5.10 Results of Survey of Glass Factory

5. Survey of the Use of Energy in Model Factory

5.10 Results of Survey of Glass Factory

5.10.1 Outline of the Factory

(1) Name of the factory : Rayen Cura

(2) Type of product : Glass

(3) Location of the Factory : Bandera de los Andes 6070 (Carril Nacional), Rodeo de la Cruz-Mendoza (5525)

(4) Summary

The factory produces 130,000 wine and champagne bottles daily. The factory was originally built 40 years ago. Under a modernization program, the factory has been innovated since eight years ago, centralizing the melting furnaces, renewing bottle forming machines, and improving the material yard.

Rayen Cura is a small one of the 12 glass factories in Argentina, but holds a share of about 80% of the wine and champagne bottle market in that country because, for one thing, the price of products is not so high and, for another, other factories do not produce wine and champagne bottles except when they have extra capacity to do so.

Because wine exports are on the increase, Rayen Cura is planning to renew the old equipment that still remains in the plant to improve quality and raise the production capacity.

80 to 90 tons of material is melted daily. The material is mostly (85%) cullet.

The fuel was changed to natural gas in 1984.

(5) Number of employees : 175, of which one is engineer.

(6) Survey period : November 21 to 25, 1988

(7) Survey members

Name	Assignment
Mitsuo Iguchi	Chief
Shoji Nakai	Glass process
Isamu Taki	Heat management
Yukio Nozaki	Heat management
Teruo Nakagawa	Heat management
Toshio Sugimoto	Electrical management

INT members

Mr. Ernesto M. Leikis	Chief
Mr. Marcelo A. Silvosa	Unit operation, process
Mr. Jorge A. Fiora	Unit operation, process
Mr. Alberto Berset	Heat using equipment
Mr. Anibal A. Monzon	Heat using equipment, mobile unit driving
Mr. Miguel A. Bermejo	Electric power receiving and distributing equipment
Mr. Arturo D. Verghelet	Electric power receiving and distributing equipment
Mr. Osvaldo H. Franco	Electric power receiving and distributing equipment

(8) Interviewed

Mr. Anibal Cucurella	Factory manager

Ing. Miguel A. Bosio Technical advisor

(9) Production

Table 5–10–1 Production

Year	1983	1984	1985	1986	1987
Molten Glass (ton)			23,639	24,297	30,346
Bottles (million)	30.9	42.9	38.5	39.1	47.3

(10) Energy consumption

Table 5–10–2 Energy Consumption

Year	1983	1984	1985	1986	1987
Natural Gas $1000m^3$	0	300	7,310	7,090	7,886
Oil kl	4,500	5,700	0	0	0
Elect. Power MWh	2,300	3,470	3,258	3,480	4,189
Energy/Molten Glass					
Natural Gas m^3/t			309.2	291.8	259.9
Power KWh/t			137.8	143.2	138.0

