2008 Prize of the Chairman of ECCJ

"Enhancement of Basic Capabilities to Become an Energy Conserving Plant" - Our Challenge to Energy Conservation Utilizing Wisdom and Innovative Ideas of Employees

K's Tec Co., Ltd.

◎ **Keywords:** **Rationalization of heating, cooling, and heat transfer**
Prevention of energy loss due to radiation, heat transfer, and resistance, etc.
Rationalization in conversion of electricity into motive power and heat, etc.

◎ Outline of Theme

"I heard a rumor that there is an *outstanding dyeing plant* near Mikawa interchange of Hokuriku Expressway in Japan"
"The fabric dyeing work in that plant is the best in the world and they do so in environmentally-friendly way."
"Employees of the plant are energetic and creative with many ideas, leading their customers more energized."

Having desire to become a plant with such reputation, all members of K's Tec plant have started working on reduction of energy losses. Since it has not been so long since our project was launched, only the first step of our efforts is described in this report.

◎ Implementation Period for the Said Example

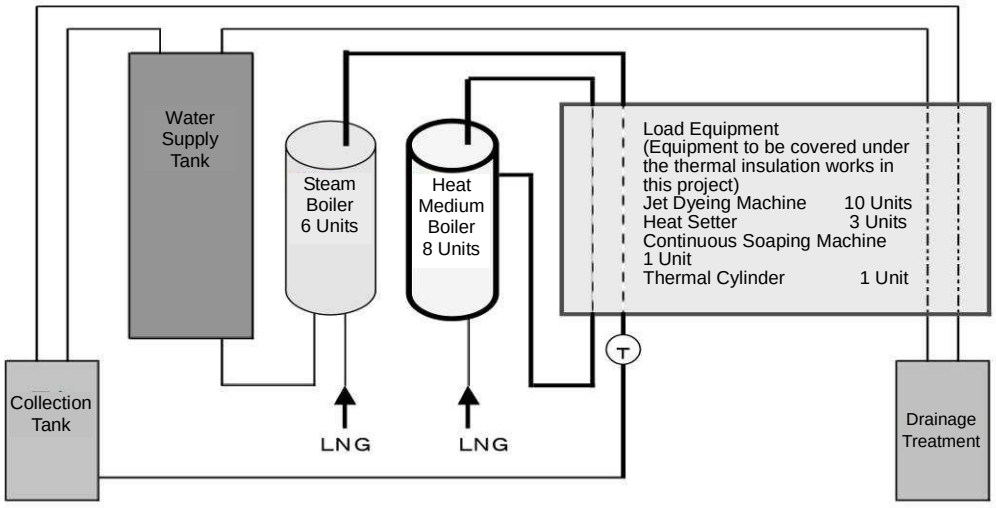
- Project Planning Period — December 2007 – March 2008
- Measures Implementation Period — April – June 2008
- Measures Effect Verification Period — July 2008 – Present

◎ Outline of the Business Establishment

- Scope of Business　Development, production, and sales of materials for automobile interiors and clothing
- No. of Employees　78
- Designated Energy Management Factory
  Type1 designated energy management factory
- Annual Energy Usage Amount (Actual results for fiscal year 2007)

LNG	2,085 t/year	
Electricity	3,918,000 kWh/year	
Crude oil equivalent	3,940 kl/year	
CO_2 equivalent	7,416 t/year	

◎ Process Flow of Target Facility



1. Reasons for Theme Selection

In fiscal year 2007, K's Tec shifted its entire energy source to LNG, the cleaner energy with less CO_2 emission per unit of heat quantity, compared to oil fuels such as heavy oil and LPG, etc.

Taking this opportunity of the energy change, K's Tec determined to set our 2008 target to take on challenge for “energy conservation” carried by entire plant and to enhance basic capabilities of the plant heading for manufacturing cost reductions.

To achieve the target, organizational restructuring placing “Cost Reduction Project“ as a core was carried out, and more active small group activities for improved productivity and

reduced waste of time, goods, and processes were encouraged. Furthermore, improvements in equipment aiming to energy-loss reductions were planned.

The small group activities for energy conservation have been carried out by all departments including Administration, Manufacturing, and Quality Assurance.

In dyeing industry, which uses large amount of water and is also called “water business”, reduction of “water” will consequently reduce energy to be used for warming water and drying materials. Taking these into consideration, the manufacturing floor workers determined to make their efforts toward “water saving”.

