2007 Prize of Director General of Regional Bureau of Economy, Trade and Industry

Energy Intensity 5% Reduction for Continuous 2 Years! Activities of Technology Div. in 2 Years after its Start

Japan Tobacco Inc.
Kyushu Factory, Technology Division

◎ **Key Words: Rationalization of heating, cooling and heat transfer (Electric power application facilities)**
Rationalization of conversion of electricity to power , heat, etc. (Air conditioners)

◎ Outline of Theme

The Technology Division started 2 years ago when our organization was reformed. The mission of the Technology Division was to reduce the production cost by the management of the facilities and the environment.

This factory had introduced energy conservation systems from the beginning when it started operation in 1986 to reduce the initial and running cost. This factory had been recognized as a top energy conservation factory in JT organization, and as an opportunity to be established the Technology Division, we have continued the activities to further reduce the production cost.

There are energy conservation methods such as (1) improvement of the facilities and (2) improvement of the operation in general. In addition to those already existing methods, we tried to change the number of revolution of the fans and to visualize the operation of the air conditioners. By doing so, we could reduce the energy intensity by 5% for continuous 2 years. Here are the details.

◎ Implementation period for the said Example

April, 2005 – March, 2007

- Planning period April, 2005 – December, 2006, Total 21 months
- Implementation period August 2005 – March, 2007, Total 20 months
- Effect verification period August, 2005 – March, 2007, Total 20 months

◎ Outline of the Business Establishment

Production items Cigarette tobacco

Employees 261 (As of April 1, 2007)

Type 1 designated energy management factory

◎ Process Flow of Target Facility

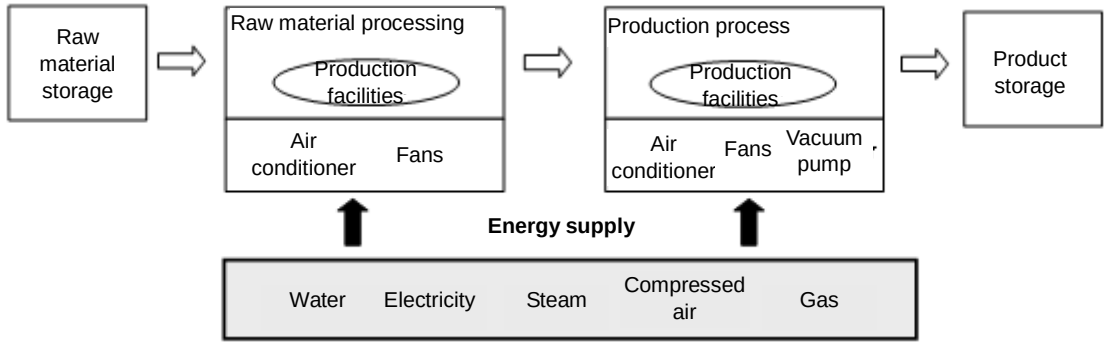

Fig. 1

1. Reasons for Theme Selection

This factory aimed to be an energy conservation factory from the beginning when it was built and adopted the variable pitch axial flow fans and the VAV system for the air conditioning and the outdoor air cooling by the outside and environment air enthalpy difference computing system for the control. Also new technologies such as waste heat recovery system and the medium water treatment system have been introduced.

Furthermore, we have tried to reduce the air conditioner power and to make the capacity of the vacuum pump smaller according to the change of the energy consumption. However, we have to continue the efforts not only to preserve the environment but also to further reduce the production cost to cope with the change of the operational environment such as social attitude toward tobacco and competition with foreign products.

The Technology Division will take measures as much as possible to improve the facilities and to change the operation by having everybody participate in the activities.

2. Understanding and Analysis of Current Situation

As shown in Fig. 2, the energy intensity of this factory in 2004 was as much as 10KL/100 million tobaccos less than the average of main 4 factories (including Kyushu), demonstrating that this factory was a top class energy conservation factory. The energy using in the Kyushu factory is only gas and electricity. We changed the heavy oil boilers to the gas fired small through flow boilers to greatly reduce CO_2 emission and get rid of chlorofluorocarbon. However, we need to further reduce the energy consumption.

