2007 Prize of the Chairman of ECCJ

Send Back Strategy from Type 2 Designated Energy Management Factory

Asahi Sangyo Co., Ltd., STEP-1 Promotion Room
Energy Conservation Project Team

◎ **Keywords: Rationalization of Conversion of Electricity to Power and Heat, etc. (Electric power application equipment, electric heating equipment, etc.)**

◎ Outline of Theme

Our company has implemented energy conservation activities mainly for the compressors since fiscal year 2004. When we started the activities, the electric power used by the compressors used to account for approximately 39% of the total electric power consumption. It accounts for 30% now and we could reduce the power contract from 1,390 kW to 1,240 kW. As a result, our company could be excluded from a type 2 designated energy management factory. Our energy conservation activities reducing a great deal of electricity were so successful that we would like to present the improvement we made.

◎ Implementation Period for the Said Example

Primary Improvement: Total change of air piping, introduction of inverter system for rolling machines.

- Project Planning Period — April 2004 – July 2004 — Total 4 months
- Measures Implementation Period — Aug. 2004 – Aug. 2005 — Total 13 months
- Measures Effect Verification Period — Sept. 2005 – Nov. 2005 — Total 3 months

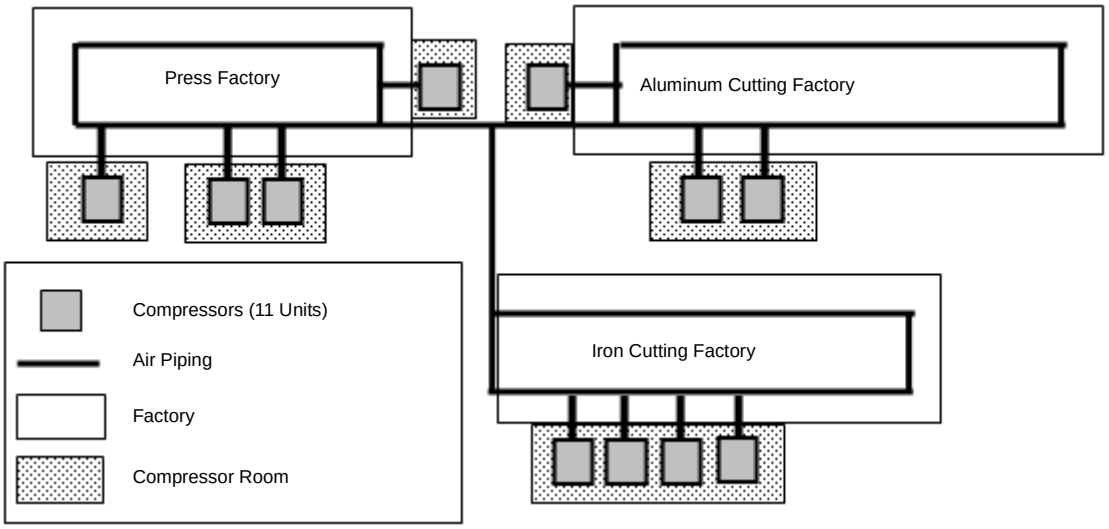
Secondary Improvement: Manufacturing of high-efficiency nozzles and gravity stockers, stop of air supply when equipment is not used.

- Project Planning Period — January 2006 – March 2006 — Total 3 months
- Measures Implementation Period — April 2006 – January 2007 — Total 10 months
- Measures Effect Verification Period — February 2007 – March 2007 — Total 2 months

◎ Outline of the Business Establishment

- Items Produced　Parts for car air conditioners
- No. of Employees　88 (including 14 contract workers, as of April 1, 2007)
- Not designated as energy management factory Electric Power Consumption: 5,762,000 kWh　(Energy consumption in FY2006, crude oil equivalent　1,486 kl)

◎ Outline of Target Facilities (before improvement)



1. Reasons for Theme Selection

Our company added the number of equipment as the volume of our work increased since later part of 2003. As a result, the use of electric power greatly increased and the company was designated as type 2 energy management factory. It made us concerned about the situation, so we seriously started energy conservation activities. Almost 100% of the energy we use was electricity. Of it, the compressors accounted for 39% (actual of 2003), so we decided to focus the energy conservation activities on the compressors because we could expect a great deal of energy conservation by doing so. (Fig. 1)