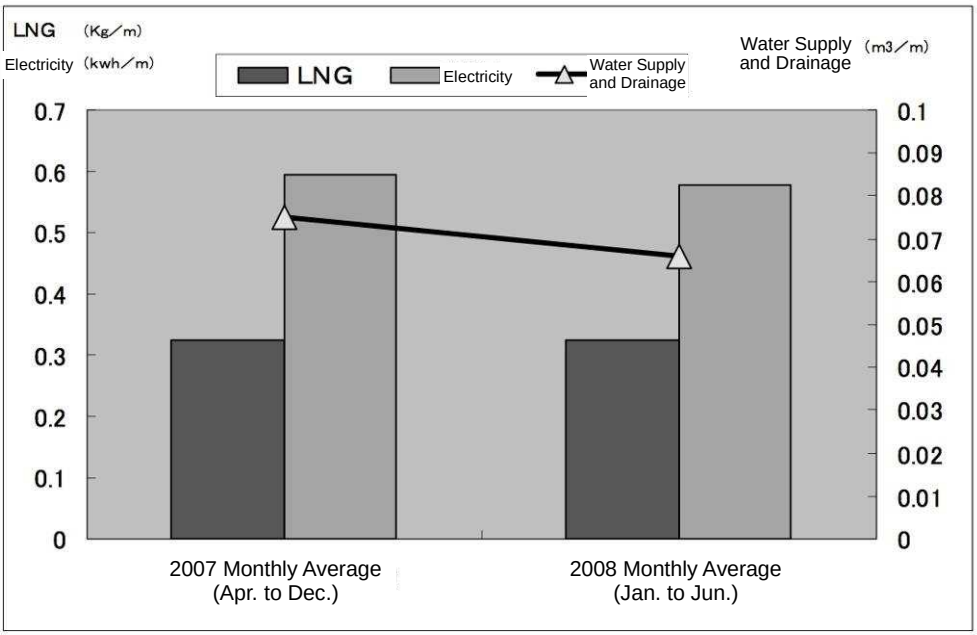
Since our plant was designed to be and actually is equipped with collection lines from drainage, we determined to focus on mitigating heat released by machines and pipes as our target for improving equipment.

2. Progress of Activities

(1) Analysis and Understanding of Current Situation

Intensities	2007 Monthly Average (Apr. - Dec.)	2008 Monthly Average (Jan. - Jun.)
LNG (kg/m)	0.326	0.325
Electricity (kWh/m)	0.595	0.577
Water Supply and Drainage (m^3/m)	0.0752	0.066

* 2007 data above only includes values after April when the full-scale shift to LNG was completed.



Our records for 2007 showed that 75 kg of water was used for 1 m of fabric (approx. 500 g). Following our trials and errors seeking for better water saving method started in January 2008, we succeeded in gradually reducing amount of supplied water used in dyeing processes.

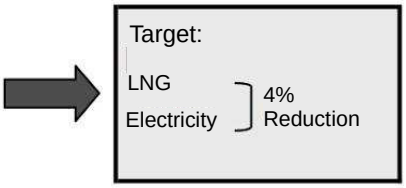
During the period from January to June 2008, about 10 % reduction compared to 2007 average was actually achieved, however, LNG consumption remained flat.

We determined to start examining effectiveness of the measures in July, after ensuring further water saving through small group activities were in place and accelerating completion of equipment improvement works which were still under construction.

(2) Target Settings

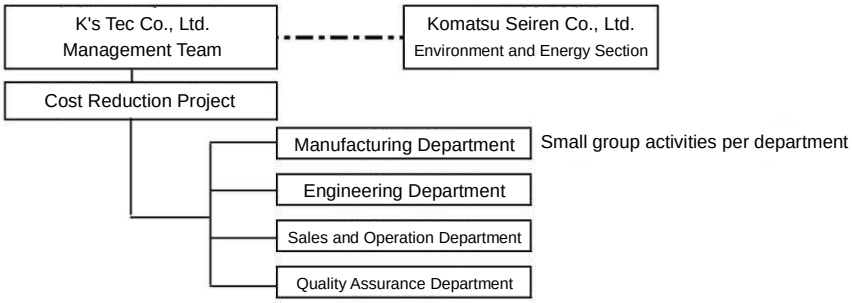
Establishing a project team to play a role of driving force for the small group activities for energy conservation per department, we made our efforts toward achieving the target which was calculated assuming reduced LNG and electricity consumptions due to synergistic effect with the equipment improvements. (Evaluation was based on intensities, using the data between January and July before the equipment improvements as comparison data.)

