2007 Prize of the Chairman of ECCJ

Energy Conservation Activities by Integrating Production with Infrastructure

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◎ **Keywords: Prevention of Energy Loss due to Radiation, Heat Transfer, and Resistance, etc. (Prevention of electricity loss caused by resistance, etc.)**

◎ Outline of Theme

Our company achieved a great CO_2 reduction by converting the CGS to the UPS based on the environmental action plan made by the Sakata energy conservation project (Part-1).
We know that it is important to improve efficiency not only through the upper grade measures but also through how to use energy efficiently, so we started the energy conservation project (Part-2) last year and produced big fruit by integrating the production with the infrastructure based on “the three actuals, Sangen Shug”i ((go to the site, make a direct observation, and determine the facts). This case study presents the energy conservation measures (energy conservation tuning) which we implemented by changing the settings for the equipment without investing much but examining the relationship between the production process and its conditions.

◎ Implementation Period for the Said Example

● Project Planning Period	December 2006 – July 2007	Total 8 months
● Measures Implementation Period	December 2006 – July 2007	Total 7 months
● Measures Effect Verification Period	January 2007 – July 2007	Total 7 months

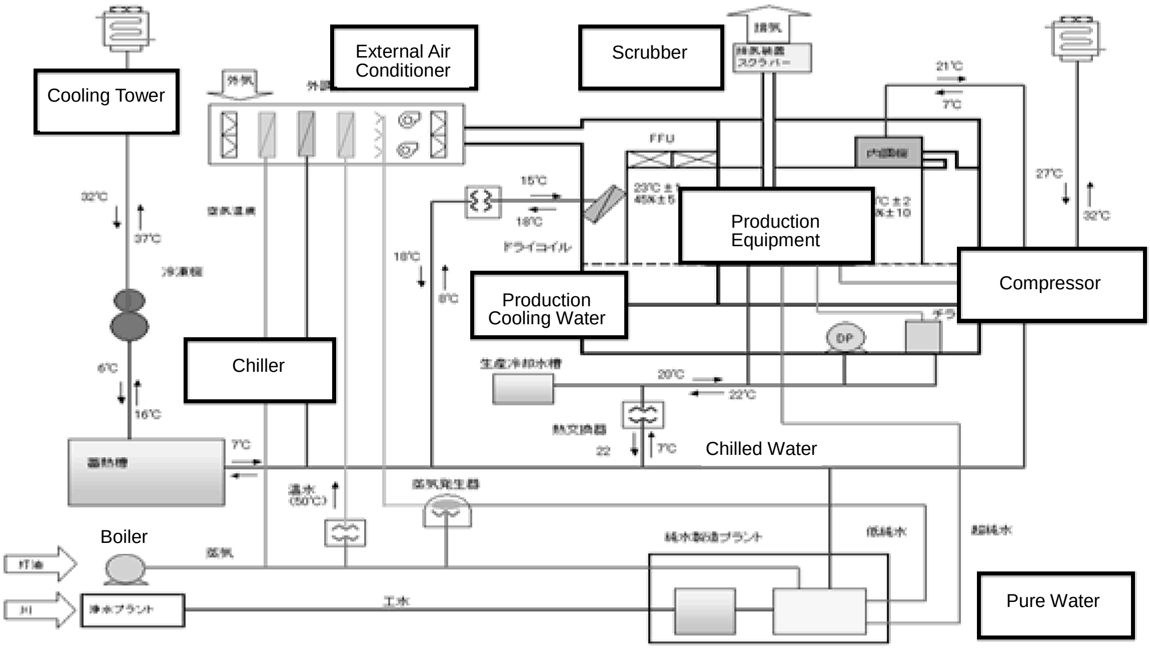
◎ Outline of the Business Establishment

- Items Produced: Wafer process
- No. of Employees: 1,200
- Type 1 designated energy management factory
- Annual Energy Consamptin (Fiscal year 2006, actual of the work place)

LPG	443 t
Electricity	214,526 Mwh
Steam	190,471 GJ
Kerosene	4,222 KL
Heavy oil A	364 KL
Total crude oil	63,378 KL

