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

Energy Conservation utilizing Energy Management System

Mitsubishi Electric Corporation, Electricity Distribution System Mfg.
Production System Division, Production Management Section
Environment Management Group

◎ Key Words: Others (Energy management system for each facility)

◎ Outline of Theme

Since the foundation of this factory in 1978, we have taken energy conservation measures focusing on the utility facilities. Especially, since 1998 when we were certified for ISO14001, we have strengthened and promoted the energy conservation measures for lighting systems, air conditioning systems, compressors, boilers, etc. However, we could not take effective measures and could not achieve good results for the production facilities which consume approximate 60% of whole energy of the factory because there were a lot of facilities and the state of the production and the state of energy consumption of those facilities were not able to catch in a real-time respectively. So we introduced the Web system in 2004 which could know the production quantity and electricity consumed in each facility to visualize the use of energy in real time. By this introduction, we could implement full energy conservation activities covering from the unit of factories to the unit of production facilities as the end of the production system.

This management system was named EM system (*1), and we are currently implementing the energy conservation activities based on the data obtained by the EM system across the organization. (hereafter, called EM activities (*2)).

*1 The EM system means the system with which people using personal computers in the factory can watch the data of the energy management system (production quantity, electricity used, specific unit (electricity used/production quantity) of each facility) in real-time.

*2 The EM activities mean the activities in which people concerned watch the specific unit data and, if there is a time zone when the specific unit becomes bad (increased), analyze the cause and improve it (EM: Energy-loss Minimum).

◎ Implementation Period for the Said Example

- Planning period July, 2004 to December, 2004
- Implementation period December, 2004 to February 2005
- Effect verification period April, 2005 to April, 2007

◎ Outline of the Business Establishment

- Production item Switches of 84KV or less
- (Distribution boards, breakers, C-GIS, control centers)
- Employees 1245
- Type 1 designated energy management factory

◎ Process Flow of Target Facility

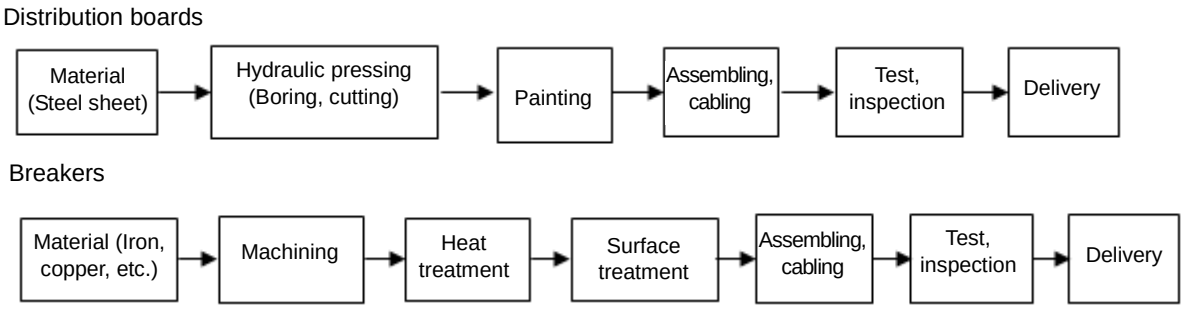


Fig. 1. Production process for distribution boards and breakers

1. Reasons for Theme Selection

The energy conservation for the utility equipments such as air conditioners, lighting, compressors, boilers, etc. has been made a circuit of activity. To further implement the energy conservation, it is inevitable to implement the activities for the production facilities which consume approximately 60% of the whole energy used. To do this, it is important to improve the mechanism that visualizes problems and the state of the energy use of each production facility.

So, as a tool to do this, we established a system that enabled everybody in the factory to know the energy specific unit (electricity used/production volume) of each production facility

using personal computers. Using this management system, the energy management division, the production division (from management managers to operators) and the production technology division jointly implemented the activities (EM activities) and there have been remarkable achievement since 2004. Here are the details.