		Projected Reductions per Month		
Target Utilities		Water Supply and Drainage	LNG	Electricity
Project Activities (Water conservation)		100t	1,400kg	—
Equipment Improvements	Thermal Insulation Work	—	5,300kg	—
	Improvement of Lights	—	—	13,000kW
Total		100t	6,700kg	13,000kW
Reduction Rate		0.30%	3.80%	4.10%



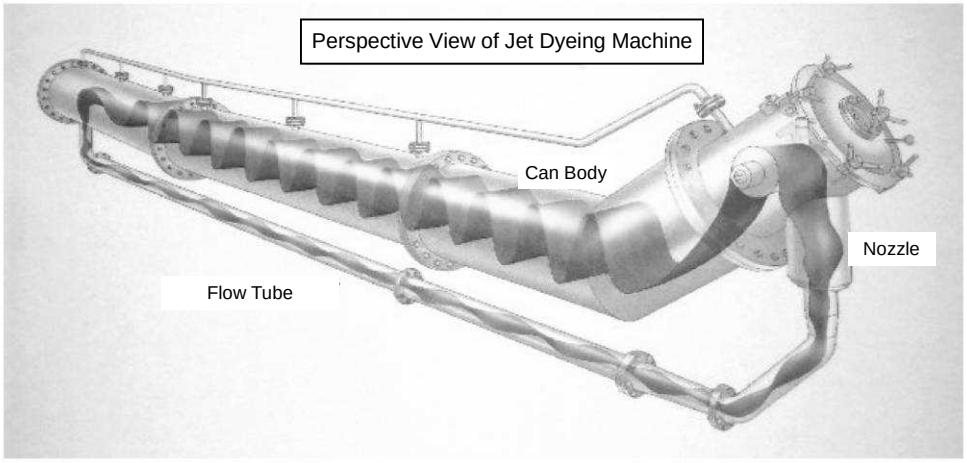
(3) Implementation Structure

- Changes in process conditions (water saving, etc.) shall be planned and tried by Manufacturing Department and/or Engineering Department. The changes shall be controlled and managed by Quality Assurance Department.
- The equipment improvements shall determined and implemented by the K's Tec Management Team, in corroboration with Environment and Energy Section of Komatsu Seiren Co., Ltd.
- Weekly progress shall be checked and followed up by the Project Team.



(4) Details of Measures

1) Case study of the measures placed in the project (Dyeing department)



In order for every member of Dyeing Department to be aware of the reduction effect and to motivate themselves for the activities, we calculated the effect when amount of dye liquor in dyeing process would be reduced.

In addition, to prevent quality deterioration caused by the water savings, the Cost Reduction Project Team set out some rules for control and management of the changed points for each department.