2. Understanding and Analysis of Current Situation

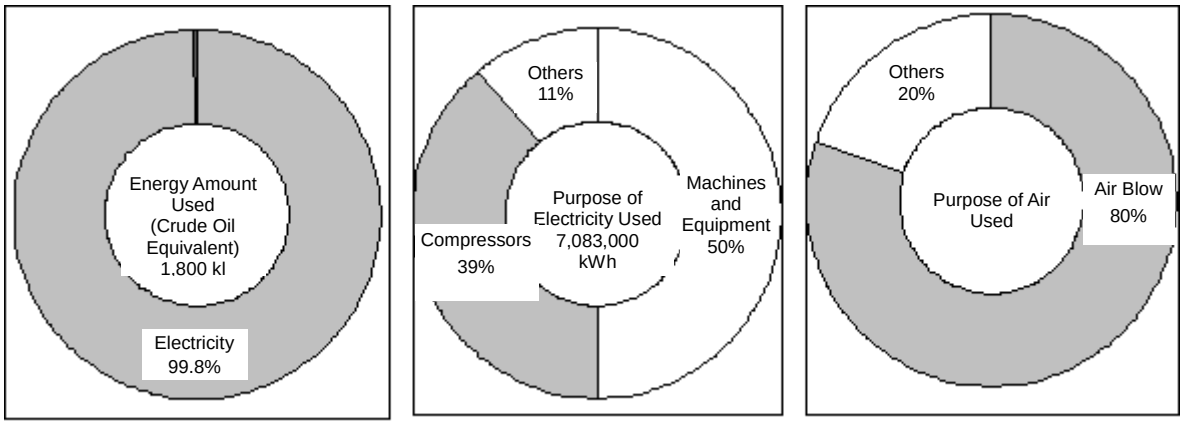


Fig. 1 Energy Used by Our Company

There were 11 compressors in total, i.e. eight 37 kW units and three 22 kW units. 11 units were fully operated in daytime, but sometimes causing the equipment to stop due to the shortage of the air. So the improvement of the compressors was most important for the company in light of both energy conservation and productivity.

3. Progress of Activities

(1) Implementation Structure

We set up “the Energy Conservation Project” and started the activities to be promoted mainly by the STEP-1 promotion room supported by the engineers of the maintenance section and the managers of the production division.

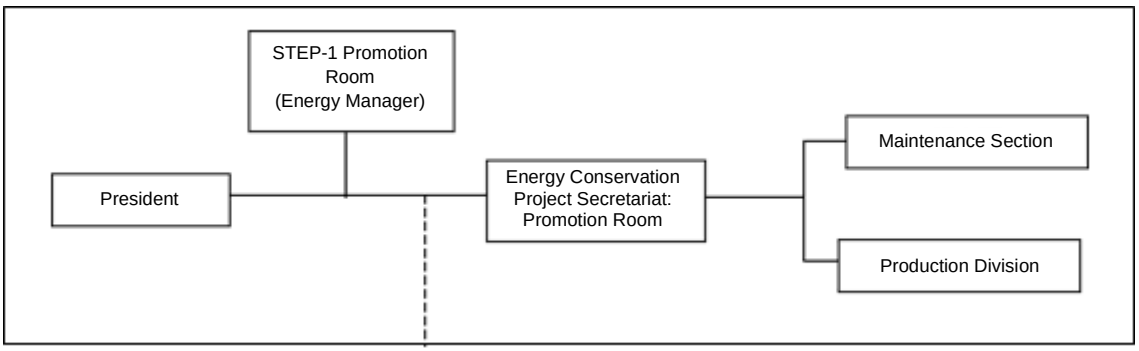


Fig. 2 Program Structure

(2) Target Settings

We set up our primary target aiming to reduce 15% of the total electric power consumption

used by the whole factory by reducing mainly the electric power used by the compressors. By doing so, we wanted to terminate the designation of our factory as type 2 energy management factory.