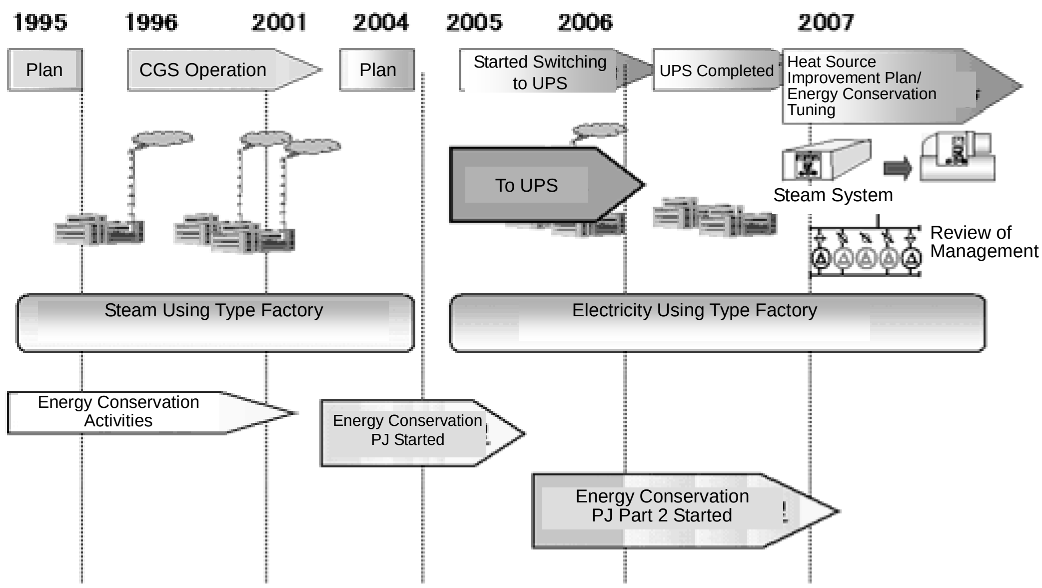
◎ Process Flow of Target Facility

Relationship between Production Equipment and Infrastructure



1. Reasons for Theme Selection

(Fig. 1)



We introduced the CGS in 1995, since then we actively pursued energy conservation as a steam using type factory. Then, we started switching to the UPS considering its merit in cost and environmental aspects (Fig. 1), so we had to change our energy conservation activities to those suited to a electricity using type factory. We started the Sakata energy conservation project focusing on the following activities based on the idea that the energy conservation was management techniques and it was important to act from the original viewpoint such as reviewing the margin, etc.

[1] To clarify the problems for which we did not taken action because we did not know the cause of the problem and to do so by thoroughly examining them at the workplace.

[2] To think of the corrective measures from the viewpoint of the whole factory instead of leaving the activities to limited people responsible for the problems.

2. Understanding and Analysis of Current Situation

The theme of the activity this time was to identify the unknown part of problems and to take measures after we were convinced of the effectiveness of the measures. So we decided to focus our activities on the exhaust air equipment (scrubber), the cooling water pump for production and the pure water equipment. Those had been difficult to improve because of affecting the production.

In case of production equipment too, we focused on the dry pump which had been difficult to improve.

(1) Understanding of Current Situation

We started with the brain storming in all to discuss the reason why we hesitated to act (Table 1). Each of us disclosed the problems we had and analyzed them. What we knew was the fact that we had not discussed with the production division people the way to solve the problem which had made us hesitate to act.

(Table 1) Discussion Result

Target Equipment	Reason of Hesitation due to Facility	Energy Conservation Proposal	Items to be Studied
Scrubber	Effect to the production equipment due to change of exhaust air	Reduction of exhaust air volume	Actual exhaust air volume and factor of change
Production cooling water (1)	Effect to the production equipment due to change of flow rate	Reduction of cooling water flow rate /Improvement of dry pump	Actual flow rate and action to change / Confirmation of cooling water supply temperature and ΔT
Pure water equipment	Problem of pure water quality	Change of water supply pressure	Study of how to secure water quality
Production cooling water (2: Reference)	Influence on the production equipment due to increase of cooling water supply temperature	Cascade system for dry pump cooling water and INV system for supply	Study of dry pump production cooling waterΔT and supply temperature conditions

(2) Analysis of Current Situation

We mutually agreed that we should, based on the understanding and analysis of the current situation, first make the production division people understand the status of the equipment and persuade them to work with us.