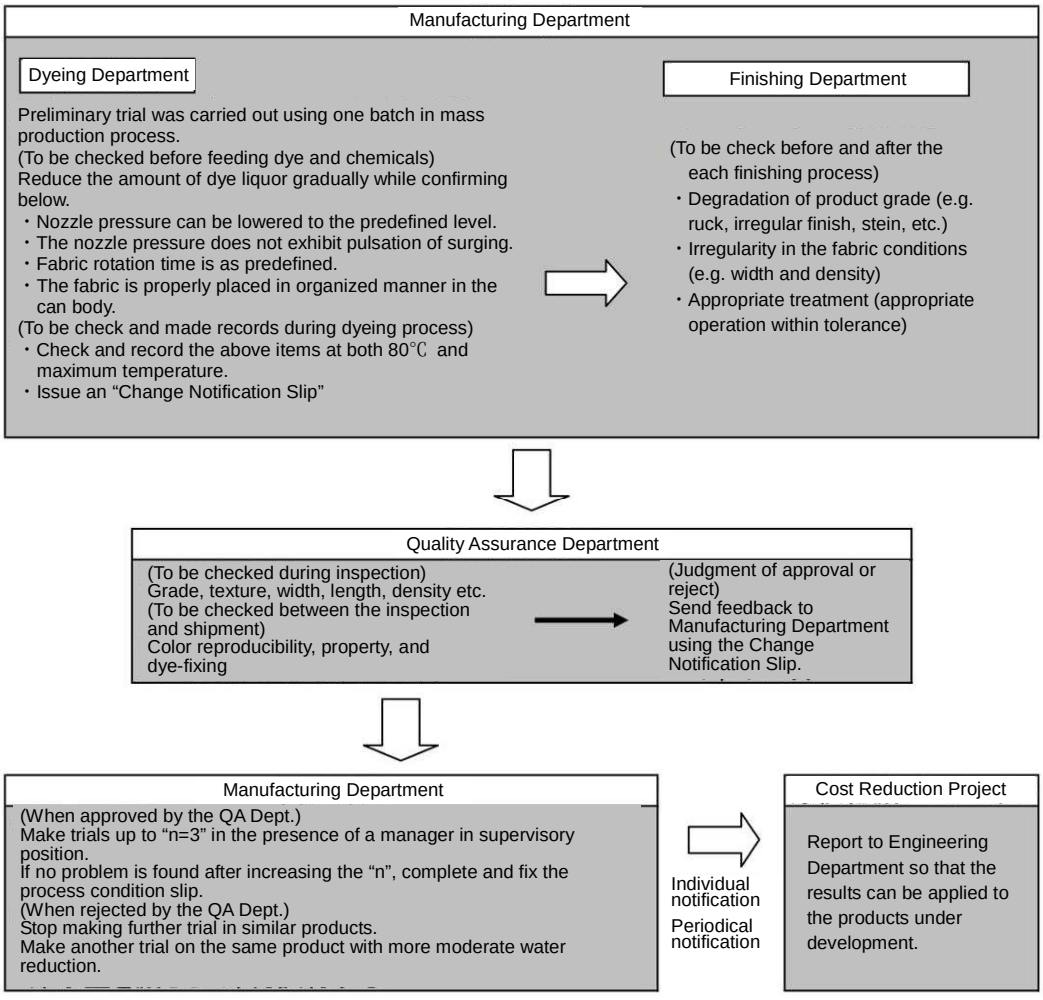
Study on steam usage by dyeing machines

Amount of dye liquor	2,500 L/batch	
Weight dyed materials	240 kg	Steam cor ⇨ ı
Max. dyeing temperature	135 ℃	497 kg/batch
Dwell at max. temperature	30 minutes	
Dyeing machine model	Machine heat-insulated on its can body	

Estimated LNG reduction when the amount of dye liquor was reduced from 2,500 L/batch to 2,400 L/batch (water saving of 100 L)

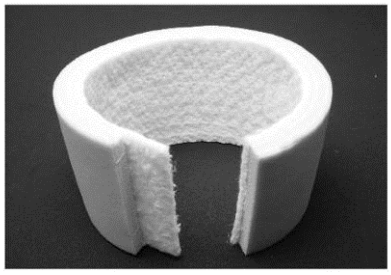
Heat quantity of 0.6 MPa steam	2,747 kJ/kg -- Steam	
Heat quantity of LNG	54,500 kJ/kg-LNG	1.36 kg-LN[illegible] [illegible] L
Boiler efficiency	93%	
Heat release loss	10%	

Rules for controlling and managing the changes



2) Case study of equipment improvements

a. Reduced heat-release loss of pipes



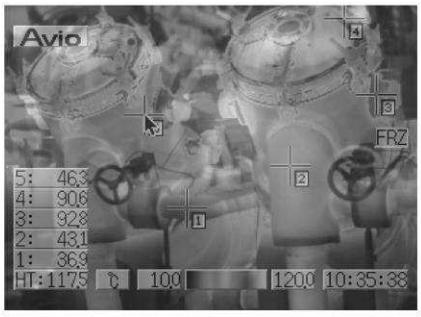
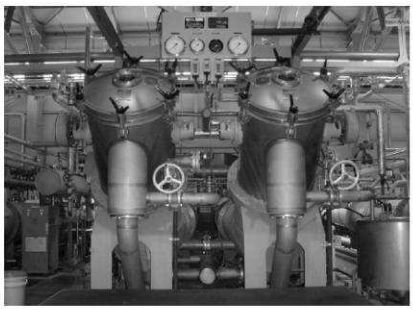
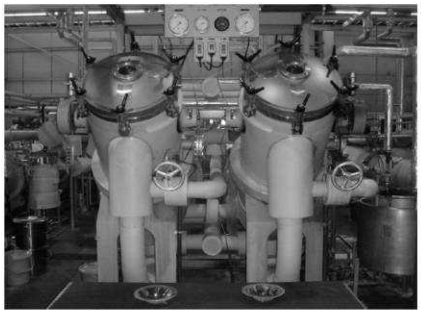
Using thermographic inspection, energy reduction effect made by covering bare heat pipes with thermal insulation was calculated. As the thermal insulation material, a double-layered structure with thermal-resistant glass fiber and PE (polyethylene) foam insulation was selected. Number of lamination to be applied was determined based on use of the pipes as follows:

- Pipes for heat medium at 230℃: 5 mm glass fiber layer x 3 + 5 mm PE layer x 2
- Pipes for steam at 135℃: 5 mm glass fiber x 1 + 5 mm PE layer x 2