(3) Problem Points and their Investigation

1) Problem of air blow

The air blow accounted for approximately 80% of the compressed air used in the factory. It was a mass consumption process. (Fig. 1)

2) Problem of air supply line

The pressure loss was big because the diameters of the pipes were small and the piping was not constructed as a loop. Meanwhile, there was pulsation because the tank capacity was small, causing the system to stop.

3) Problem of compressor operation

The units were not controlled by group because they were dispersed. There were no stop valves for every line, so the air was being supplied even when the production equipment was not working.

4) Problem of conveyor operation

The stocker's motor and the air cylinder of the transfer machine were working for useless to the movement.

5) Problem of motor driving

The spindle motors (22 kW x 3 lines) were running when there is no processing works.

4. Details of Measures

Figure 3 shows the details of the measures and the transition of the electric power consumption.

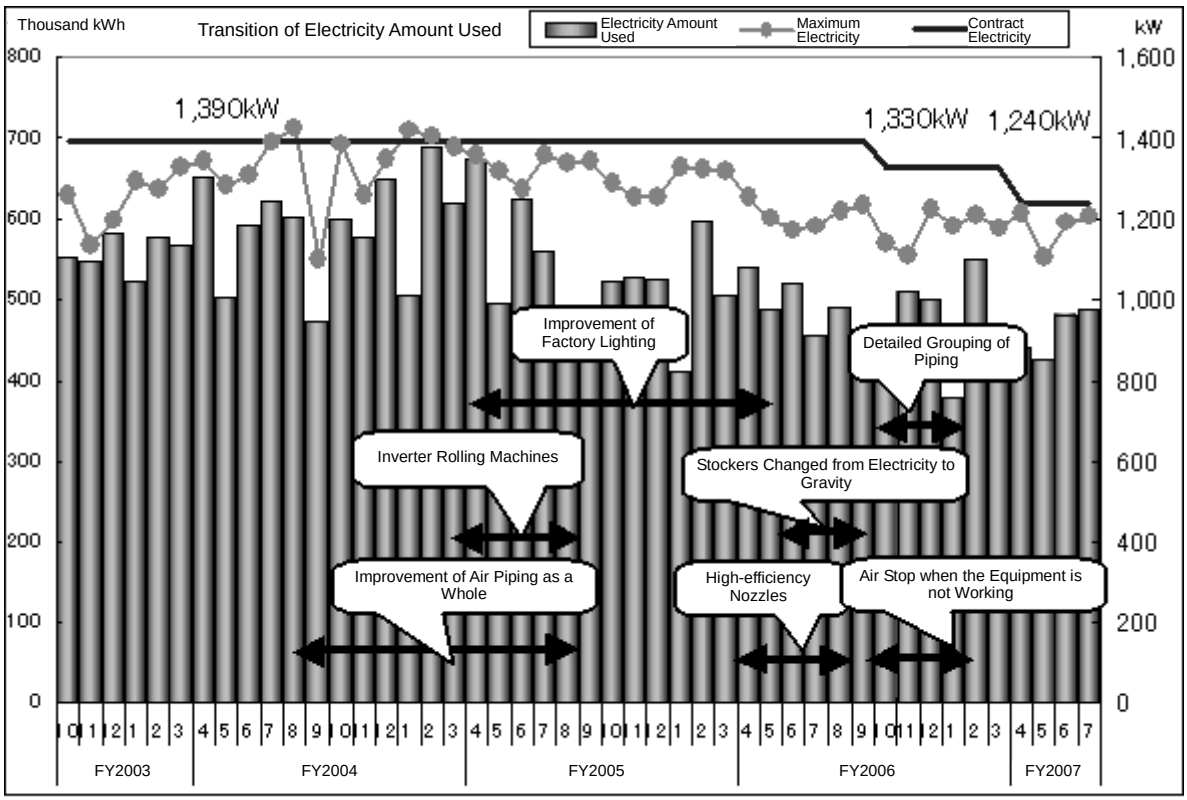


Fig. 8 Measures and Transition of Electric Power Consumption

(1) Improvement of Air Blow

For the air blow before the improvement (Fig. 5), the air was taken from the front of the regulator, so the air with the supply pressure (0.69 MPa) was supplied. And pipes which had been cut were used for the tips of the air blow as is, so the air might have been used in excess.