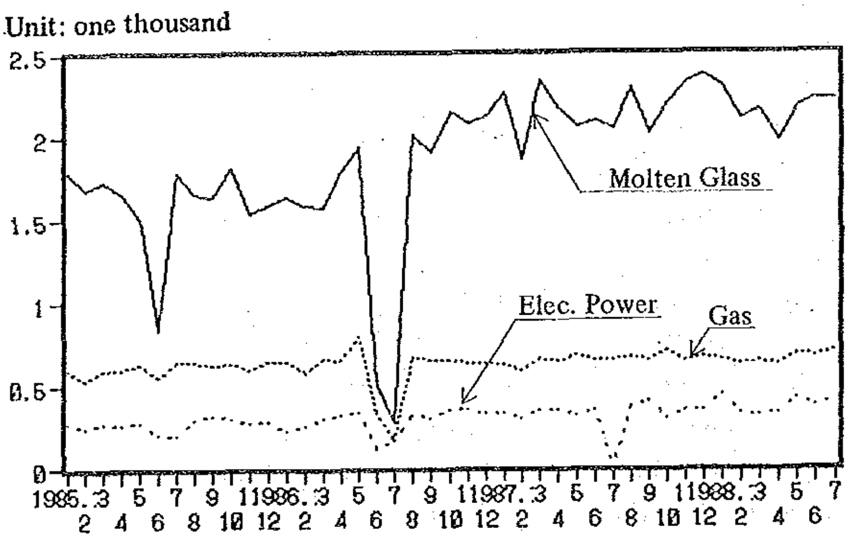


Figure 5–10–1 Production, Energy Consumption

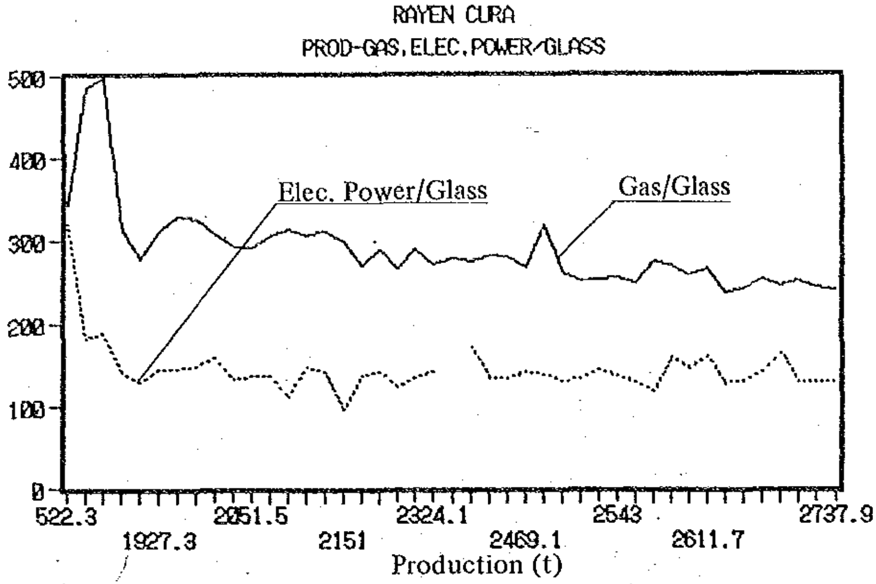