(1) Transition of production specific unit of energy (Figure 2)

We established the EM system in 2004 to strengthen the energy conservation activities and started detailed improvement activities from 2005. Thereafter remarkable energy conservation was promoted and the energy specific unit was greatly improved (10.6% less in 2005 compared with 2004 and 5.5% less in 2006 compared with 2005).

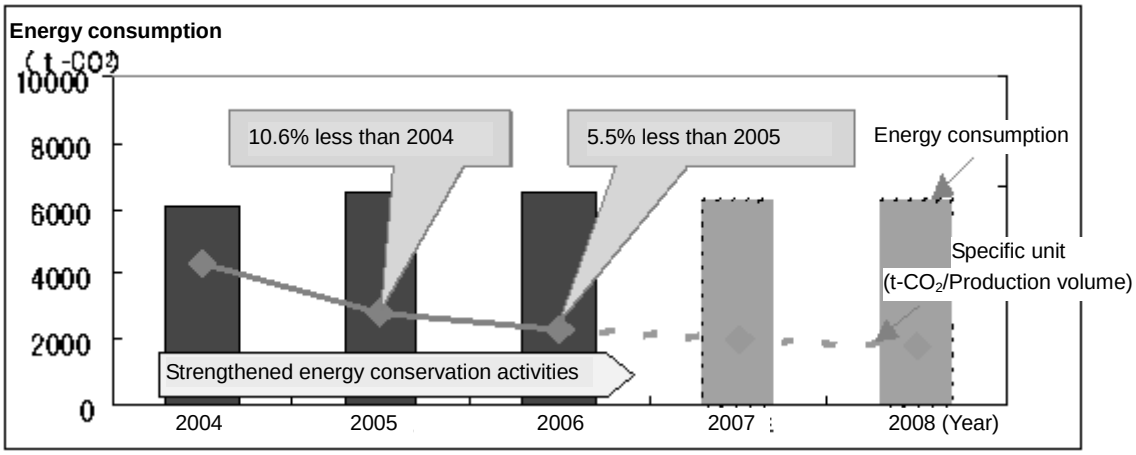


Fig. 2. Transition of Production specific unit / Energy consumption

2. Understanding and Analysis of Current Situation

(1) Understanding of Current Situation

1) Breakdown of energy type (Fig.3)

- The share of electric energy in the whole energy is 77% in this factory.
- It means we have to improve the use of electric energy.

2) Break down of facilities using energy (Fig. 4)

- Among the facilities using energy, the production facilities account for 60%.
- We need to improve the energy use of the production facilities, especially that of “electric furnaces” and “metal sheet, machinery and painting facilities”.

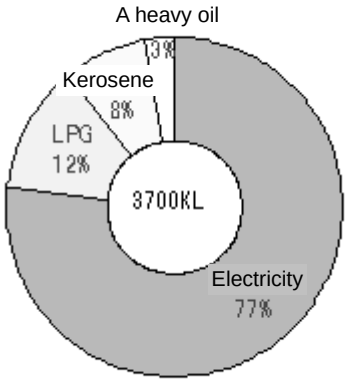


Fig. 3. Share of energy type

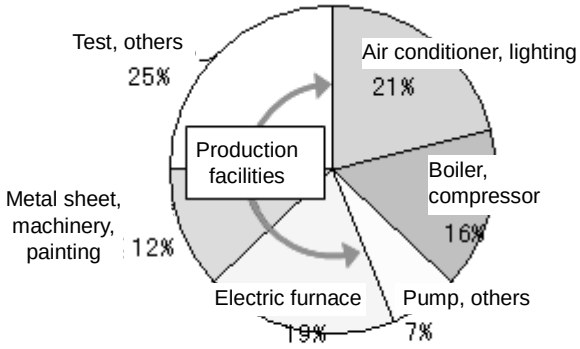


Fig. 4. Energy use share of facilities

3) Outline of electric facilities/heat facilities

Table 1. Electric facilities

Item	Content
Receiving voltage	66kV
Contracted electricity	3,500kW
Electricity consumption in a year	12,260 MWh (2006)
Number of secondary transformation facilities	10 facilities

(2006) Designated as type 1 energy management factory by its consolidated management for heat and electricity.