	Total Surface Area	Temp. before Thermal Insulation Work	Temp. after Thermal Insulation Work	Heat Transfer Coefficient	Emissivity	Heat Quantity at Heat Source		Conductive Heat Transfer	Convective Heat Transfer	Radiant Heat Transfer	Reduced Heat Quantity	Reduction	
	m2	℃	℃	α	ε	Heat source	kcal/kg	kcal/h	kcal/h	kcal/h	kcal/h		kg/h
Pipes of Dyeing Machine	70	112.9	60.0	15	0.74	Steam of 6 kg/cm2	550	55,545	22,383	25016	102944	Steam	187.17
Heat Insulation on Cylinder (Small diameter)	0.575	95.3	56.7	15	0.74	Steam of 2 kg/cm2	530	332	123	136	591	Steam	1.12
Heat Insulation on Cylinder (Large diameter)	1	95.0	60.0	15	0.74	Steam of 2 kg/cm2	530	519	188	216	923	Steam	1.74
												Total Steam	190.03

	Total Surface Area	Temp. before thermal insulation work	Temp. after thermal insulation work	Heat Transfer Coefficient	Emissivity	Heat Quantity at Heat Source		Conductive Heat Transfer	Convective Heat Transfer	Radiant Heat Transfer	Reduced Heat Quantity	Reduction	
	m2	℃	℃	α	ε	Heat source	kcal/kg	kcal/h	kcal/h	kcal/h	kcal/h		kg/h
Pipes of Dyeing Machine	15	84.4	34.9	15	0.74	LNG	13,020	11,137	4,414	3,976	19,527	LNG	1.50
Heat Insulation on Cylinder (Small diameter)	58	189.6	60.0	15	0.74	LNG	13,020	112,752	56,845	70,277	239,874	LNG	18.42
Heat Insulation on Cylinder (Large diameter)	26	189.6	60.0	15	0.74	LNG	13,020	50,544	25,482	31,503	107,529	LNG	8.26
												Total LNG	28.18

Photos and thermographic images before and after thermal insulation work

Before Thermal Insulation Work	After Thermal Insulation Work
	
	

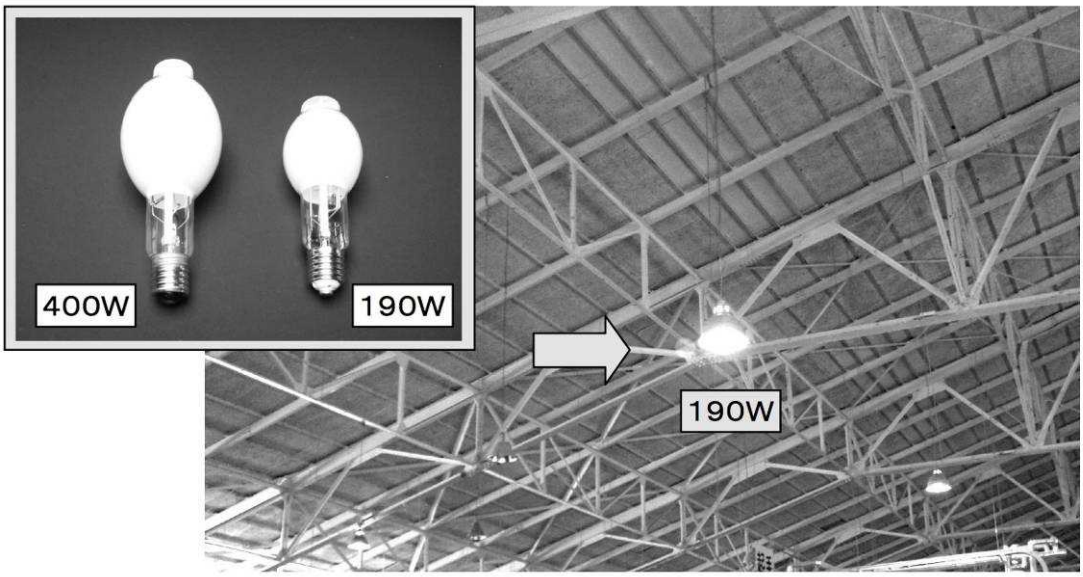
b. Case study of reduced electricity consumption

Preliminary study was carried out following understanding of current situation and developing guidelines for measures to be taken.