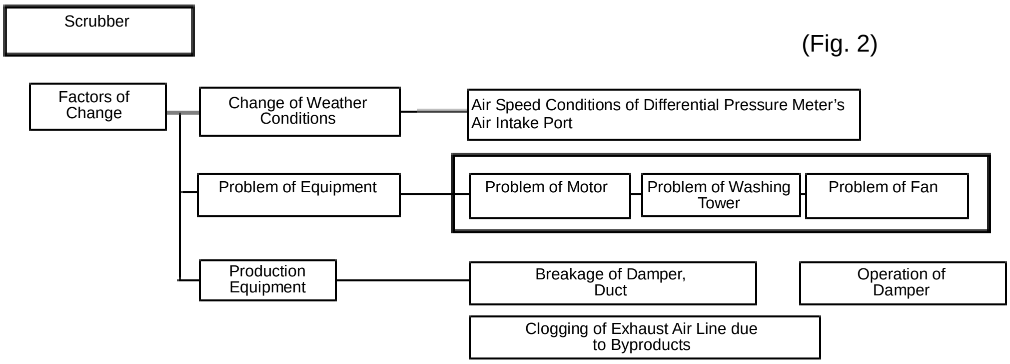
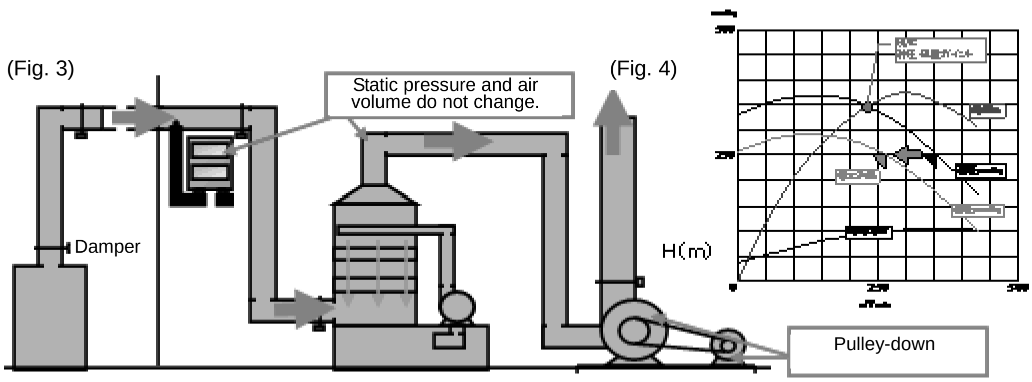
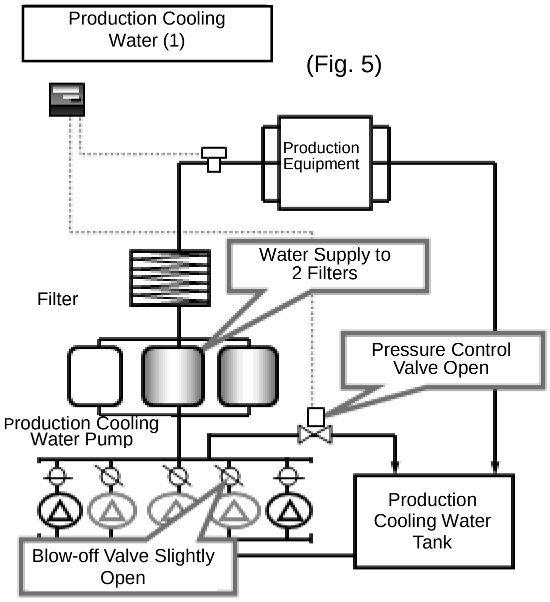


Figure 2 summarizes the factors of change. Looking into the actual operation, we confirmed that the possibility of the trouble happening to the equipment was low because it was being improved to make the operation stable.