Figure 5–10–2 Energy Consumption/Product

Electric power unit price	0.04 U$S/kWh
Natural gas unit price	0.06 U$S/Nm^3

(11) Plant layout

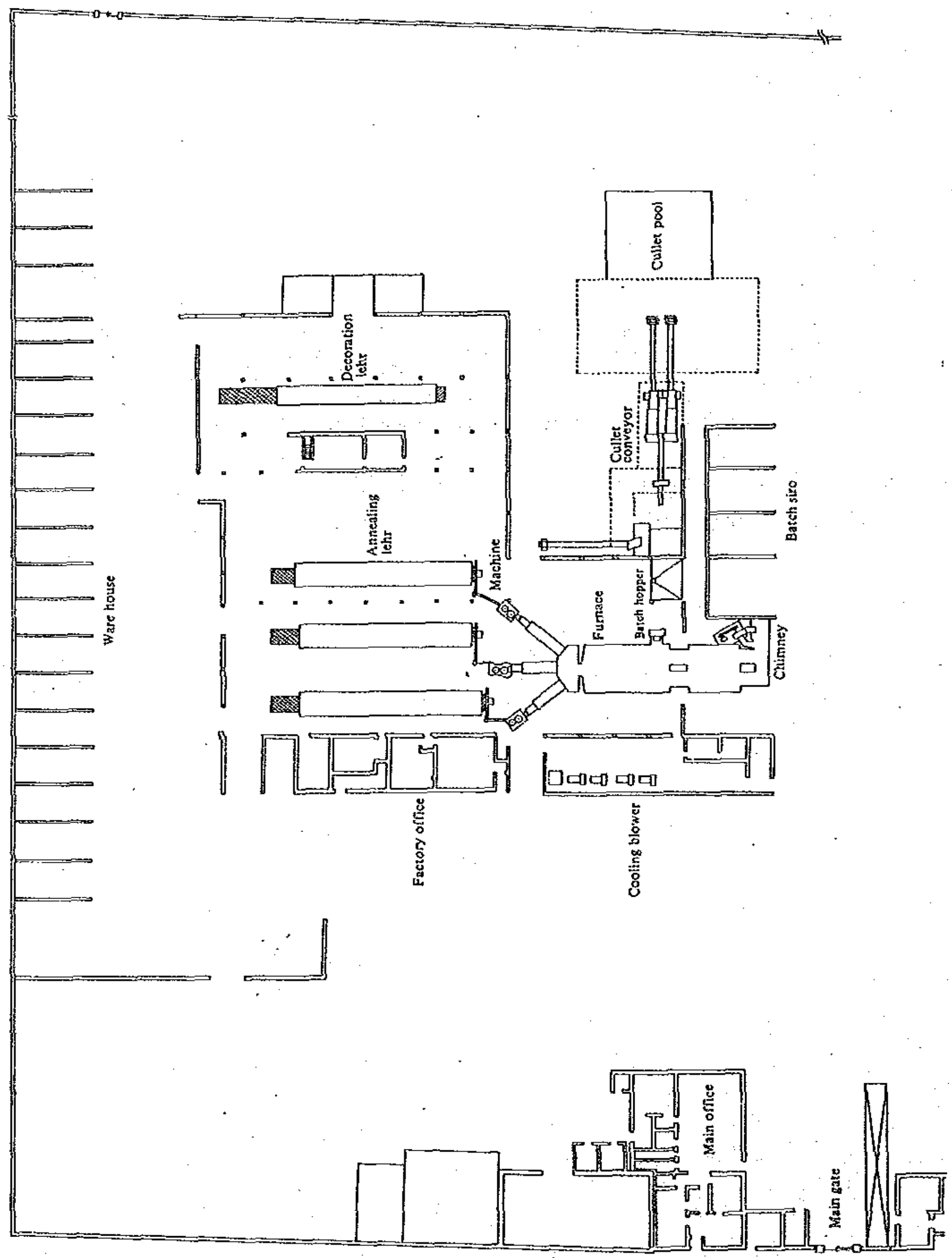