Table 2. Rating and use of heat facilities

Facility name		Rating	Number of units	Main use
Boiler	Gas boiler	Steam generation 750kg	3	Pre-painting treatment
	Kerosene boiler	Steam generation 750kg	3	Pre-plating treatment
	C building boiler	Steam generation 400kg	1	Pre-plating treatment
	Insulation boiler	Steam generation 200kg	2	Heating and drying of mold
Water heater	Hot Water boiler	10 million kcal	1	Heating
	Washing hot water supply	30 thousand kcal	7	Hand washing
LPG generation facility	Tank	15t	1	Boiler, drying

4) Main energy conservation measures of utility equipments

With the key words such as high-efficiency, small and distributed systems, automatic process, etc, energy conservation measures were taken for air conditioning systems, lighting systems, compressors, boilers, etc. and remarkable achievement was made. Meanwhile, in order to reduce the peak electricity in daytime, the air conditioning for offices of the design division and the management division was renewed to the ice storage air conditioning system.

Table 3. Main energy conservation measures of utility equipments

Item		Content
Facility improvement	1. Lighting system	Adoption of high-efficiency equipment (Hf lights + Reflection mirror cover) - Fluorescent lamps 110W → 50W (approx. 1,400 lamps) Mercury lights 400W → 230W (150 lamps)
		*3 Adoption of MELSAVE (Illuminance sensor + Human sensitivity SW + Use of outside light) Office building 1 – 3F, The entrance of office building
	2. Air conditioning system	Adoption of inverter air conditioners, small and distributed system/laminated air conditioners Ice storage air conditioners
		Change of fuel (Thermal source for heating, Kerosene →electricity)
	3. Boilers, compressors	Boilers: Small and distributed systems (2t (2 units) → 0.75t (6 units)) Small water heaters installed for bathrooms.
		Compressors: Distributed/High-efficiency (using inverters)
	4. Others	Use of inverters for fan pumps, control of number of fans. Control of fan temperature, control of cooling water temperature, strengthening of thermal insulation for washing vessels.
	5. Power receiving and distribution facility	Demand control, power factor control, air conditioning control Adoption of top runner transformers, installation of low voltage condensers

Energy conservation by measures above. 529Mwh (4.5% of electric energy)

(2) Problems and Measures of Energy Conservation

[1] It is difficult to improve the specific unit only by energy conservation measures for utility equipments.

[2] It is important to take energy conservation measures for the production equipments that consume approx. 60% of total energy consumption.

- In order to implement energy conservation measures for the production

equipments, it is necessary to conduct the activities involving working sites. “Understanding of energy consumption and production quantity of each facility” and “visualization of energy” is important.

Based on the above study, we decided to establish the EM system.
Using the EM system, we promoted the energy conservation activities by establishing the Energy Conservation Committee (which finds wasteful use of energy, watching the real-time data of the EM system, and discusses and implements improvement) and implementing small group activities.

(3) Outline of EM system

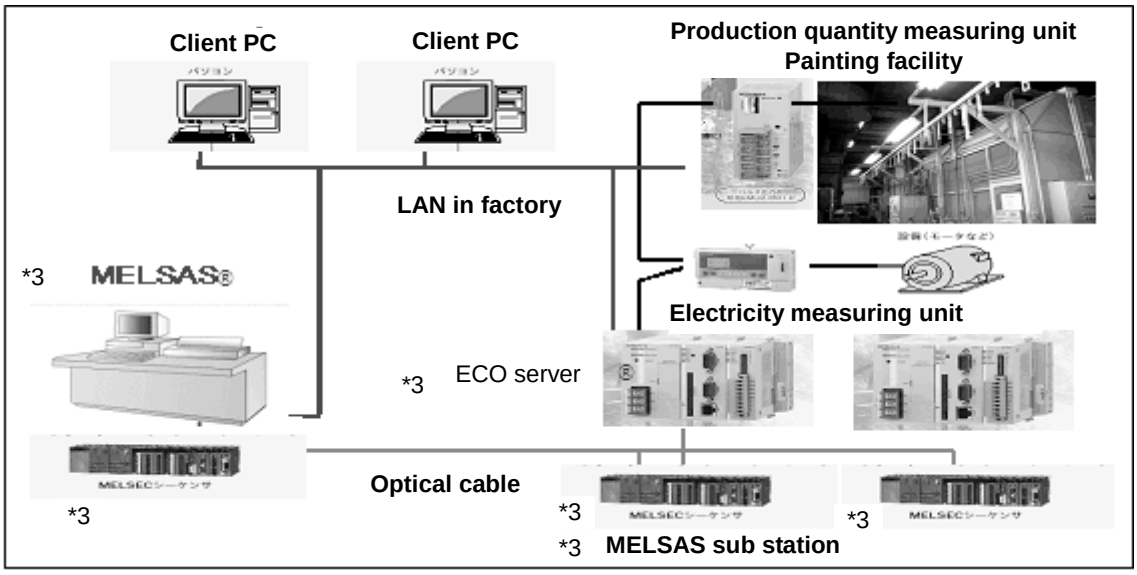
[1] It measures the production quantity with the pulse counter of the photo cell sensor limit switch (LS), etc.