After hearing the opinions of professionals about these problems, we decided to use high-efficiency nozzles. By doing so, we selected the best ones after examining the following points and measuring the flow with a flow meter.

[1] Shape and diameter of the high-efficiency nozzle

[2] Optimization of the air pressure using the regulator

[3] Adjustment of the nozzle position

[4] Resetting of the blow time

[5] From bi-directional simultaneous blow to uni-directional alternate blow (Fig. 4)

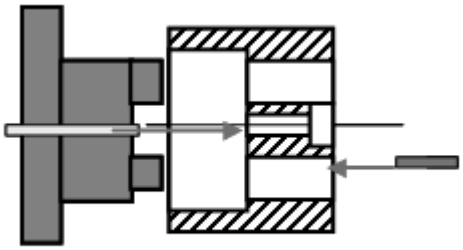


Fig. 4 Changing from Bi-direction to Alternate Blow

As shown in Fig. 6, we added one regulator for the air blow and changed the air blow in the factory to that of the high-efficiency nozzle.

We also installed an air gun behind the regulator and changed the nozzle to the high-efficiency nozzle. Table 1 shows the result.

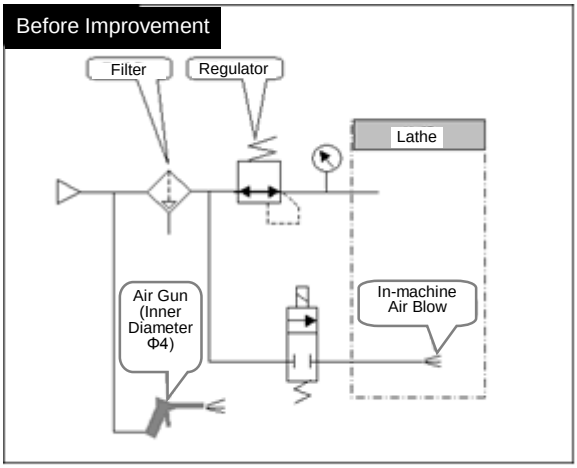


Fig. 5 Air Blow Piping Diagram before Improvement

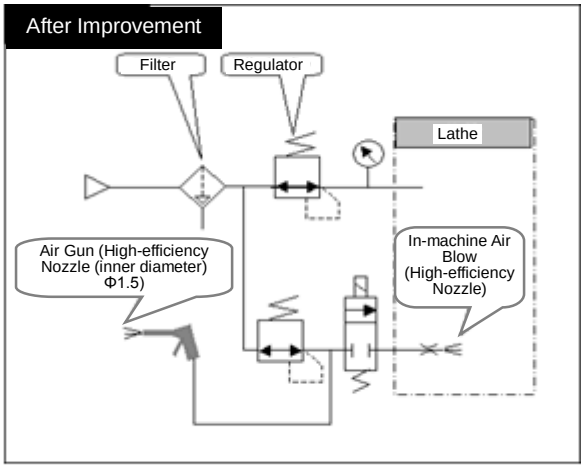


Fig. 6 Air Blow Piping Diagram after Improvement

Table 1 Air Amount Used per Product

No.	Nozzle Shape	Equipment Name	Before Improvement	Measure 1	Measure 2	Effect
1		Swing Detector (Rolling)	50 L/piece	15 L/piece	10 L/piece	80% Cut
				Nozzle Change Φ6 → Φ0.75 (4 Piece Pairs)	Regulator Fixing (0.69→0.3 MPa Setting)	
2		Lathe (Rolling)	24 L/piece	103 L/piece	63 L/piece	50% Cut
				Nozzle Change Φ8 → Φ2.5	Regulator Fixing (0.69→0.5 MPa Setting)	
3		Lathe (Ring)	125 L/piece	87 L/piece		30% Cut
				Nozzle Change Φ6 → Φ2.5 Regulator Fixing 0.69→0.4 MPa Setting		
4		Lathe (CB)	820 L/piece	430 L/piece		48% Cut
				Reference Level Cleaning Nozzle Φ8→Φ2 Tool Rest Nozzle Change Φ5→Φ2 Regulator Fixing 0.69→0.4 MPa Setting		
5		Lathe (CB)	683 L/piece	410 L/piece		25% Cut
				Reference Level Cleaning Nozzle Φ6→Φ4 Tool Rest Nozzle Change Φ6→Φ4 Regulator Fixing 0.69→0.5 MPa Setting		

The table.1 shows the comparison of the air amount used by typical equipment (lathes). As shown in this table, there was a great deal of energy conservation.