Figure 5-10-3 Factory Layout

(12) Production process

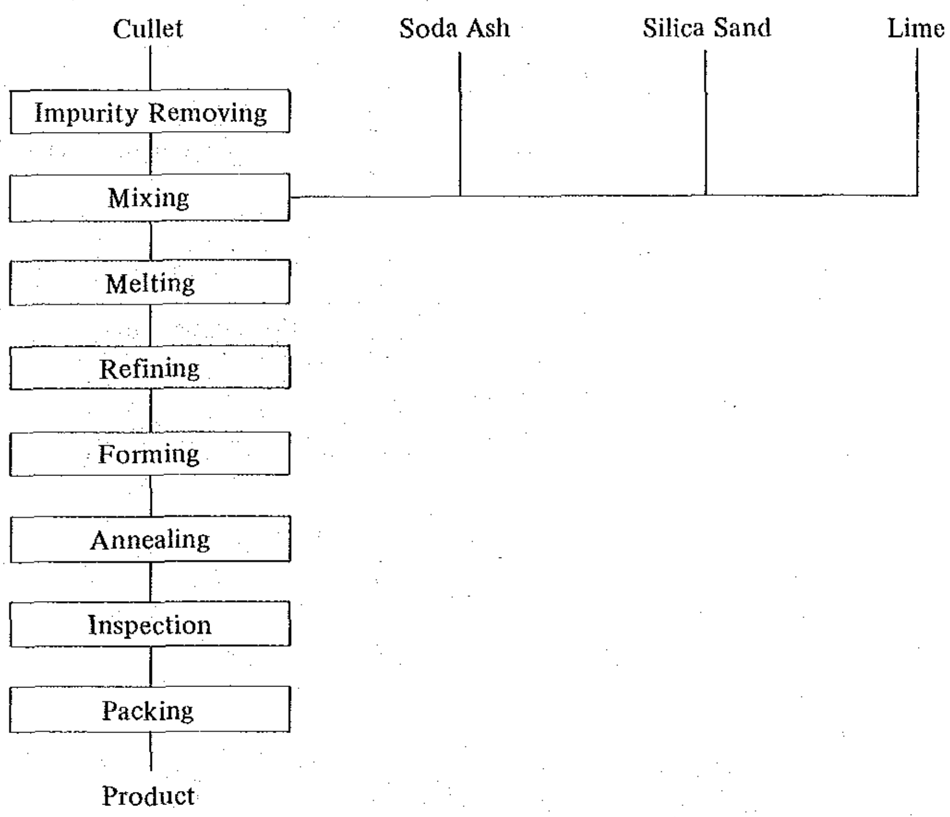
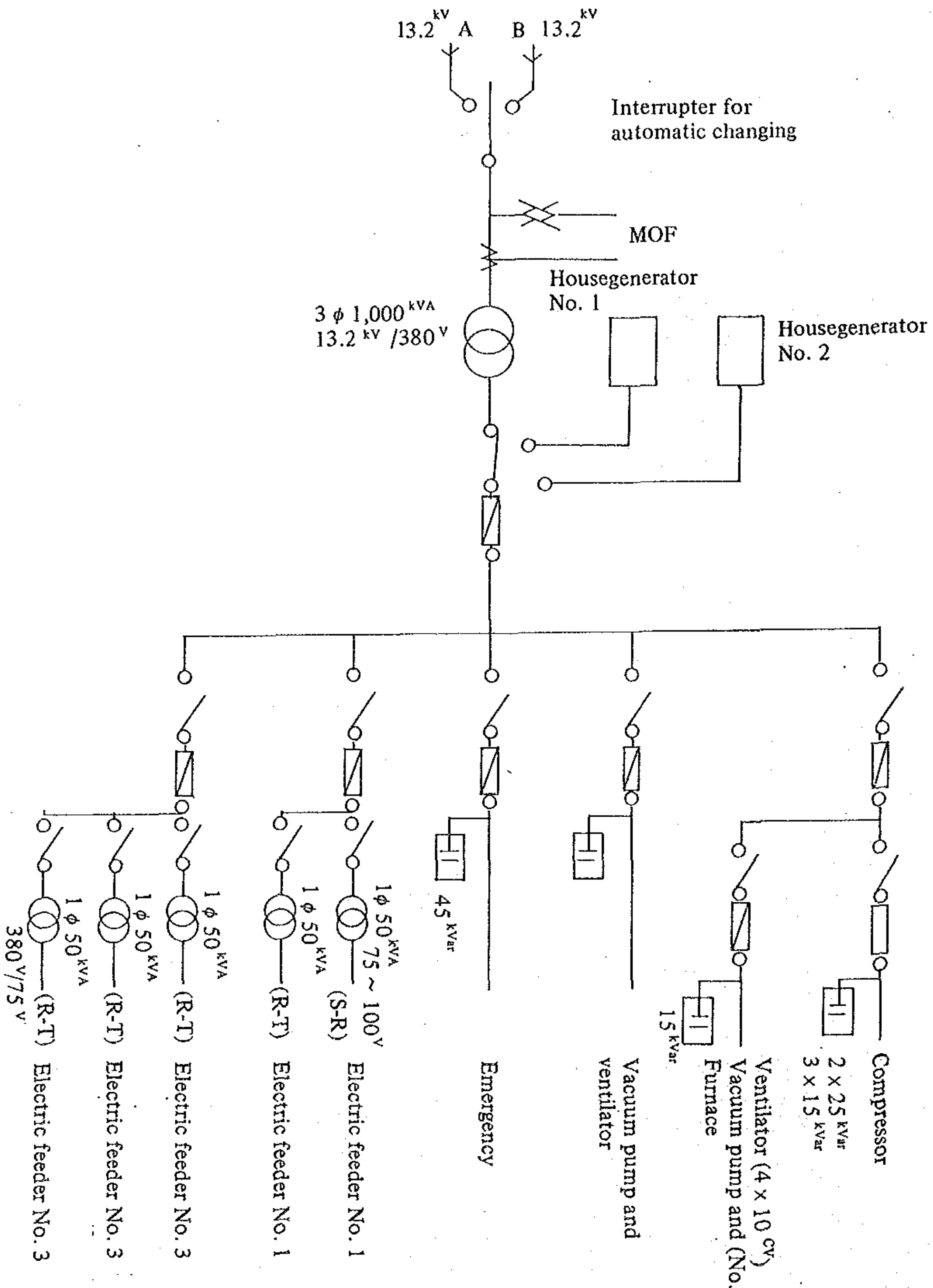