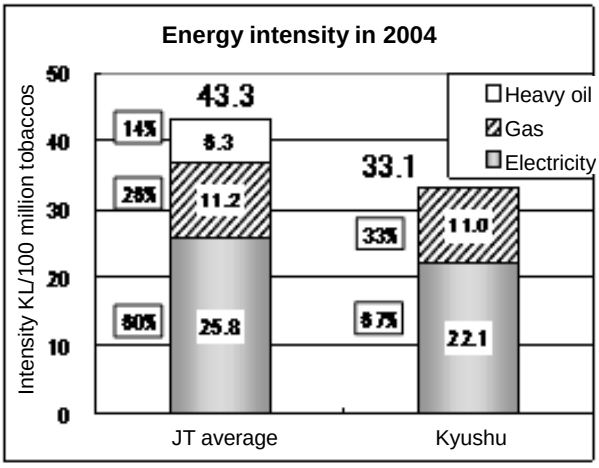

Figure-2

3. Progress of Activities

(1) Implementation Structure

The Technology Division controls the entire factory as secretariat of the environment management system.

Based on the idea that the energy conservation activity is part of the environment management system, it is controlled by the Global Environment Committee.

As the organization to take action, there is Facility Management Committee and energy managers are positioned there (Figure-3).

The activities presented here were proposed by the Technology Division and implemented jointly by the divisions concerned while reporting the progress to each Committee.

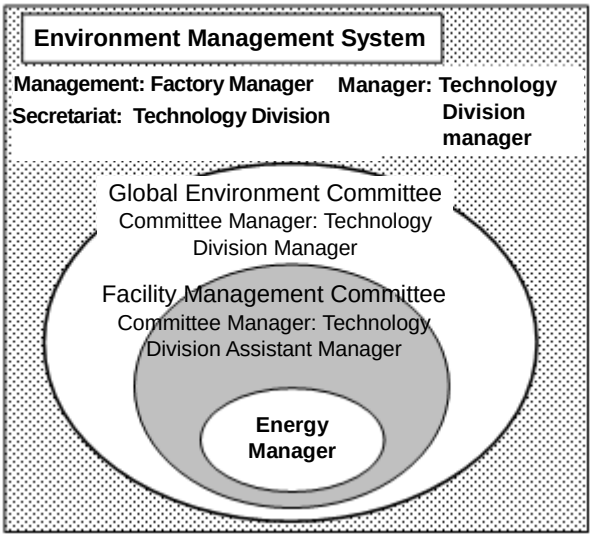

Fig. 3

(2) Target Settings

The Energy Intensity to be reduced by 1% from the previous year.

Main problems

[1] Facility improvement …

a) Change of the number of revolution of fans for dust removal and exhaust.

b) Cut of the number of fans by integrating the dust removal systems.

[2] Operation change …

c) Reduction of the steam consumption by visualizing the operation state of the air conditioners.

4. Details of Measures

4.1 Change of number of revolution of fans for dust removal and exhaust systems

4.1.1 Problem Points and their Investigation

In the raw material processing process, hoods are installed at the places where dust is likely to be generated such as the transit parts of the belt conveyors and the dust is sucked and removed by the fans. The fans also ventilate the rotor machines which spray steam or fragrance.

The raw material processing process operates continuously almost for 24 hours a day and the electricity consumed by the fans is much. So we studied if there is room for energy conservation.

Illustration of dust removal and exhaust

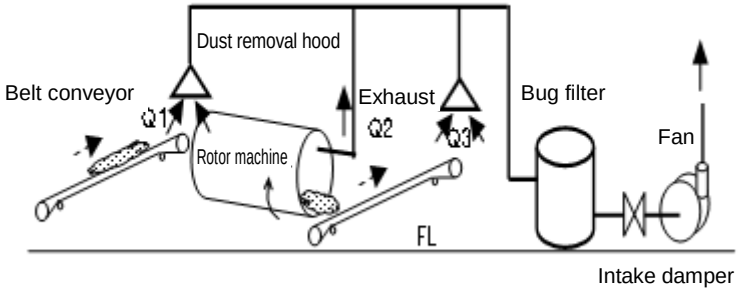

Fig. 4

[1] Study of the opening of fan's intake damper

As the result of the study, we found that a lot of dampers were being used with the opening of less than 50%. In other words, the air volume was adjusted by closing the damper so that the fans were being used with air volume which is less than designed volume. So the electricity consumption could have been reduced by reducing the number of revolution.