[2] It measures the electricity consumption with the electricity measuring unit.

[3] It acquires data such as production quantity and electricity amount with B net and stores them in the ECO Server® (data acquisition unit).

[4] The data of the Eco Server® are put on the LAN in the factory so that people can watch them real-time on their personal computers.

[5] Figure of EM system structure. (Fig.5) (Monitoring point; Electricity amount: 130 points, production quantity: 37 points)



*3 expresses the product name of our company.

Fig.5. EM system structure by MELSAS ECO server

[6] Display of specific unit in EM system (data of 2 days)

- The upper bar graph shows the production quantity per unit time and the line graph shows the specific unit.
- The lower bar graph shows the electricity consumption per unit time.
- The specific unit is displayed real-time and the time when a problem occurs (the intensity goes bad) can be known immediately.
- The result after clearing the cause making the specific unit bad can be immediately seen in the graph.

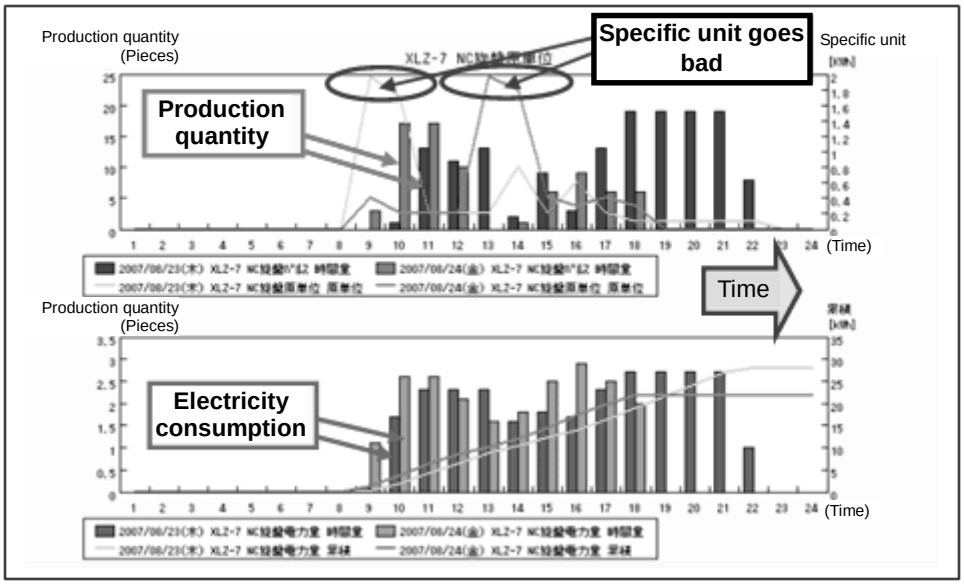


Fig. 6. Graph of specific unit, electricity consumption and production quantity

3. Progress of activities

(1) Energy conservation activity organization

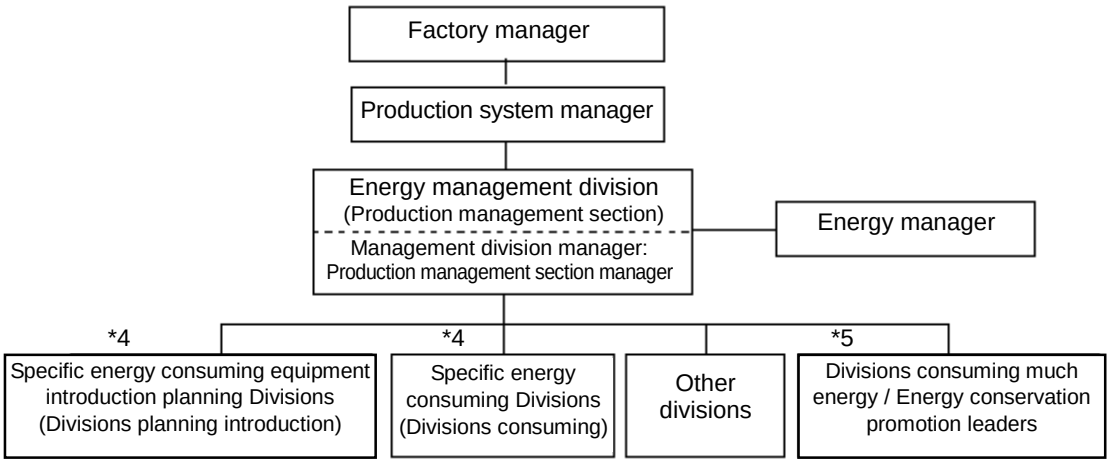


Fig. 7. Energy conservation activity organization

*4. The specific energy consumption equipments mean the equipments that consume yearly 100 MWhor more of electricity or 30L/h or more of kerosene equivalent to crude oil. The divisions consuming specific energy must establish appropriate management criteria for operating the equipments and make effort to improve the situation through understanding of the energy consumption, production quantity and specific unit.