Figure 5–10–4 Production Process

(13) One line diagram



(S-R), (R-T): Phase

Figure 5–10–5 One Line Diagram

(14) Major equipment

Table 5–10–3 Major Equipment

Name	Number	Specification
Batch Mixer	1	Magnet, Metal Detector
Tank Furnace	1	End Port, 5 x 9 m
Regenerator	1	
Forehearth	3	Electric Forehearth (2) Gas Forehearth (1)
Forming Machine	3	Roirant (2) 50 bottles/min O'Neil (1) 20 bottles/min
Annealing Lehr	3	Net 1.8 m(w) x 22.4 m(l)
Compressor	5	50 Hp (3), 90 Hp (1), 75 Hp (1)
Vacuum Pump	4	50 Hp (4)
Blower	10	10 Hp (4), 20 Hp (2), 25 Hp (1) 31 Hp (1), 100 Hp (2)

(15) Plant operating time

24 h/d X 365 d/y = 8,760 h/y

5.10.2 Energy Management

(1) Energy conservation target

The glass industry requires so much heat that energy expenditure accounts for as much as 20% of the production cost. Therefore, the factory manager and engineer take a great interest in matters concerning energy. They are aware that their energy consumption level is not quite adequate by international standard.

However, the factory does not have a concrete target for reducing energy consumption to what extent and by what time. The first step necessary for promoting an energy conservation program participated in by the superintendent and all the employees is to clearly show the direction in which the employees must proceed.

Energy can be conserved in two aspects, that is, improving the equipment and operation.

In the aspect of the equipment, the plant has the project to increase the production capacity and improve product quality to meet the growing demand for wine bottles. A long-range equipment renovation plan and an energy conservation target including better heat insulation of the melter which harmonize with capacity reinforcement and product improvement must be made clear considering available funds.

Energy conservation through more strict operation management depends much on the cooperation of the employees, and must be promoted by setting up a target, educating the employees about the proper way of operation, and providing incentives, such as commendation those with efficient performance. The factory checks percent defective daily, prepares statistics by cause, and enforces a bonus and penalty system based on percent defective. It is suggested that this system be made better use of because improvement of yield would be highly effective for energy conservation.

(2) Determining energy consumption

To improve the equipment and operation, it is essential to collect and process data on production, quality, and energy, and thus accurately determine the facts about the factory. Without data which shows the relationship of operating conditions with production, quality, and energy consumption, it won't be possible to determine what is to be emphasized and how to make the improvement plan. If variations from data values are found, or if deviation occur from the planned values or design values, clues to improvement may be found by tracking down the cause.