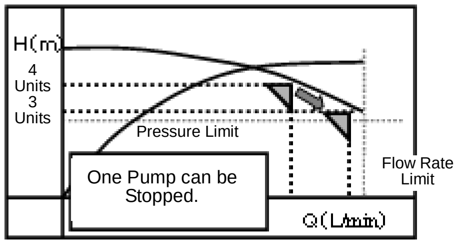
Meanwhile, we knew the detailed air volume margin from the measurement of the air volume and found that it was possible to fully open the damper and decrease the present air volume down to the necessary volume. Studying the performance curve, it was also confirmed to be possible to reduce the energy by doing pulley-down whose initial cost was low (Fig. 3 and 4).





(Fig. 5)

Pump operation point (For 1 unit) (Fig. 6)



We surveyed the workplace and found the following possibilities for improvements (Fig. 5).

[1] Pressure loss by supplying water to the filter.

[2] Possibility of over flow rate because of the opening of the pressure control valve.

[3] Pressure loss due to the opening of the blow-off valve.

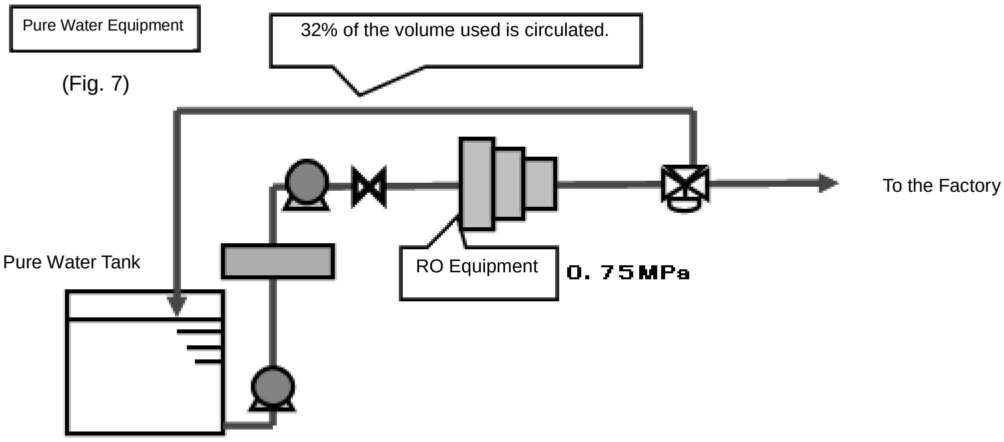
Confirming this state with the performance curve, we thought we could stop one pump if improved (Fig. 6), and it was confirmed by the fact that the actual flow rate corresponded to the value measured by an ultra-sonic flow meter.

When changing the flow rate, the influence of pump's trouble was the most concern. But from the past experience, we knew that the possibility of the trouble was very low. To the contrary, since the number of the pumps was increased, the increase of the defect rate and the increase of the maintenance cost became our concern.

We realized again that it was important to understand the current situation in detail when operating the equipment.

Pure Water Equipment

(Fig. 7)



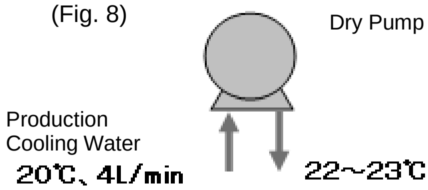
We checked the pure water equipment of the workplace and found that 32% of the total pure water used was circulated (Fig. 7). This was because, from the designing viewpoint, the water supply pressure was necessary not to lower the TOC removal rate of the RO equipment and, as a result, excessive water was being circulated. If the TOC rate is lowered, it was likely to affect the production, so we decided to study it with the maker and the production division.

Production cooling water (2: Reference)

- This theme had been implemented in May, 2006 prior to this project (part-2). This project was motivated by this theme. We have not published this theme, so we present it here for your information. There are about 1,000 dry pumps and all of them use the production cooling water (Fig. 8). The electricity for supplying the water was large, so we studied the corrective measures in relation to the production cooling water equipment to make synergic effect.