*5. The divisions consuming much energy mean the divisions that own equipments which consume a lot of energy for plating, painting, metal sheet, heat treatment, etc. (workplaces that require rationalization of energy use). In this case, energy conservation promotion leaders must be appointed to have them decide energy conservation theme every year and implement energy conservation activities at their workplaces.

(2) Setting of energy conservation activity target

[1] Reduction of production specific unit by 2% /year

[2] Reduction of production specific unit by 25% by 2010 compared with 1990.

(3) Energy conservation activities using EM system (EM activities)

[1] Energy Conservation Committee (EM meeting)

Implementation:	Once a month
Members:	The managers of the energy management division and the divisions using energy (section managers/group leaders), production technology staff.
Content:	Gathering in the EM meeting room, discuss problems and corrective measures with watching the EM data.
- Improvement procedures:	Decrease of wasteful time in which energy isn't used for processing. → Increase of productivity in short processing time
- Improvement method:	Improvement of both facilities and operation. Horizontal application of energy conservation and improvement to other divisions.

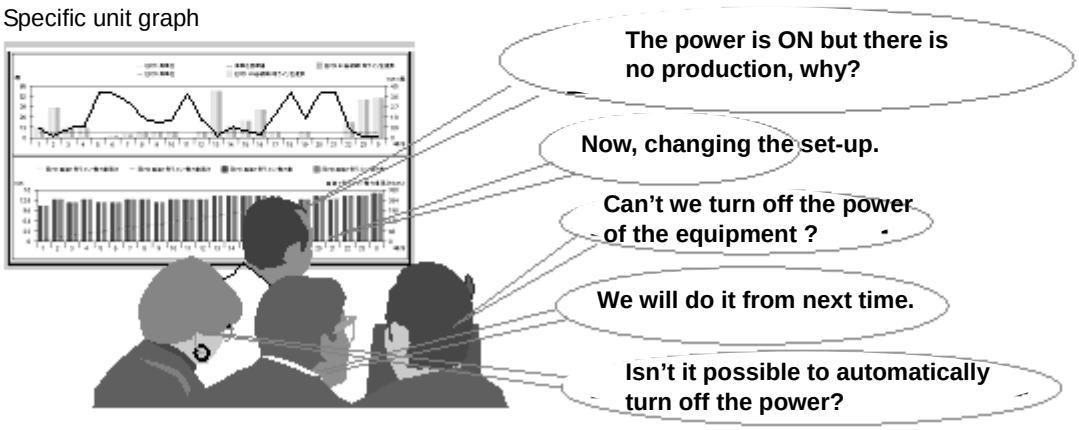


Fig. 8. Image of EM meeting

→ Improvement is made to automatically turn off the power when the equipments are not doing machining.