[2] Study of current air volume

We measured the air volume at hood's 203 places for 9 fans used in the raw material processing process, and we found that there were places where the air volume is too much.

[3] Study of necessary air volume and selection of machines

We re-calculated the necessary air volume assuming that the air volume of the hood connection duct is 5 to 10m^3/min at one place.

We set the air volume slightly more for the place where there was a lot of dust. We added 10m^3/min as surplus to the total air volume of each system and made it the necessary air volume for the fans.

Based on the above study, we chose 5 fans from 9 fans which may generate great effect by reducing the air volume.

Fan list Before improvement

System name	Air volume (m^3/min)	Number of revolution (rpm)	Shaft power (kw)	Estimated reduction (kw)
RMP dust removal No. 1 Motor 55 kw	440	2300	49	∆11
RMP dust removal No. 6 90kw	430	2560	67	∆15
RMP exhaust A 45kw	200	3100	29	∆5
RMP exhaust B 37kw	210	3680	29	∆5
RMP exhaust D 132kw	695	1750	103	∆20

RMP: raw material processing process

Table-1

4.1.2 Details of Measures

(1) Study of method for changing number of revolution

Generally, it is said that the energy conservation by changing the number of revolution is most effective. The methods for changing the number of revolution include (1) inverter control and (2) change of pulleys. Considering the fact that there were some fans using high voltage motors, the inverter method required a lot of investment cost and the fans were usually used with constant air volume, we decided to adopt the method that changes the pulleys.

(2) Change of pulleys

We changed the pulleys of 5 fans.

Table-2 shows the air volume, the number of revolution and the shaft power after changing the pulleys.

Note that in case of the fan of RMP exhaust D system, the shaft power was less than estimation compared with the drop of the air volume.

Fan list Before improvement

System name	Air volume (m^3/min)	Number of revolution (rpm)	Shaft power (kw)	Estimated reduction (kw)
RPM dust removal No. 1 Motor 55 kw	370	2060	35	∆14 (∆29%)
RPM dust removal No. 6 90kw	340	2310	52	∆15 (∆22%)
RPM exhaust A 45kw	150	2610	25	∆4 (∆14%)
RPM exhaust B 37kw	145	3330	23.5	∆8 (∆19%)
RPM exhaust D 132kw	490	1660	9.6	∆7 (∆7%)

Table-2

4.1.3 Effects achieved after Implementing Measures

Table-3 shows the effect of the change of the fan pulleys. Although the pay back time became longer than 3.3 year as planned originally, the electricity was reduced by 16% from the state before the measures were taken.

Reduction of electricity kwh/year	Reduction of electricity cost Thousand yen/year	Pay back time years
260,000	*1 1,351	4.1

*1 The reduction amount was calculated with only the unit price of electricity.

Table-3

4.2 Reduction of number of fans by integrating dust removal systems

4.2.1 Problem Points and their Investigation

When we planned the integration of the outgoing lines of crushing silo, we sorted out the dust removal ducts in correspondence to the removal of the belt conveyors. As the dust removal had been done by 2 systems with 2 fans, we thought that energy conservation would be able to promot if we could stop one fan after reviewing the air volume. To be more specific, we studied the following points.

(1) To review the current air volume by finding the places where air volume is too much.

(2) At the places where dust is little, we dare to stop the dust removal.

As the result, the reduction of the air volume was estimated to be 360m^3/min, making it possible to stop the fan of No.8 system the motor capacity of which was 45kw.

4.2.2 Details of Measures

As Fig.5 shows, the ducts which became unnecessary were removed, No. 8 system duct was integrated into No.4 system and No. 8 fan was stopped.