An example of the air amount used for one product and the monetary amount of the effect in case of No. 5 lathe (CB).
Air amount used for one product: 683 L (before improvement) → 410 L (after improvement)
Monetary amount of effect: Minus 130,000 yen/year (unit price of air: 2.0 yen/m^3)
Before improvement: 683 L x 240,000 pieces/year = 163,920 m^3
After improvement: 410 L x 240,000 pieces/year = 98,400 m^3 (Amount reduced in a year = 65,520 m^3)

We attached high-efficiency nozzles to all of the lathes, air guns and automatic detectors in the company.

(2) Improvement of Air Supply Line

We reviewed the route of the air piping and totally changed it based on our own design. The major change was that we changed the diameter of the main air pipe, which was then 50A, to 100A and we also changed the route going through the receiver tank and supplies air to the line. We increase the number of the receivers from 4 units to 13units (300 L to 1000 L) and changed the piping to a loop structure. As a result, the air capacity was saved, preventing the equipment from being stopped due to the shortage of the air capacity, so we could lower the source pressure of the compressor by 0.11 MPa.

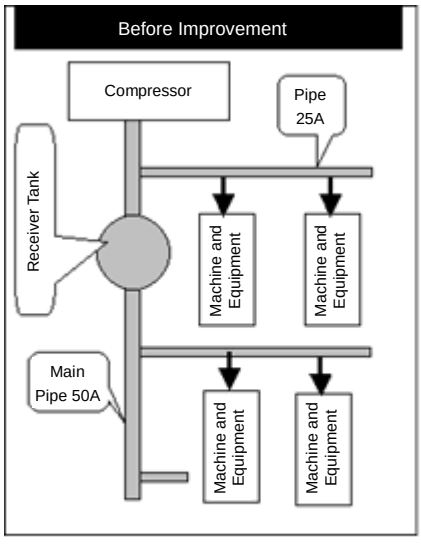


Fig. 7 Piping before Improvement

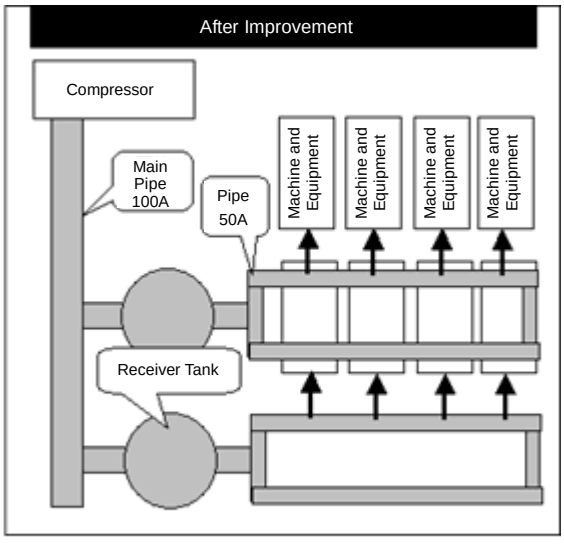


Fig. 8 Piping after Improvement

Table 2 Supply Pressure and Usable Pressure of Compressor before and after Improvement

	Before Improvement	After Improvement	Reduction of Setting Pressure Realized by Improvement
Unload	0.69MPa	0.58MPa	△0.11MPa
On-load	0.60MPa	0.50MPa	△0.10MPa
Inlet of Machine	(0.40MPa)	0.48MPa	(+0.08MPa)

Fig. 9 Receiver Tank

(3) Improvement of Compressor Operation

When changing the air piping, we also changed the layout of the compressors. We divided the air supply into 3 factories and installed the compressors and the electric valves for each system, so that each factory could operate independently. As a result, the air was no longer supplied to the factories which did not need the air at night or during holidays. Also, in order to prevent the air leakage from pneumatic devices of the equipment which were not working and to prevent the air from being consumed for nothing, we made it possible to stop the air on each line and on each machine using ball valves. By doing this, we made energy conservation.