	Before Improvements	Improvement Plan	Result from Preliminary Study on 3 Units
Type of Lighting	Mercury lamp	Use lamp with higher efficiency than current one	HID metal halide lamp
Number of Fixtures	117	Keep current number	Trail of 3 out of117
Height of Lights	6 m	Lower the position	5.5 m
Electricity Consumption	400 W	200 W	190 W
Electricity/Unit	0.434 kW	Lower than current level	0.223 kW
Electric Current/Unit	2.2 A	Lower than current level	1.2 A
Light Reflector	Slight dirtiness	Use after cleaning	Used after cleaning
Life of Lamp	12,000 hours	Keep current condition	12,000 hours
Illuminance	66 to 208 lx	Keep current condition	90 to 328 lx
Brightness	-	No discomfort is expressed	No discomfort

The results of the preliminary study were determined to be positive. Based on the calculated improvement effect, all 117 units were replaced.

Reduced electricity consumption: 0.211 kw/unit x 117 units x 552 hours/month = 13,627 kwh/month

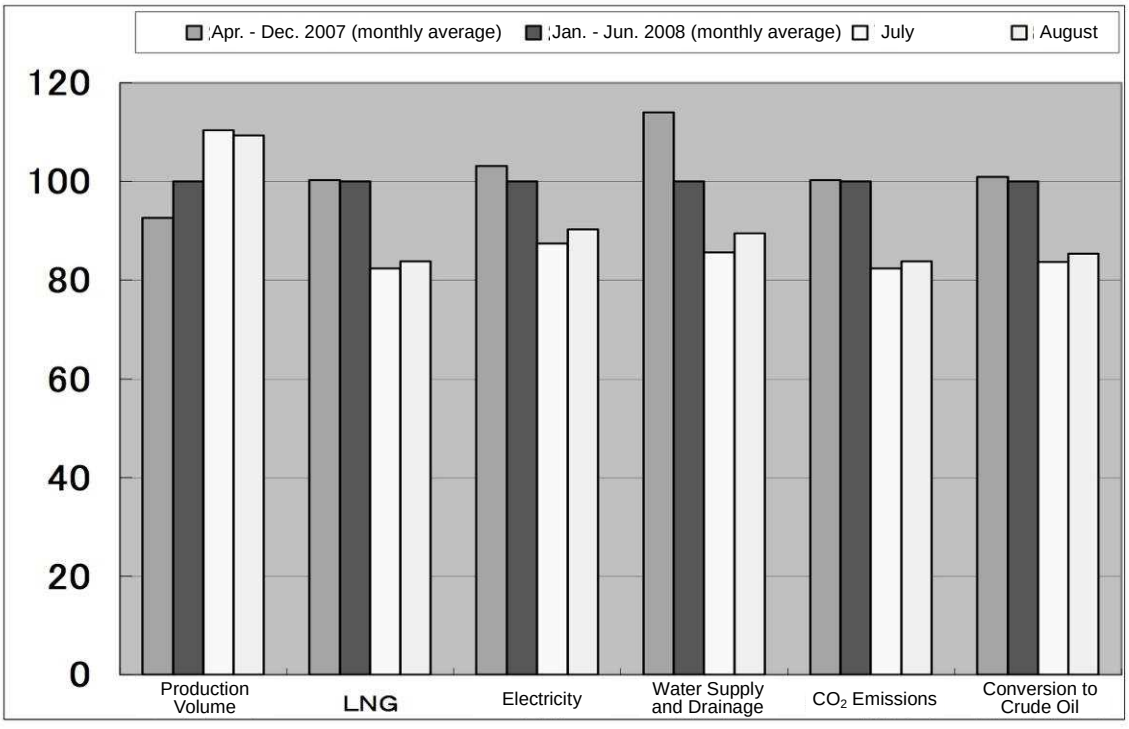


(5) Effects Achieved after Implementing Measures

Actual changes in various energy-related items

Term	Apr. - Dec. 2007 (Monthly Average)	Jan. - Jun. 2008 (Monthly Average)	July (Reduction Rate)	August (Reduction Rate)
No. of Operation Day (days/month)	23.89	22.67	22.00	21.00
Production Volume (m/month)	531,276	544,269	582,617	550,970
Production Volume (m/day)	22,239	24,012	26,483	26,237
LNG (kg/month)	173,017	176,805	155,855	149,863
LNG (kg/m)	0.3257	0.3248	0.2675 (17.7)	0.2720 (16.3)
LNG (kg/day)	7,243	7,800	7,084 (9.2)	7,136 (8.5)
Electricity (kwh/month)	315,916	314,061	293,970 (6.4)	287,115 (8.6)
Electricity (kwh/m)	0.5946	0.5770	0.5046 (12.6)	0.5211 (9.7)
Electricity (kwh/day)	13,224	13,856	13,362 (3.6)	13,672 (1.3)
Water supply and drainage (m3/month)	39,942	35,917	32,908 (8.4)	32,505 (9.5)
Water Supply and Drainage (m^3/m)	0.07518	0.06599	0.05648 (14.4)	0.05900 (10.6)
Water Supply and Drainage (m^3/day)	1,672	1,585	1,496 (5.6)	1,548 (2.3)
CO_2 Emissions (t-CO_2)	466.9	477.1	420.6 (11.8)	404.4 (15.2)
CO_2 Emissions (t-CO_2/m)	0.0008788	0.0008766	0.0007219 (17.6)	0.0007340 (16.3)
CO_2 Emissions (t-CO_2/day)	19.54	21.05	19.12 (9.2)	19.26 (8.5)
Crude Oil Equivalent (kl/month)	324.5	329.4	294.8 (10.5)	284.6 (13.6)
to Crude Oil Equivalent (kl/m)	0.0006109	0.0006052	0.0005059 (16.4)	0.0005165 (14.6)
Crude Oil Equivalent (kl/day)	13.59	14.53	13.40 (7.8)	13.55 (6.7)