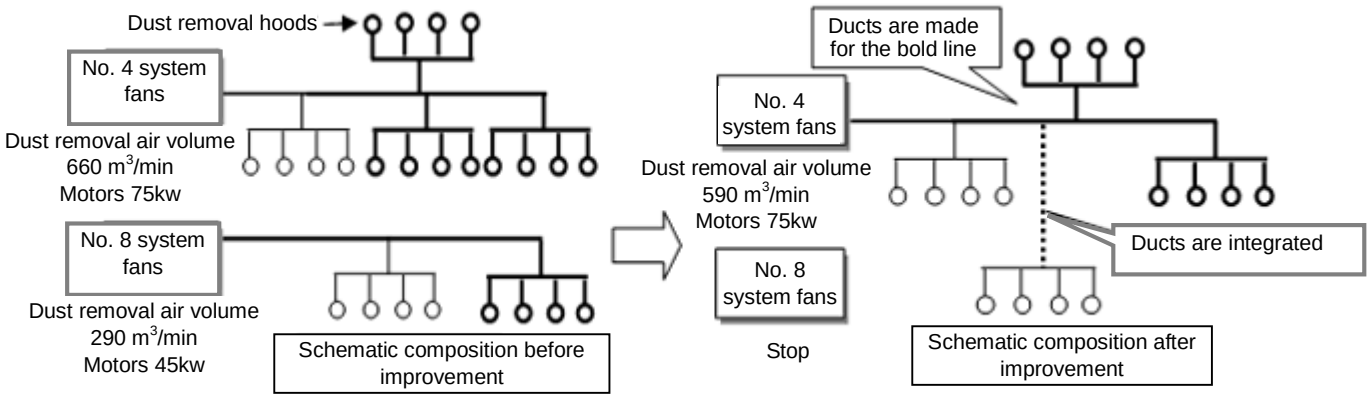

Figure-5

4.2.3 Effects achieved after Implementing Measures

Table4 shows the effect of stopping No. 8 system fan.

The outgoing lines of crushing silo were integrated in order to simplify the facilities and reduce the powder dust and, by doing so, the cost of cleaning and maintenance work was reduced and the quality of the product was improved. In addition to these effects, it resulted in the reduction of the running cost by stopping the fans.

Reduction of electricity kwh/year	Reduction of electricity cost Thousand yen/year	Pay back time years
223,000	*1 1,160	3.4

*1 The reduction amount was calculated with only the unit price of electricity.

Table.4

4.3 Reduction of steam consumption by visualizing the operation state of air conditioners

4.3.1 Problem Points and their Investigation

The air conditioners were controlled by DDC from the beginning of operation, but the only way to confirm the operation state was to watch the data of the air conditioning controller at the work site. So the air conditioning monitoring board was introduced in May, 2004 for central management of the operation of each air conditioner to easily analyze and to improve the use of energy. For 1 year after its introduction, we would mainly confirm the operation state and collect data, but after that, we gradually started to focus on finding

wasteful use of energy. The steam had been used for the heating and humidification in the winter. As the result of our study of past data, we realized that the steam valves had been opened and closed very frequently.

[1] When starting air conditioners in the winter, even if the room temperature is higher than set temperature, the heating valve is kept open for about 1 hour

2 units of air conditioners in the product system (AC4,AC5) operate from 5:09 a.m. to 9:44 p.m.

The heating valve is controlled by the set value of the air supply temperature within the range from 18°C to 40°C in correspondence to the difference between the room temperature and set value. As the result of the study, we found that, because the air supply temperature was set at 40°C, the control started from 40°C when the air conditioning were started and the heating valve was kept open.