[2] Small group activities

In case of small group activities too, the data of the EM system make it possible to understand problems and confirm effect easily so the EM system can be used as a useful tool.

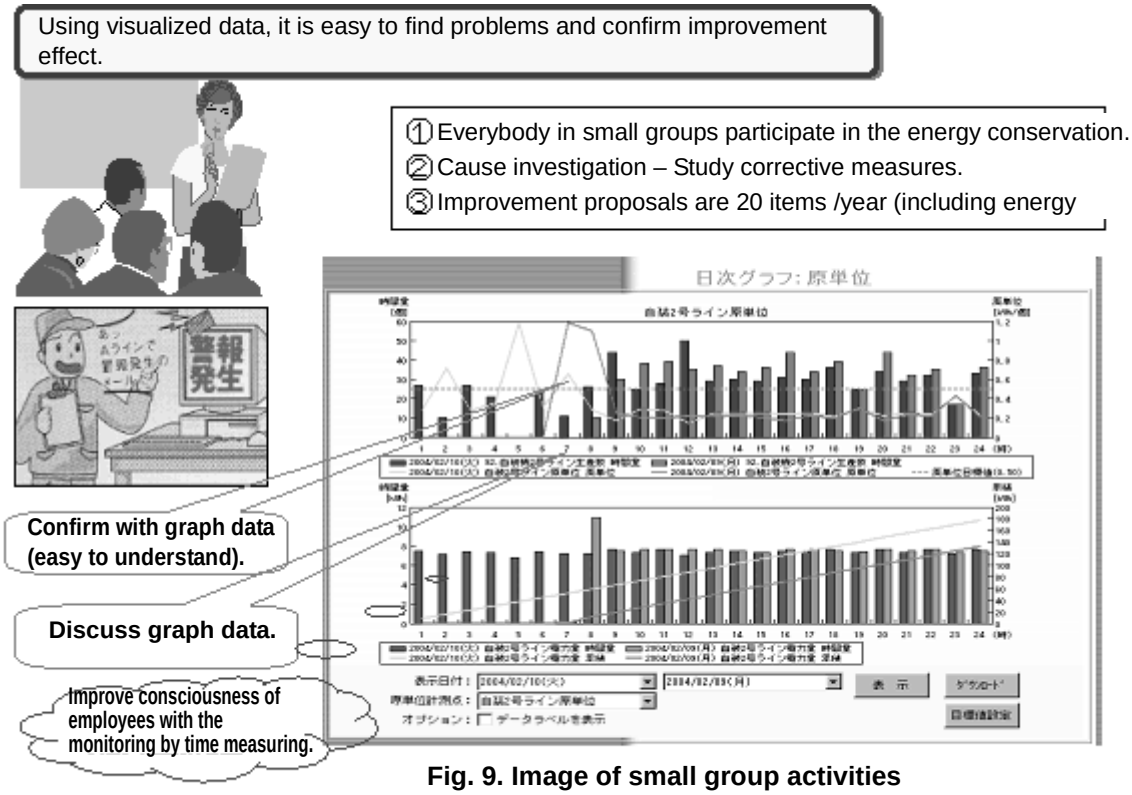


Fig. 9. Image of small group activities

→ The small group activities using the EM system were implemented in 4 divisions

4. Details of Measures

(1) Case 1(Reduction of specific unit in metal sheet turret punch press)