Changes in intensities (Percentage to the average between January and June, 2008)



Against our projection of 4% reduction to be achieved by three major measures (Water savings of dyeing machines, inhibition of heat emission from pipes, and replacement of lighting fixtures), we obtained excellent reduction results significantly exceeding the projection in July and August. We assume that due to some measures which were not originally planned, such as replacement of heat-medium oil for boilers and more rationalized timing of raising machine temperatures, have worked effectively.

However, since the data we obtained was only for less than 2 months, it is necessary to continue the measures and keep track of them as sustainable “Cost Reduction Project”, in order to determine how much contribution they make for further development of the improvement activities.

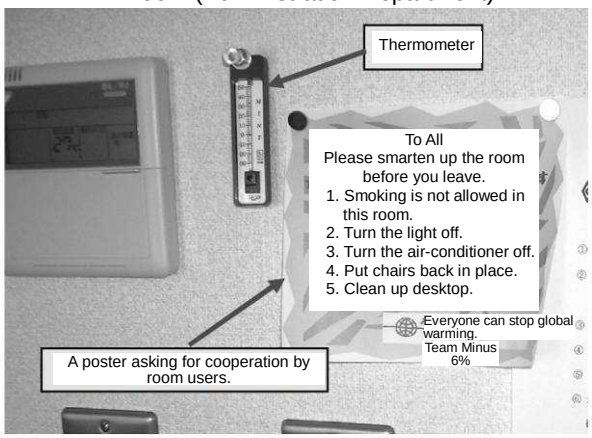
We believe the task required for us next is to develop a mechanism to evaluate proposals and measures.

3. Summary

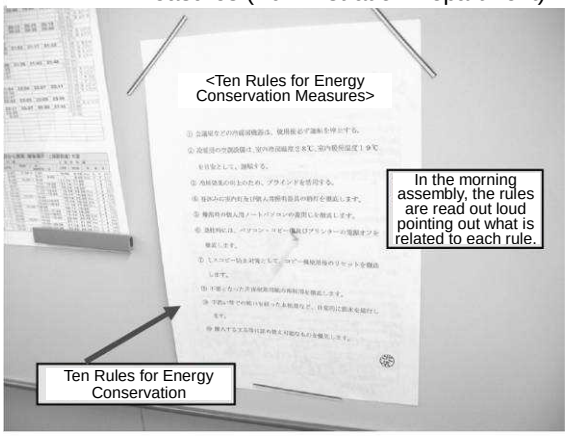
We realize that, as a result of launching the “Cost Reduction Project”, awareness in energy conservation has been raised and is being stabilized among employees of entire company. We also realize that it was proven in the course of overall efforts in the past two months that although each measure taken by each department did not produce large energy conservation effect, we could achieve large conservation by building up small measures and efforts we made while we did not have enough meters and personnel to measure the results in each improvement measure. It was the foremost achievement that our efforts in implementing the measures did not “end up in vain”.

During the project, the innovative ideas provided by each employee were firstly discussed on the table of small group meeting, then forwarded to the project team, and finally put into practice. We consider the process we followed was our “enhancement of basic capabilities to become an energy conservation plant”. Not only the Manufacturing Department, but also Administration Department took part in the project by individual commitment management as well as improvement measures involving customers. Such activities resulted in, as by-product, appealing the company approach toward energy conservation to customers.