The temperature of the production cooling water supplied to the dry pumps was 20℃ which was common to other equipment. The return temperature was 22℃ to 23℃ and there was no much difference. Meanwhile, it was confirmed that the temperature for supplying water to the dry pump on the specifications was 30℃, so the cascade connection seemed to work effectively.

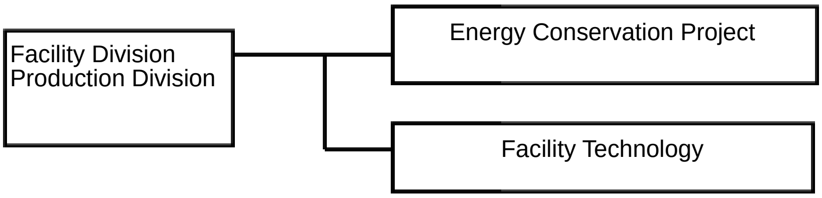
(Fig. 8)



3. Progress of Activities

(1) Implementation Structure

(Fig. 9)



As Fig. 9 shows, the activities involved the organization as a whole. Thanks to the cooperation of the facility technology division, we could learn and implement the way to do the analysis and verification based on theories.

(2) Target Settings

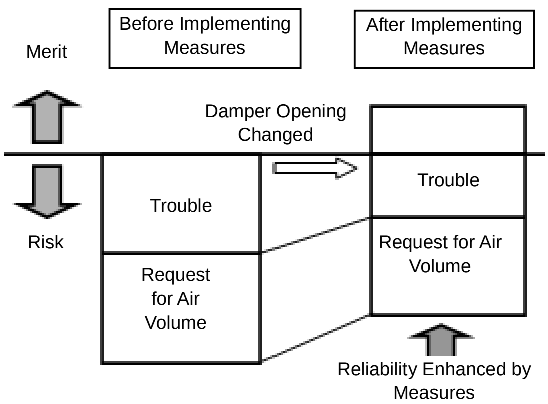
Based on the business plan, we started the activities with the target aiming to reduce the cost by 15 million yen/year which corresponded to 800 t-CO_2/year.

(3) Problem Points and their Investigation

There were problems carried on from the past and problems presented by the production division. We studied them in the project, planned corrective measures and proposed them.

Scrubber

(Fig. 10)



The production division presented the following concern.

[1] Is not the possibility of trouble increased?

[2] What is the action if there is a request for the air volume?

As an answer, we explained how to use the flow control by the pulley and told them that the reliability of the operation would not change. As regards the request for the air volume, we told them that we would have 20% extra capacity.

We explained that the possibility of the clogging would be lowered to the contrary, because the damper would fully open, enhancing the reliability and reducing the cost, which they understood and we step forward (Fig. 10)

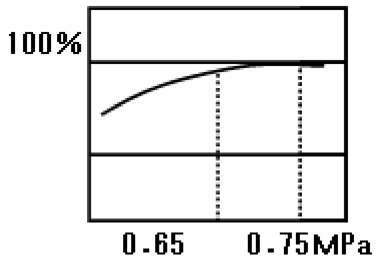
Production cooling water (1)

We replied to the production division that if we stopped 1 pump, we could add to auxiliary pumps, improving the action for emergency and reducing the maintenance cost, and even if we changed the flow rate, the possibility of trouble would be low. We also made them understand that if the production cooling water of the dry pump was a cascade system, we could expect more effect, and we proceeded with this idea.