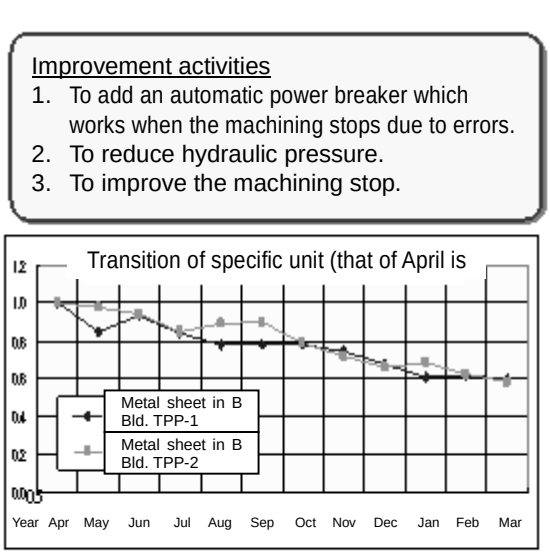
This facility consumes a lot of electricity for boring and cutting of metal sheets when making doors and inner parts for the electric distribution boards. The facility operates automatically 24 hours a day.

1) Problem Points

(a) When the facility is operating automatically at night, even if the machining is stopped because materials run out or there is machining error, the auxiliary machines such as hydraulic pumps or cooling pumps are running.

(b) Machining pressure is set to the maximum regardless of the thickness or sorts of the materials.

2) Results of Measures



- Energy conservation effect 168 (Mwh/year)
- The specific unit was reduced by 40% in 2005.

Fig.10. Transition of specific unit (Turret punch press)

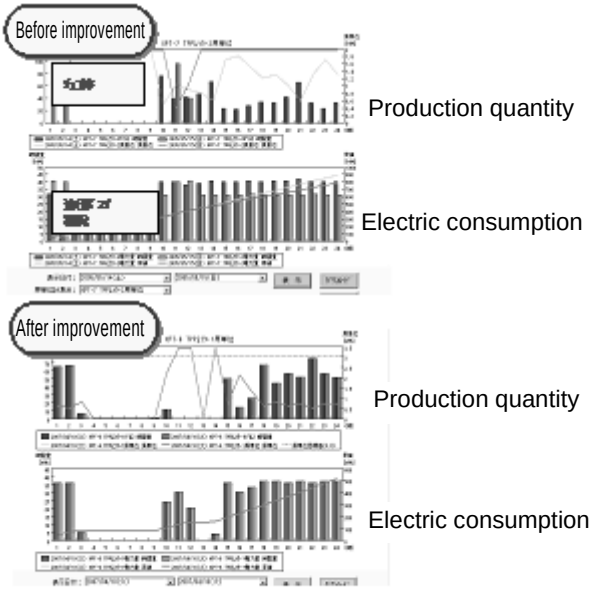


Fig. 11. EM data (Above: Before improvement, Below: After improvement)

(2) Case 2 (Reduction of specific unit of electric furnace)

This equipment consumes the most electric energy in the factory with its electric furnace which applies heat treatment to the breaker parts or to samples.

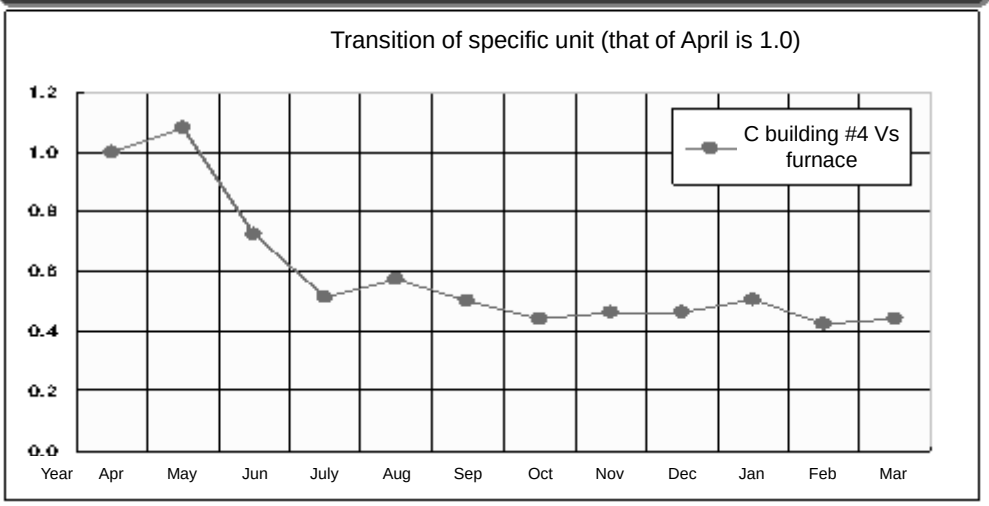
1) Problems Points

(a) The power is kept ON even if there are no parts in the furnace because of the delay of the production plan or of the preparation for the production.