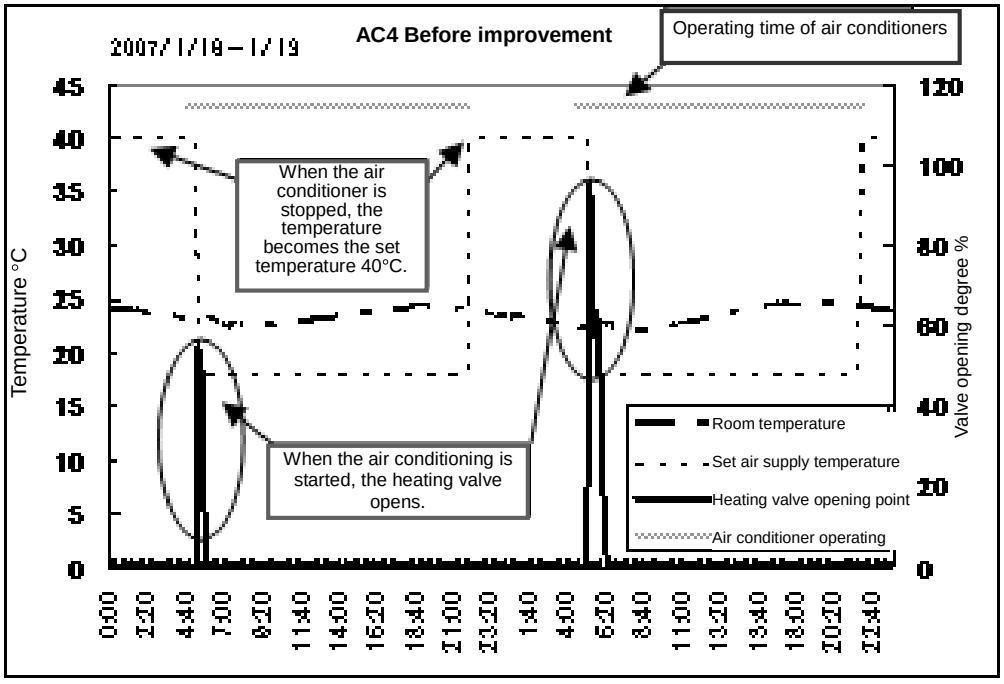

Fig. 6

[2] Washer's heating valve for humidification repeats opening and closing at 0 – 100%

The humidification is done by spraying the hot water generated by the inline mixer in the washer room. About 7 air conditioners used in the raw material processing process and the product process, it was noted that the washer pump (*1) and the washer heating valve (*2) frequently repeated the ON and OFF.

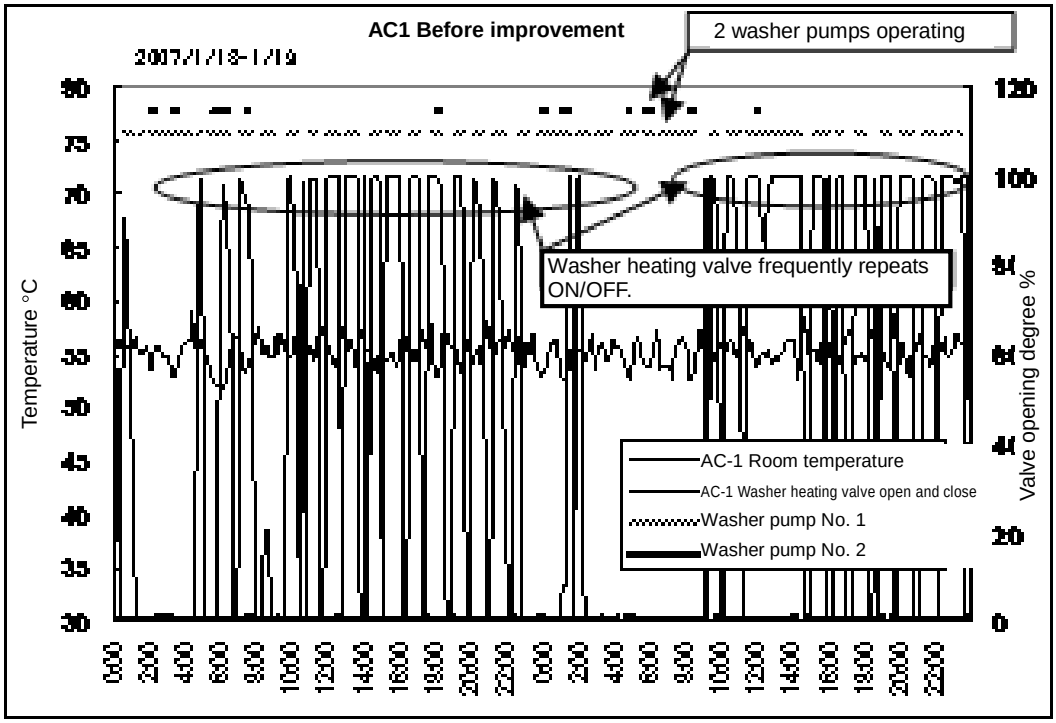

Figure-7

As the result of our study, we found that, although the control of the washer heating valve was 0% when the washer pump was stopped, it could be opened 100% when the pump was started because the calculation of the dew point temperature of supplied air was continued. As the result, it was thought that the room humidity became unstable and it makes the pump start and stop frequently.