Pure water equipment

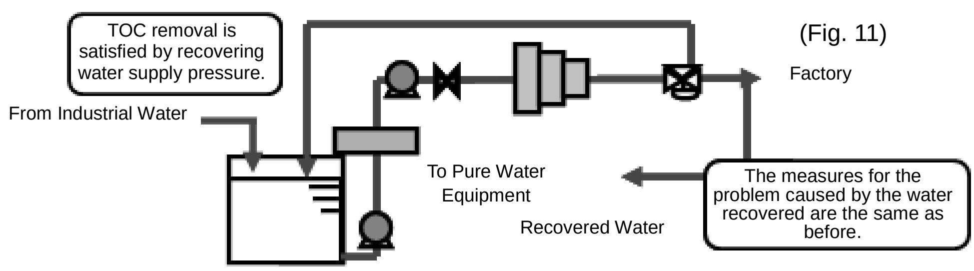
When changing the water supply pressure of the RO equipment, the problem is that the TOC removal rate might come down. So the project team investigated the correlation between the TOC removal rate and the water supply pressure (Fig. 11).

(Fig. 11)
Desalting rate = TOC removal rate graph



As a result, we found that as the RO water supply pressure came down, the TOC removal rate also came down, but if the water quality was ordinary, the pressure could be reduced from 0.75MPa to 0.65MPa. Then, all we had to do was to investigate the cause that made the water quality high, which the production division was concerned about, and convince the production division people that these measures would not increase the risk even in the state of increase.

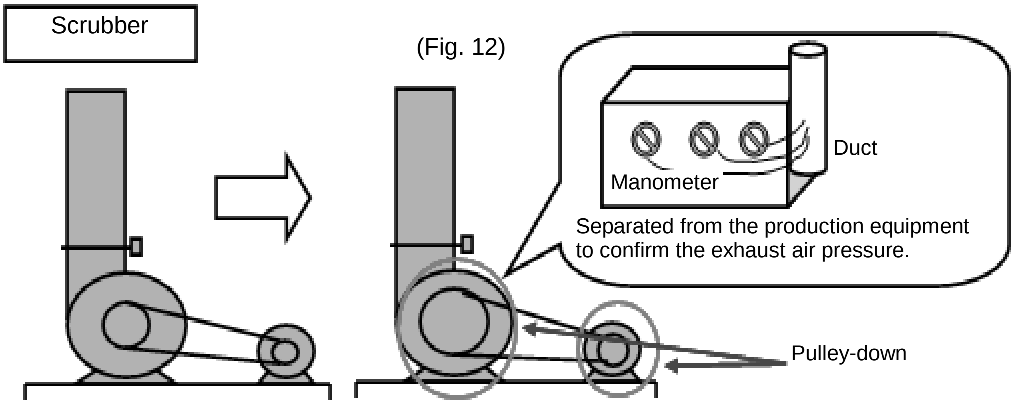
Cause of TOC Increase



(Fig. 11)

There are two causes that increase the TOC, i.e. the industrial water and the water recovered from the factory (Fig. 11). From the past results, the increase of TOC was supposed to be caused by the recovered water, and the action was same in both cases, i.e. before and after implementing the measures. Meanwhile, if the industrial water is the cause, the TOD tends to increase gradually. In this case, it was confirmed that the TOC was satisfactorily removed by returning the water supply pressure of the RO equipment to the original pressure. So the production division understood the findings including the measures we proposed.

4. Details of Measures



(Fig. 12)

We conducted the flow control by pulley-down to change the air volume. Then, the production division and we independently checked if the 20% extra capacity could be secured, and it was confirmed that the value was within the range as planned on the performance curve (Fig. 12).

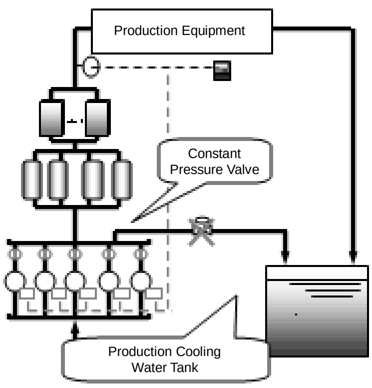
Production cooling water (1)

To reduce the pressure loss as one of the measures, we added the pump with filter. The valve was fully opened and one pump was stopped.