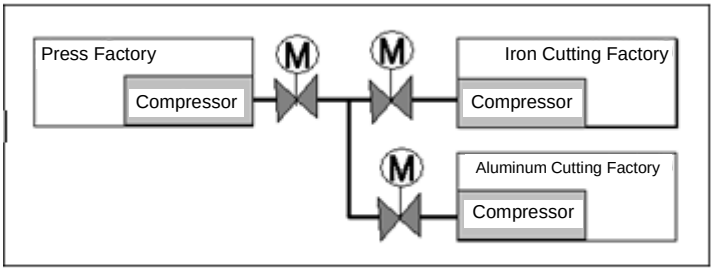


Fig. 10 Air Piping Schematic

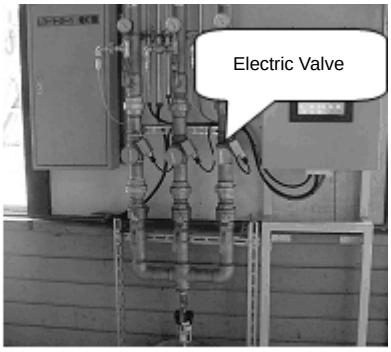


Fig. 11 Example of Electric Valve Used

Fig. 12 Stopping Air on Each Line

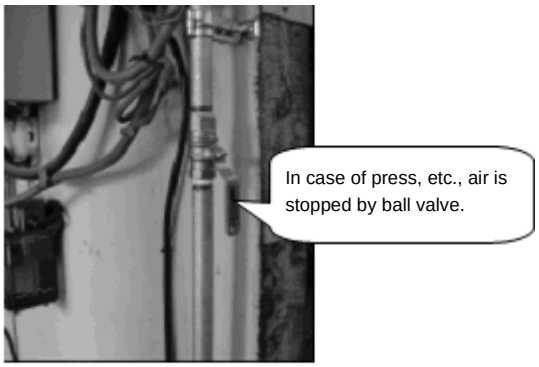


Fig. 13 Stopping Air on Each Machine (Press)

(4) Improvement of Conveyor Operation (Changing from electric system to using gravity system)

There were 2 lines in the transfer machine, and the stocker used to keep the 0.2 kW motor running even if there were no products during the line was running. Meanwhile, 60 air cylinders were used and there was leakage of air among them. So we changed the system to an energy conservation conveyor system which used only 10 air cylinders and reduced the consumption of electricity. It was the slide system stocker using gravity as shown in Fig. 15. Thanks to this improvement, the trouble of the conveyor was eliminated, the line became compact and the productivity was enhanced because the operational work was eased.

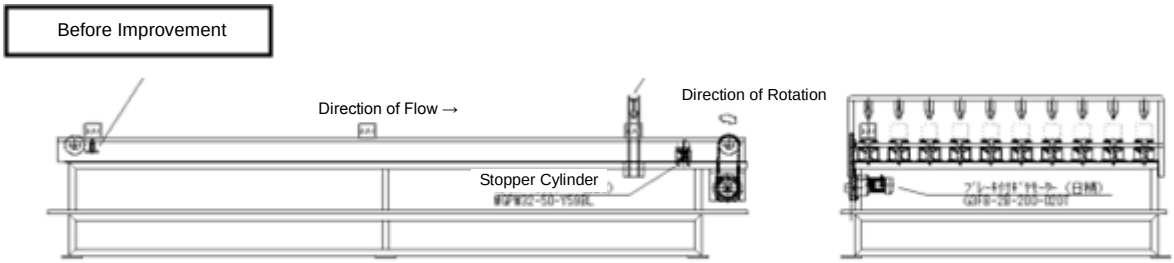


Fig. 14 Stocker before Improvement (Conveyor)