(*1)Washer pump control:

ON/OFF control with the room humidity and the setting of humidity.

(*2)Washer heating valve :

While changing the dew point temperature of supplying air with the room humidity and the setting of humidity, proportional control by the dew point temperature of supplying air is done.

4.3.2 Details of Measures

[1] Operation of steam valve for heating

By setting the air supply temperature after stopping the air conditioner at 18°C, the software was changed to start the control from the 18°C setting when the air conditioner is started.

[2] Operation of washer heating valve

The software was changed so that the calculation of the air supply dew point temperature is stopped when the washer pump is stopped and, when the pump is restarted, the calculation of the washer heating valve starts from 0%.

4.3.3 Effects achieved after Implementing Measures

[1] Operation of steam valve for heating

As the result of changing the control, the operation of the heating valve was stabilized when the air conditioner starts, as Figure-8 shows, it no longer opened 100%.

AC5 air conditioner showed similar result.

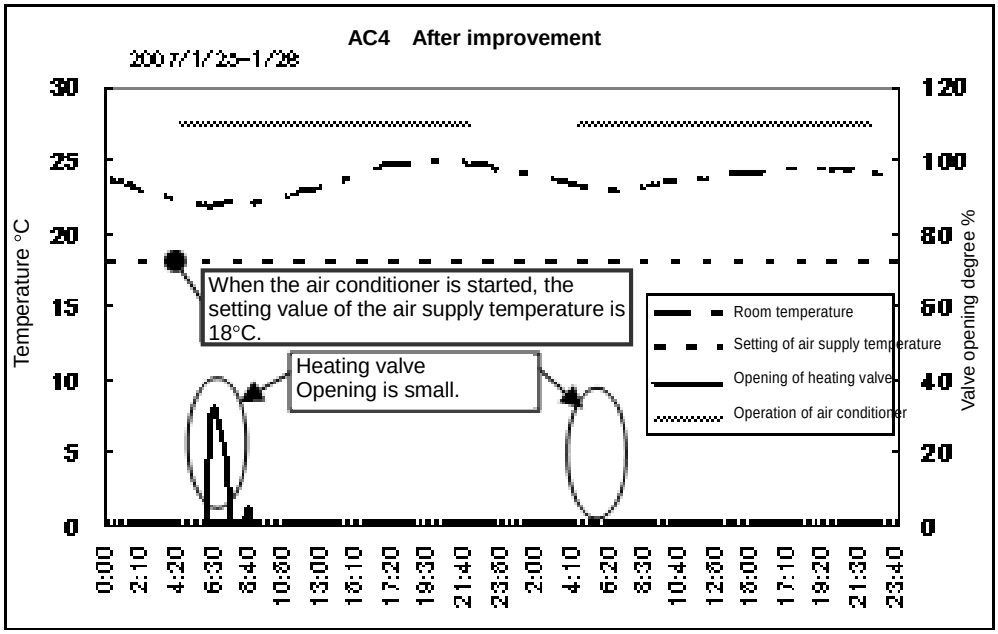

Fig.8

[2] Operation of washer heating valve

As shown in Fig. 9, the number of ON/OFF of the washer pump became less and the operation of the washer heating valve was stabilized.

Similar result was obtained from other air conditioners too.