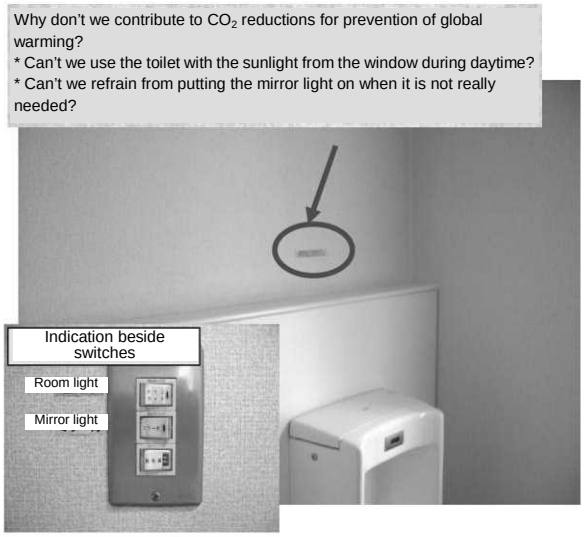
Example 1: Poster for Energy Conservation in Reception Room (Administration Department)



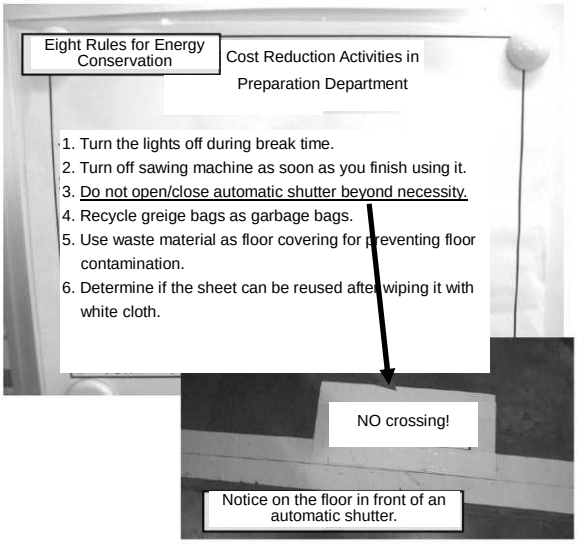
Example 2: 10 Rules for Energy Conservation Measures (Administration Department)



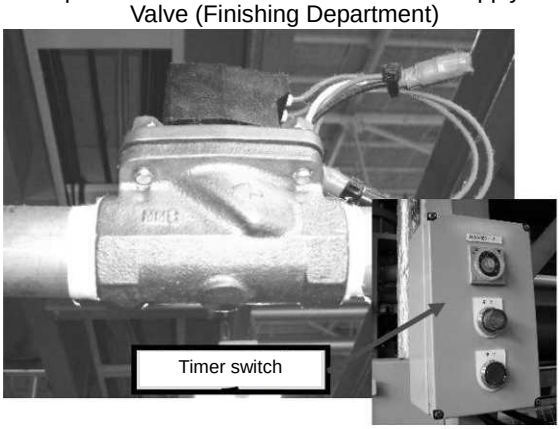
Example 3: Notice for Energy Conservation Posted in Lavatories (Administration Department)



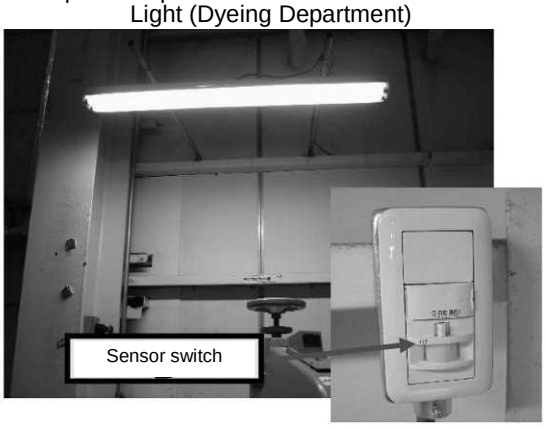
Example 4: Eight Rules for Energy Conservation Measures (Preparation Department)



Example 5: Installation of Timer on Water Supply Valve (Finishing Department)



Example 6: Replacement with Sensor-controlled Light (Dyeing Department)



4. Future Plans

Although it is expected that developing further ideas on future measures is more difficult, we

will focus on maintaining our motivations toward device and improvement of ideas, which we regard as basic capabilities to become more energy conserving plant.

We are determined to maintain and improve the results we obtained through the two-month project by continued efforts to have the “Cost Reduction Project” keep showing its approach not to disregard small suggesting by employees and not to overlook even a tiny improvement effect they bring.

At this point where less than two months have passed since we launched the full-scale activities, the “enhancement of basic capabilities to become an energy conserving plant” project still has many factors need refinement and we have many points to reflect on. Our future activities will focus on expanding the “first step” described in this report to “second and third steps”, which would lead us to more concrete achievement.