Production cooling water (2: Reference)

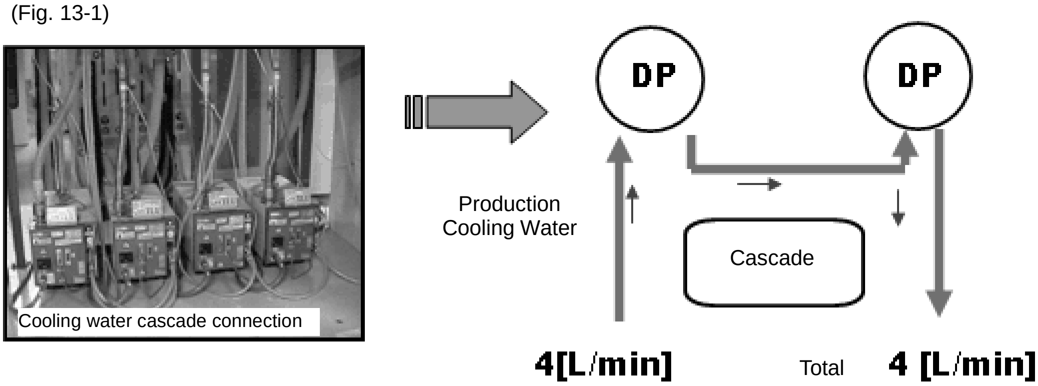
We made the cascade connection for the production cooling water of 115 dry pumps and, as a result, we could reduce the flow rate by 230 L/min (Fig. 13, Fig. 13-1). Then, we installed the inverter to the pumps for supplying the production cooling water and, as a result, we could solve the problem of the water returning to the tank by the constant pressure valve.

(Fig. 13)



The electricity saved by the cascading alone was not much, but the fact that we worked with the equipment and production people for a common purpose had a great effect to promote the energy conservation activities since then.

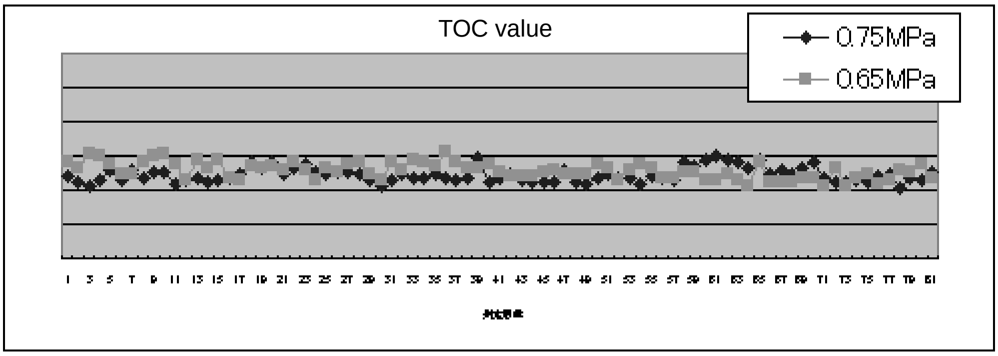
(Fig. 13-1)



Pure water equipment

On the pure water equipment, there was no change to the TOC removal rate due to the change of the pressure even in the verification data (Fig. 14) in which the water supply pressure was dropped to 0.65Mpa by the inverter.

(Fig. 14)



5. Effects achieved after Implementing Measures

Every one of us deployed the achievement of this project and implemented 11 measures in total. As a result, we could reduce the energy cost as well as CO_2 emission and it was much more than the target (Table 2).

(Table 2)

Energy Conservation Items	Monetary Amount of Effects (Thousand yen/year)	Reduction CO_2-t/year
Review of production cooling water pump (from 4 units to 3 units) (1)	1,850	95
INV control of production cooling water pump (including dry pump) (2)	12,000	440
Low pure water RO pressure	1,454	75
Pulley-down of scrubber	700	36
Review of operational management of electricity room PAC	200	10
Reduction of number of PAC operation units in monitor room	100	5
Review of setting for cooling tower's cooling water temperature	2,429	125
Automatic control by INV of chilled water secondary pump	2,700	143
Optimization of boiler operation	5,000	230
Stopping of dry coil chilled water pump in Photo room	700	36
Lowering of external air conditioner blow-off temperature	1,400	75
Total effect	28,533	1,271

* Cases described here.
*1 Calculated based on the effect measured during the period and considering the operation hours in a year.