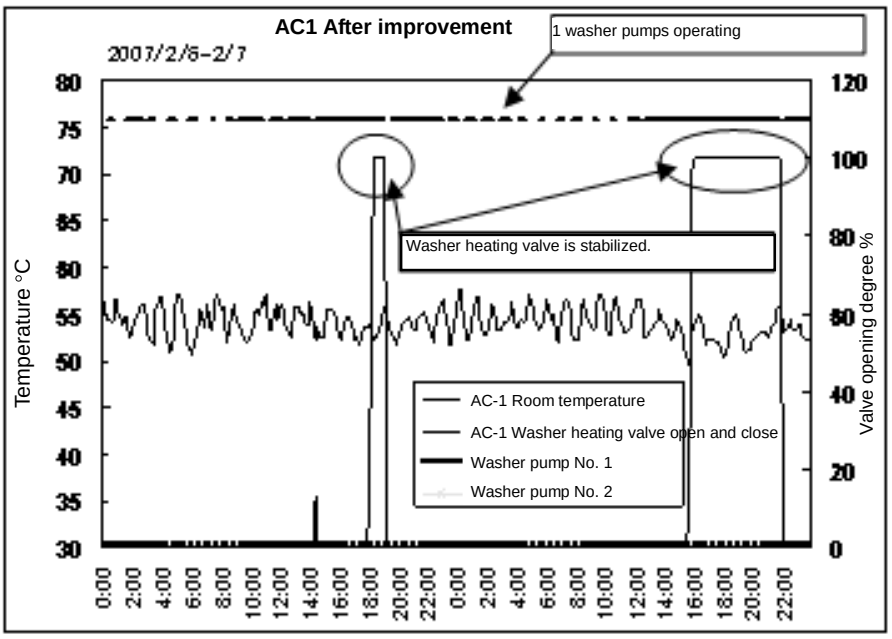

Figure-9

[3] Steam and gas as boiler fuel

Reduction of steam consumption.

As the result of the measures, the steam consumption by air conditioners was reduced by 31% to 68% compared with that in the previous year.

As the steam is generated by the gas fired once-through boiler, the gas intensity was greatly reduced, as shown in Fig.10.

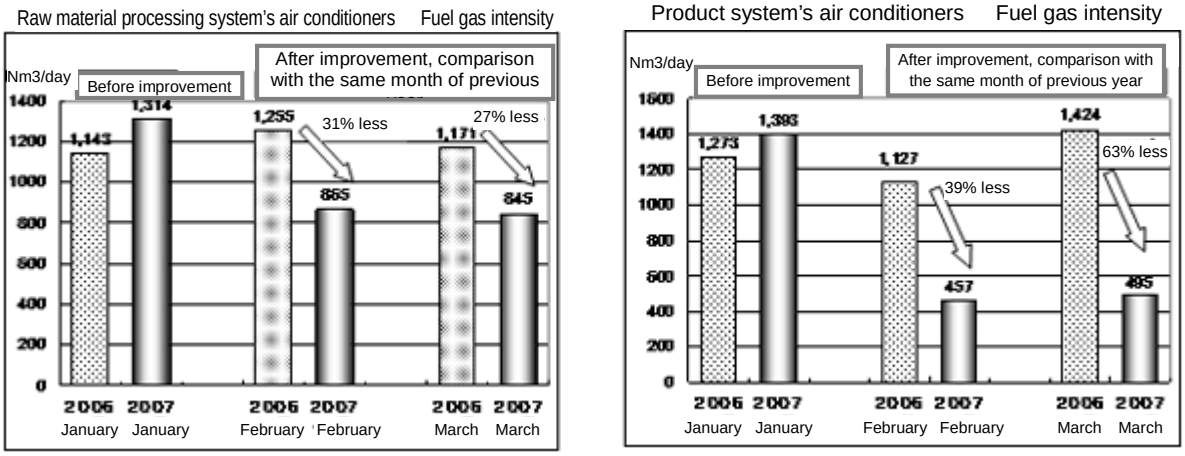

Fig. 10

[4] Reduce of the gas charge of air conditioning system

Thanks to the reduction of the gas intensity, the gas charge was reduced as shown by Table-5.

Gas charge of Air conditioning system Comparison with previous year Unit: One thousand yen

February, 2006	2,233	March, 2006	2,689
February, 2007	1,427	March, 2007	1,424
Amount cut	806	Amount cut	1,265

Table-5

[5] Effect of visualization

By expressing the operation data with graphs, the tendency of the facilities was understood time-sequentially and problems of the control which we had not known till then were clarified and improvement was made for them.

4.4 Other implementation

4.4.1 Reduction of number of vacuum pumps

2 air cooling 75kw vacuum pumps were being operated for the production machines in the product process, and we studied if it was possible to cut the number of pumps as the number of the machines decreased.

After we studied the necessary vacuum volume after reducing the number of the machines and the capacity of the vacuum pump, we decided to operate only 1 pump.

As the vacuum pressure had to be maintained, we confirmed that there were no problems with people responsible for the products.

With this improvement, electricity 206,000kwh could be cut with no investment.

Meanwhile, there was a factory which had been studying to make the capacity of the vacuum pump smaller, and the vacuum pump stopped in our side satisfied the required specifications, so we gave it to that factory. As the result, we could contribute to the energy conservation of another factory, making double effect.

