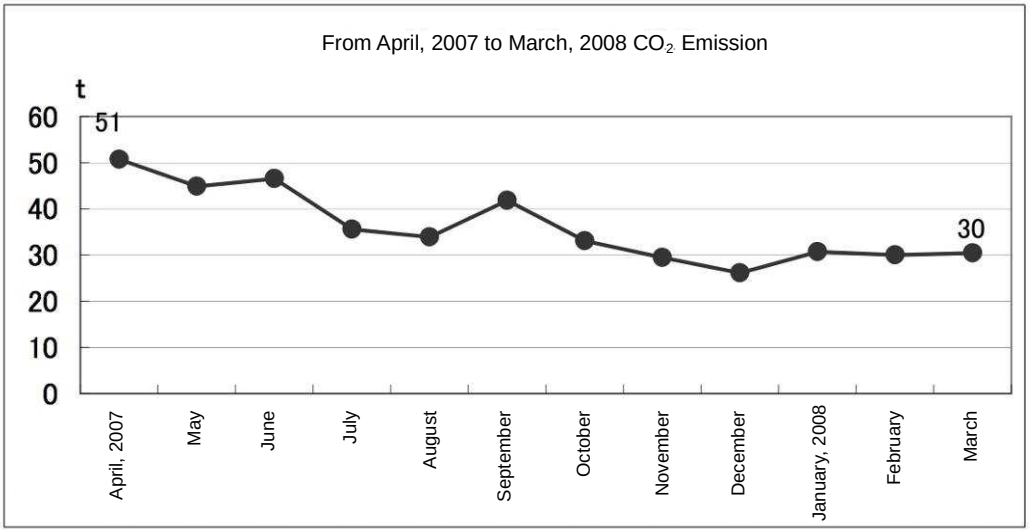


Table 11

2) Production output per hour

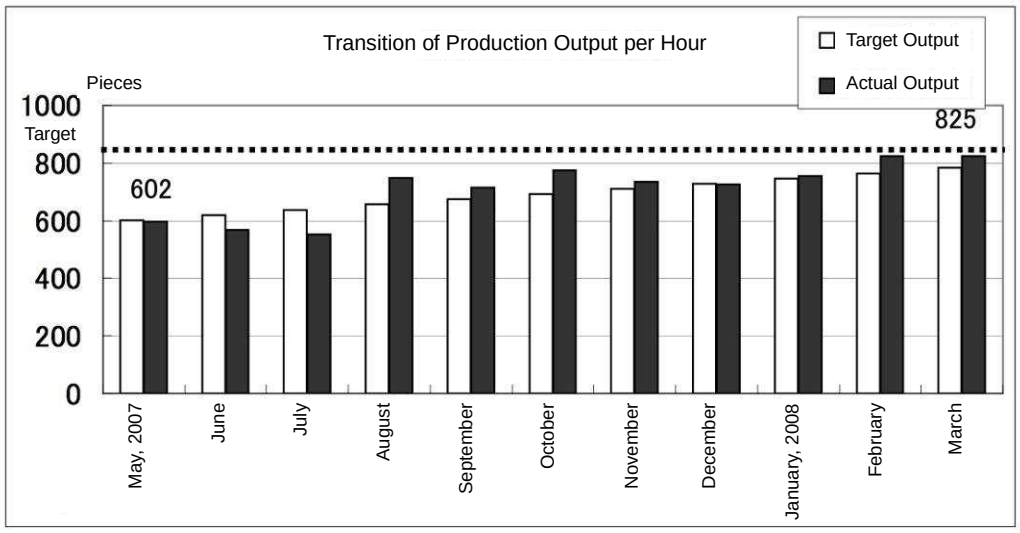


Table 12

3) Electricity amount graph

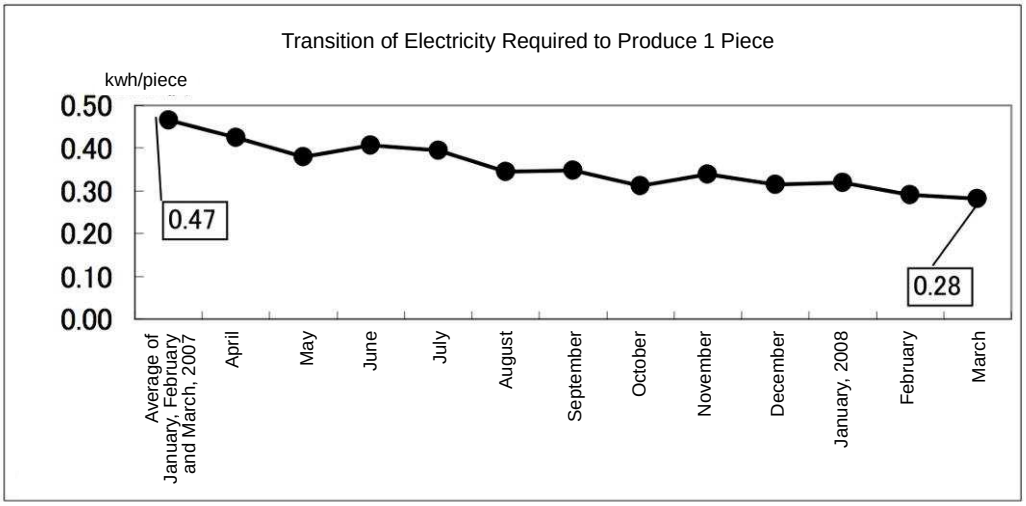


Table 13

Results of the foregoing measures

【Summary of effects of hot forging line】

Items		Before Improvement	After Improvement	Effect
Production Output per Hour		602 pieces	825 pieces	223 pieces (37%)
Electricity per Piece		0.47 kwh/piece	0.28 kwh/piece	0.19 kwh/piece (40%)
Hot Forging Line	Electricity Amount	772,615 kwh	463,569 kwh	309,046 kwh (year)
	CO_2	292 t	175 t	117 t (40%)

Table 14

3. Summary

We achieved the target, i.e. to improve the production output per hour, and, at the same time, we reduced the energy loss. As a result, we could greatly reduce the CO_2 emission. Especially, the CO_2 reduction was notable and it encouraged us to continue the activities. The improvement we made this time can be horizontally deployed to other lines, so we will continue to improve more.

4. Future Plans

We will apply the improvement we made this time as a model line to other forging lines in fiscal year 2008.

We will further reduce the CO_2 emission by improving the production output and reducing the energy loss.