The factory keeps a daily record of electric power consumption and a monthly record of gas consumption, monthly calculates electric power and gas consumption per unit product, and thus monitors the trends of energy consumption. Because gas consumption is calculated by correcting the number of days to calendar days of the month based on the invoices from the gas company, the gas consumption data does not always fit to the production figures. If an abnormal value is found in a monthly record, it is too late to determine the cause, and to take an appropriate remedial step for it. If a daily report is kept, recording the amounts of material consumption and energy consumption, temperature and other operating conditions, product quality, and yield, and if it is used as data for analysis, management would become possible in greater detail.

For this purpose, it is desirable that gas flowmeters be installed on the main equipment, including the tank furnace and lehrs, so that the operators will be able to know energy consumption. Such a simple step of installing meters can automatically induce the operators to initiate a saving action.

(3) Employee education and training

Even though the employees want to make improvements, they won't be able to do so unless they know how. It is therefore important to educate the employees through training courses, for example.

Rayen Cura has only one engineer, but he has a sufficient technical knowledge to serve as an instructor for educating the employees in the factory.

As regards access to new technical information, lectures are occasionally given by the machine and furnace material manufacturers, but there are neither technical periodicals published by the industry association nor training courses given by the same. It is desirable that INTI or other official organs provide instructions and information.

The glass industry uses a lot of equipment and does not depend much on the skills of the individual workers, but it is important to operate the equipment in a safe, reliable way according to the operation standard. The problem of breakage of bottles in the annealing lehr, for example, which will be discussed later in the report can be easily solved if the workers are aware of the importance and observe the operating conditions accordingly. If the workers take interest in solving problems apart from mere providing labor in place of the machines, they can be expected to add a tremendous force to help achieve the target.

This factory cannot afford to spare a good portion of time for employee training because it is in continuous operation. Thus, it may be effective to have a type of training dealing with specific problems and working out solutions.

Periodic training will be necessary for the temperature measurement of molten glass, the inspection of product bottles, and other items that require elimination of personal ability differences.

(4) Equipment management

Maintenance in this factory appeared generally satisfactory. The machines were kept clean and properly cared for, and the drawings were properly filed. Considering the large heat dissipation loss generated constantly, the operating factor should be raised as much as possible to reduce energy loss and costs.

5.10.3 Problems with Use of Energy and Remedial Measures

5.10.3.1 Melting Furnace

(1) Heat balance

(A) Scope of heat balance claculation

The scope is from the melter to the regenerator, and does not include the forehearths.