4.4.2 Thermal insulation of flange, valve and expansion joint of steam piping system

Thermal insulation for the steam piping had been done for the pipes except for flanges,

valves, etc. According to some literatures, energy conservation was said to be possible by applying thermal insulation to the flanges, valves, etc., so we studied. We calculated the total length of the pipes corresponding to 67 flanges and 31 valves along the steam main pipe in the boiler room and estimated the payback year by calculation of gas consumption from converting heat amount discharged from the pipe.
As the result, we were convinced that the investment could be recovered within a year, so we implemented.
It is difficult to confirm the effect of this improvement, but, when we measured the surface temperature with or without thermal insulation, we found that the surface temperature decreased approx. 60°C at steam pressure 0.72MPa, so we could confirm the reduction of heat dissipation.

4.4.3 Full implementation of electricity management

Although the management of the utility facilities is commissioned to an affiliated company, we made efforts with the operation divisions to stop the operation of the air conditioners, fans which were not interlocked with the process operation when the operation was not necessary, and we successfully reduced the electricity use by 85,800kwh in 2005 and approx. by 120,000kwh in 2006.

4.4.4 Energy conservation ideas

We encouraged all employees to propose energy conservation ideas in the special month for energy conservation.
There were 1,591 proposals in 2005 and 415 in 2006 including the energy conservation implemented at employee's households. Although many proposals were not adopted, they were useful in enhancing the consciousness of the employees including careful use of lighting or water.

5. Summary

Figure11 and 12 show the achievement of the activities in last two years.
The target of the energy intensity was to cut it by 1% compared with previous year, but it was actually cut by 6.3% in 2005 and 5.0% in 2006. If we look into the breakdown, we can know that the reduction of the gas which generates steam was little but the reduction of electricity was more than 14% in 2006 compared with 2004.

Meanwhile, if we collect the figure of the investment cost and the saved amount, we can know that the case such as change of software or reduction of operating units don't need investment, but its effect of improvement is also great.

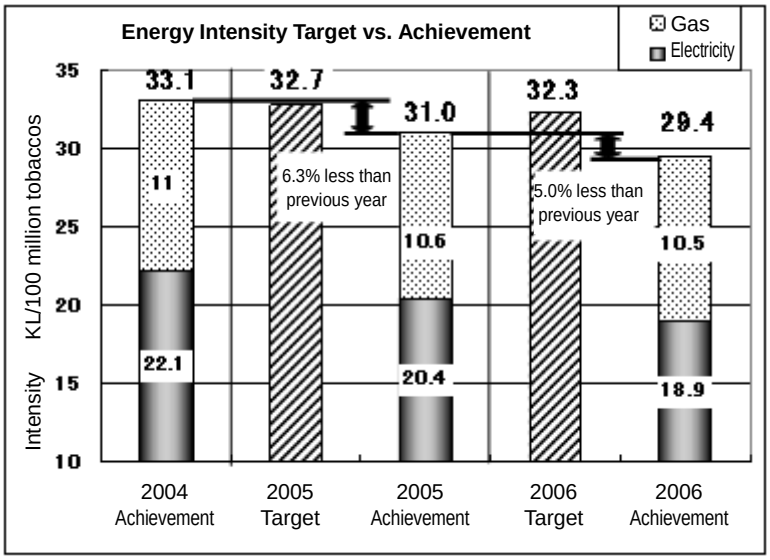

Fig. 11

Improvement items	Investment cost Thousand yen	Reduced cost Thousand yen/year
(1) Change of fan's revolution	5,500	1,351
(2) Integration of duct systems	4,000	1,160
(3) Change of air conditioner's control	0	2,071
(4) Reduction of operating vacuum pumps	0	1,070
(5) Thermal insulation of steam pipes	740	-
(6) Management of electricity use	0	535
(7) Energy conservation proposals	0	-
Total	10,240	6,187

Fig. 12

6. Future plans

The challenge of decreasing the energy intensity by 1% from previous year continues.

JT promotes the "energy conservation project" as activities of the company as a whole providing the site where relevant information is exchanged periodically.

We will implement the successful cases horizontally across the company exploiting this project to grow up among ourselves.