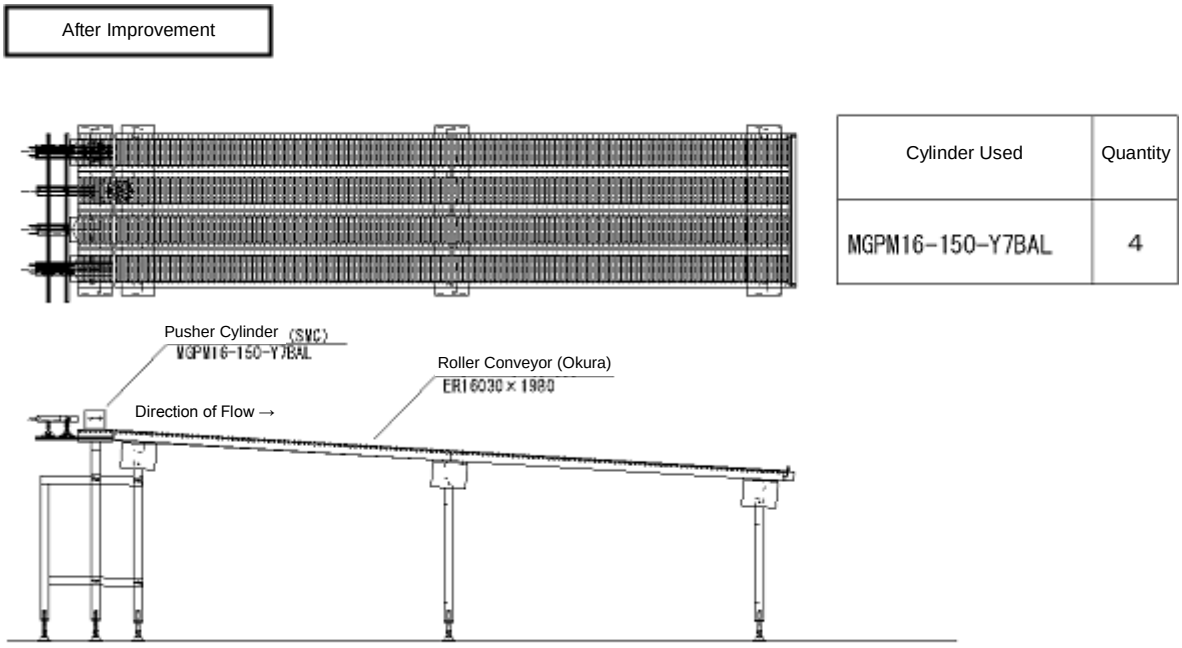


Fig. 15 Stocker after improvement (Conveyor)

Two 200V・0.2 kW motors were removed (1 motor/line x 2 lines): Total 2 motors were eliminated.

60 cylinders (30 cylinders/line) were lessened to 10 cylinders (4, 6 cylinders/line): Total 50 cylinders were eliminated.

(5) Improvement of Motor Driving (Inverter system for rolling machines)

While 1 cycle of the rolling machine was 53.2 seconds and the machining cycle time was 27.2 seconds, the spindle motor used to keep running. When it was turned ON by the electro-magnetic clutch, it started machining and when it was turned OFF, the spindle motor (22 kw x 3 lines) started idling, i.e. the spindle motor was idling for almost 50% of the time. This means when the system was operated for 8 hours, the 22 kw spindle motor was idling for 4 hours.

After the improvement, by introducing the inverter, it became possible to run the spindle motor only when machining was necessary, realizing 13% energy conservation in the entire line.

Table 3 Analysis of Rolling Machine Operation

Operation Time		Time	10	20	30	40	50	60
Before Improvement	Cycle Time	53.2 Seconds						
	Spindle Revolving Time	27.2 Seconds						
	Spindle Motor Revolving Time	Continuous Operation						
After Improvement	Cycle Time	53.2 Seconds						
	Spindle Revolving Time	27.2 Seconds						
	Spindle Motor Revolving Time	27.2 Seconds	Reduction of Operation Time by 49%					

5. Effects achieved after Implementing Measures

(1) When we started our activities in FY2004, we had used the electricity as much as 7,083,000 kWh a year, but it was reduced to 5,762,000 kWh in FY2006 (minus 19%). The contract electricity was reduced from 1,390 kW in FY2004 to 1,240 kW in FY2006 (minus 150 kW) thanks to the demand control.