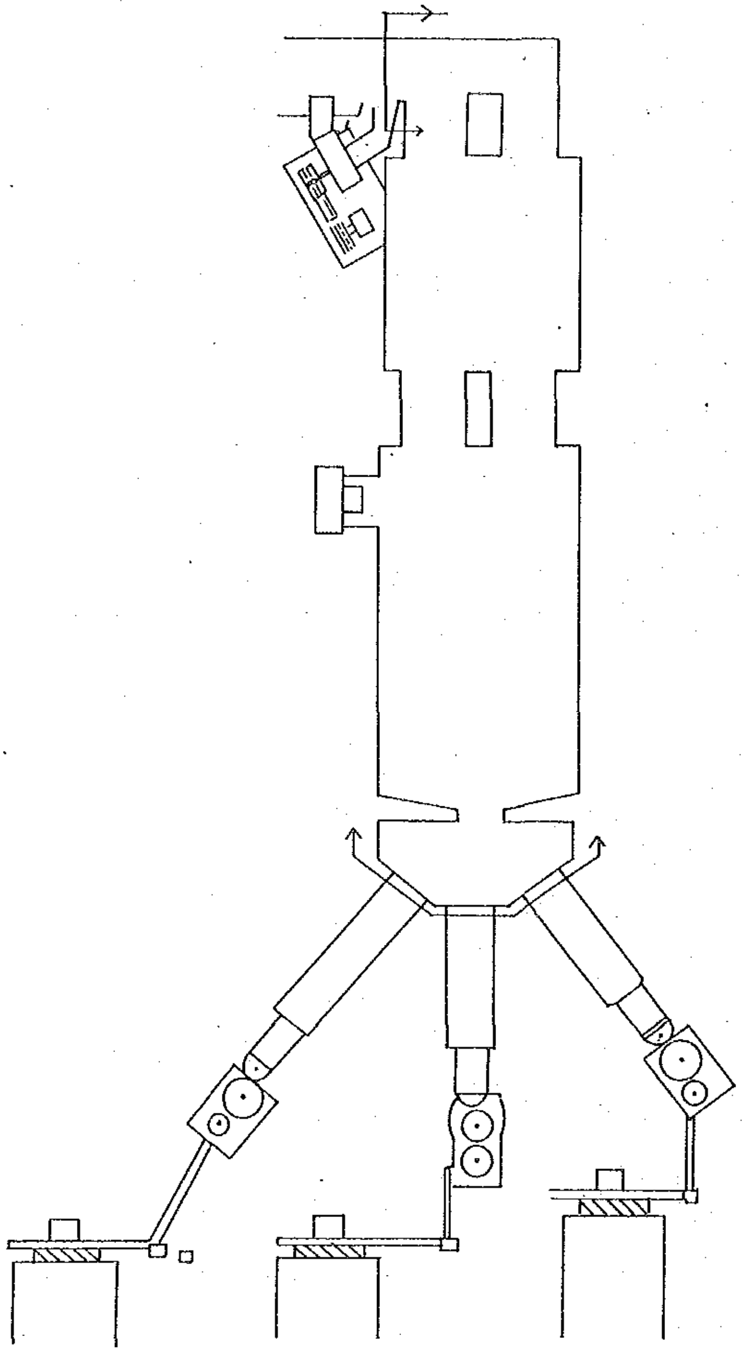


Figure 5-10-6 Scope of Heat Balance Calculation

(B) Basis of calculation

Reference temperature is set at 20°C

(a) Combustion

Table 5–10–4 Combustion

	Left combustion	Right combustion
Fuel gas		
Consumption	712.13 Nm^3/h	718.15 Nm^3/h
Temperature	32.7°C	28.7°C
Exhaust gas	(Upper part of right regenerator)	(Upper part of left regenerator)
Average composition		
O_2	4.05%	5.11%
CO_2	9.91%	9.86%
Temperature	1,210°C	1,197°C
Temperature of combustion air	(Upper part of left regenerator) 1,089°C	(Upper part of right regenerator) 1,118°C
Lower flue exhaust gas		
Average composition		
O_2	11.96%	9.80%
CO_2	4.99%	6.39%
Temperature	452°C	489°C
Gas flow velocity	3.40 m/s	2.69 m/s
Flue cross section	1.591 m^2	1.591 m^2

(b) Theoretical quantity of combustion air

$A_0 = 100/21\ (2CH_4 + 7/2C_2H_6 + 5C_3H_8 + 13/2C_4H_{10} + 8C_5H_{12} + 19/2C_6H_{14})$

$= 9.8355$ $[Nm^3/Nm^3\text{-Fuel}]$

(c) Theoretical quantity of exhaust gas

$G_0 = (3CH_4 + 5C_2H_6 + 7C_3H_6 + 9C_4H_{10} + 11C_5H_{12} + 13C_6H_{14} + N_2 + CO_2 + 79/100A_0) = 10.8740$ $[Nm^3/Nm^3\text{-Fuel}]$

(d) Composition of exhaust gas F : Fuel consumption

$CO_2 = (CH_4 + 2C_2H_6 + 3C_3H_8 + 4C_4H_{10} + 5C_5H_{12} + 6C_6H_{14} + CO_2) \times F + 52.8$

$= 1.0688 \times F + 52.8$ $[Nm^3/h]$

$H_2O = (2CH_4 + 3C_2H_6 + 4C_3H_8 + 5C_4H_{10} + 6C_5H_{12} + 7C_6H_{14}) \times F + 33.1$