(b) The power is kept ON even if the person in charge of the development has finished making the sample (operation completed).

2) Results of Measures

Improvement activities
1. The power supply was improved so that it is automatically turned off in the case of no operation (restart) for 2 hours.
2. People in charge of development were trained to review the operation so that the power was not turned on too early or it was not inadvertently kept on after the test was completed.



- Energy conservation effect 15 Mwh/year.
- The specific unit was reduced by 50% in 2005.

Fig 12. Transition of specific unit (Electric furnace)

(3) Energy conservation effect of EM activities

655 Mwh of electricity was reduced in 2 years by the EM activities.

5. Summary

The above cases (section 4) show the effectiveness of the EM activities.
In both cases, it was visually understood that the electricity was used wastefully because the power was kept ON although the machining was being stopped.
So the facility management division tried to add function that automatically turns off the power if the machining stops, but it was found that this function was induced the problems like producing bad products during processing or making the waiting time longer until the power is recovered. So the facility management division and the working division jointly set the conditions for doing that and added the function that automatically turns off the power. The first step of energy conservation was implemented this way.
The final goal is to turn wasteful operation to effective operation. To achieve this, we take measures such as improvement of daily operation or equipments in order to keep the

running without stopping the processing. We also reduce wasteful energy consumption while improving the productivity. Our goal is to make further energy conservation.
There are still equipments that can be improved. So we continue the improvement under the operation of the Energy Conservation Committee (EM meeting). We recognize that “Energy Conservation” is equal to “Improvement of productivity”. So we continue to promote the energy conservation jointly with the management division and the working division.

6. Future Plans

We just started E-JIT (Just-in-time system for energy: Use energy at where necessary, by the quantity necessary and for the time necessary) which also includes the EN activities.
We will achieve our energy conservation goal (2% reduction of production specific unit every year) by clearing the target part of the evaluation criteria under the Energy Conservation Law and by accelerating the energy conservation activities.

[1] Promotion and acceleration of improvement activities using EM system.

(Synergic effect of productivity improvement activities and energy conservation activities) → Effective use of data, participation by everybody, enhancement of consciousness.

[2] Functional enhancement of EM system → Tact of visualization → Real visualization.

[3] Expansion of energy conservation (continuous improvement)

1) Small and distributed systems, use of inverters.

2) Automatic systems.

3) Use of high-efficiency equipment.

4) Change of fuel.

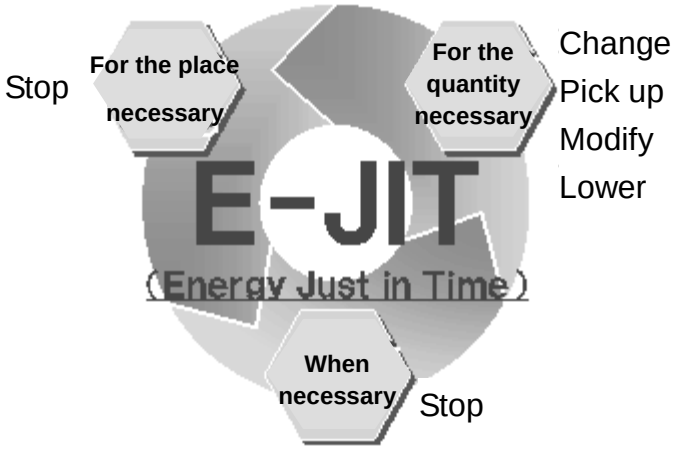


Fig. 13. Logo mark of E-JIT