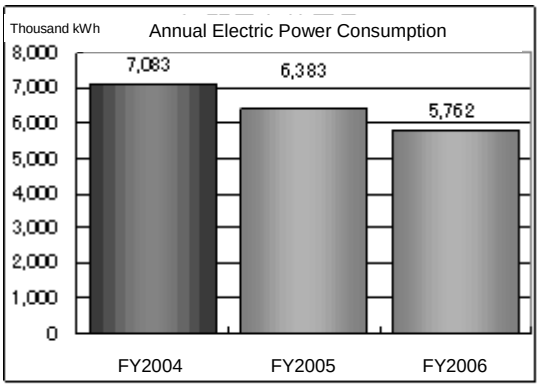


Fig. 16 Transition of Annual Electric Power Consumption

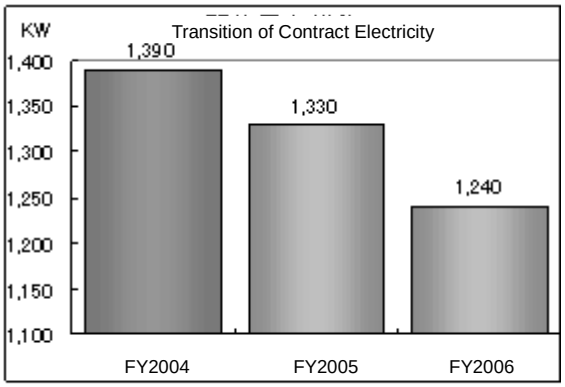


Fig. 17 Transition of Contract Electricity and Maximum Electricity

(2) The ratio of the electricity used by compressors against the total electricity was decreased from 39% in FY2004 to 29% in FY2006. Similarly, the ratio of the compressor's operating time was improved by 29%. (Fig. 18)

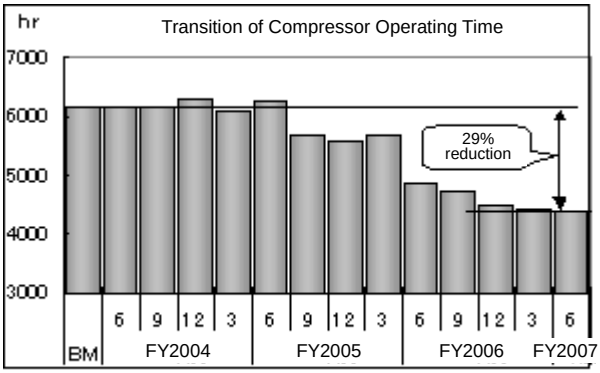


Fig. 18 Transition of Compressor Operating Time

(3) Monetary amount of direct energy conservation effect: 8 million yen/year (Investment recovery years: Approx. 8 months)

Table 4 Monetary Amount of Effect and Investment Amount

No.	Items Improved	Monetary Amount of Effect (10 thousand yen/year)	Investment Amount (10 thousand yen/year)	Recovery Years
①	Reduction of Air Blow, Pressure	470	30	0.8
②	Air Supply Line		350	
③	Compressor Operation			
④	Conveyor	3	120	——
⑤	Motor Driving	70	120	1.7
⑥	Reduction of Contract Electricity	265	0	0
	Total	808	620	0.8

6. Summary

Owing to the improvements mentioned above, the ratio of the electricity used by the compressors in the total electricity which had been 39% was reduced to 29% and the number of the compressors was reduced from 11 units to 9 units. The electric power consumption was reduced from 7,083,000 kWh in FY2004 to 5,760,000 kWh in FY2006 (minus 19%). Thus our company was exempted from type 2 designated energy management factory. Of the improvements we made this time, the improvement by means of high-efficiency nozzles resulted in the energy conservation which was greater than our expectation without making us invest much. We are confident that this improvement is applicable in many cases. In doing these improvements, we had opportunities to conduct the energy conservation activities with people working in other workplaces and we had pleasure to do so.

7. Future Plans

We will implement the quantitative control for the compressors and optimize the setting pressure for each factory. We will also introduce the inverter system to other equipments to further promote the energy conservation.