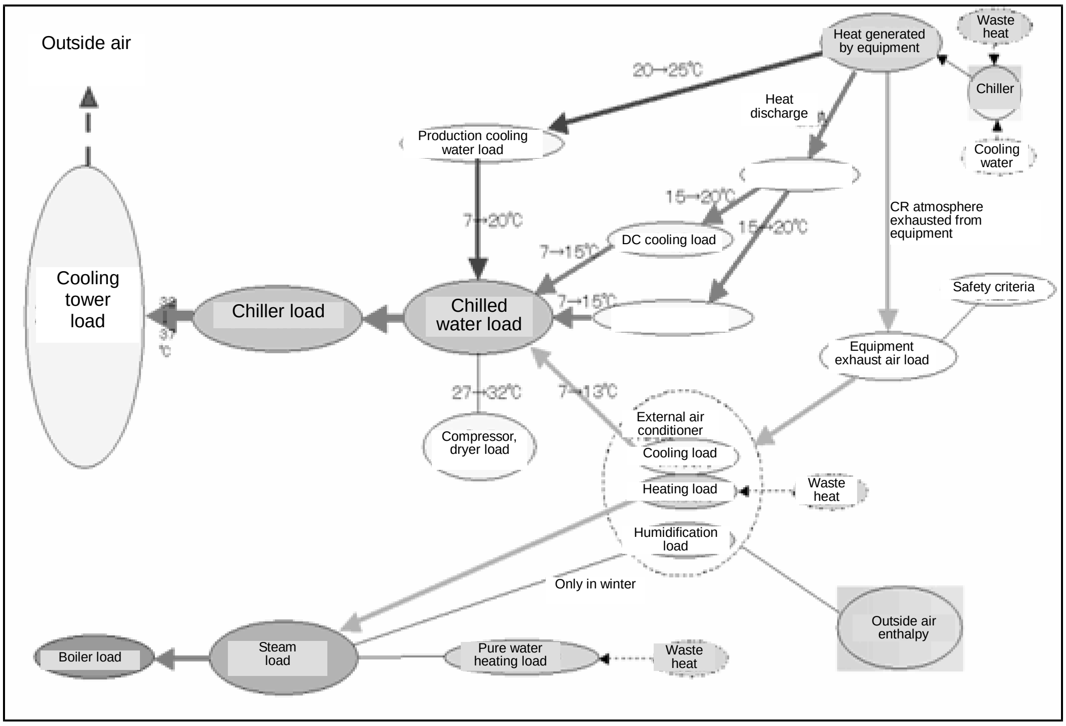
6. Summary

From these project activities, we learned a lot including importance to recognize the workplace and of the fact that we could solve any difficult problem by working with the production division.

Of the energy consumed by a semi conductor factory, approximately the half of it is the electricity used by the production equipment and the remaining is the energy consumed by the basic equipment. If there is not any production equipment in the factory, the total energy consumption is supposed to be about 10% of the factory with the production equipment. In other words, most energy is consumed by the production equipment. Of it, the energy except for pure water, compressed air, etc. is consumed as heat generated by the production equipment and by the outside air conditions associated with the exhaust air

Figure 15 shows its flow which we understood and learned through this project. In the project, we understood that it was important to consider the energy conservation in the context of the mutual dependency of various types of energy without being confined to the efficiency of individual equipment. We also realized anew that all the heat coming from the production equipment was discharged outside. We want to proceed to next action considering the flow of energy, characteristics which decide the efficiency of equipment, and the room to further improve the setting conditions for temperature, pressure, etc.

(Fig. 15)



7. Future Plans

We are planning to change the absorption type chiller to a high-efficiency electric chiller. By doing so, our factory moves to more electricity using type factory and we are intending to promote the energy conservation tuning.

This is the theme for the long term and mid term plan, and we hope we can present our achievement at the National Competition for Outstanding Case Examples of Energy Conservation in near future.