$= 2.0269 \times F + 33.1$ $[Nm^3/h]$

$N_2 = (N_2) \times F + 79/100A_0 \times F$ $[Nm^3/h]$

$SO_2 = 0.71$ $[Nm^3/h]$

(e) Quantity of air (Air passing through regenerator + air sucked into burner + leaking air)

$A = mA_0$

(f) Quantity of exhaust gas (Burnt exhaust gas + gas generated in melting process)

$G = G_0 + (A - A_0) + 86.6$ (1)

$O_2\%/100 = 0.21 \times (A - A_0)/(G - \text{water vapor})$ (2)

G (quantity of exhaust gas) and A (quantity of air) are calculated from equations (1) and (2) above.

(g) Quantity of glass taken out

Table 5–10–5 Quantity of Glass Taken Out

Forming machine No.	Glass temperature °C	Product weight g	Forming speed (bottles/min)	Quantity of glass taken out kg/h
1	1,183	545	45.4	1,486
2		520	19.6	612
3		890	31.7	1,693
Total	1,183			3,791

(h) Quantity of material (molten amount)

Table 5–10–6 Quantity of Material (Molten Amount)

	Quantity of material charged kg/h	Glass made kg/h	
Raw material			
Silica sand	407		
Soda ash	142		
Lime	102		
Gypsum	10		
Sodium nitrate	24		
Chromite	11		
Subtotal	696	569	
Cullet	3,222	3,222	Percentage of cullet 85%
Water	21	0	Batch water content 3%
Total	3,939	3,791	

(i) Quantity of gas generated from raw material

Soda ash $Na_2CO_3 \rightarrow Na_2O + CO_2 \uparrow$

CO_2 22.4 x 1/106 = 0.211 [Nm³/kg]

Lime $CaCO_3 \rightarrow CaO + CO_2 \uparrow$

CO_2 22.4 x 1/100 = 0.224 [Nm³/kg]

Gypsum $CaSO_4 \cdot 10H_2O \rightarrow CaO + SO_3 \uparrow + 10H_2O \uparrow$

SO_3 22.4 x 1/316 = 0.071 [Nm³/kg]

H_2O 22.4 x 10/316 = 0.709 [Nm³/kg]

CO_2 0.211 x 142 + 0.224 x 102 = 52.8 [Nm³/h]

SO_3 0.071 x 10 = 0.71 [Nm³/h]

H_2O 0.709 x 10 + 22.4/18 x 20.88 = 33.1 [Nm³/h]

(j) Reaction heat of vitrifaction

25 kcal/kg – Quantity of material charged (glass containing 85% cullet)

(k) Specific heat of glass

0.29 kcal/(kg°C)

(l) Cooling water

Inlet temperature : 32.4°C

Outlet temperature : 51.3°C

Quantity of cooling water : 810 m³/h

(C) Calculation of quantity of exhaust gas and of air

(a) Quantity of exhaust gas from the upper part of regenerator

Calculated from equations (1) and (2) in (B)–(f) above.

A_0 = 9.8355, G_0 = 10.8740

(1) Left combustion

F = 712.13, O_2% = 4.05 to G = 9,348, A = 8,522 [Nm³/h]

(2) Right combustion

F = 718.15, O_2% = 5.11 to G = 9,956, A = 9,124 [Nm³/h]

(b) Quantity of exhaust gas from flue

This is calculated in the same way as in (a) above.

(1) Left combustion

F = 712.13, O_2% = 11.96 to G = 16,236, A = 15,410 [Nm³/h]

(2) Right combustion

F = 718.15, O_2% = 9.80 to G = 13,502, A = 12,670 [Nm³/h]

(c) Composition of exhaust gas

Table 5–10–7 Composition of Exhaust Gas

	Upper part of right regenerator Nm³/h	%	Upper part of left regenerator Nm³/h	%	Right flue Nm³/h	%	Left flue Nm³/h	%
O_2	319	3.41	433	4.34	1,765	10.87	1,177	8.71
N_2	6,739	72.08	7,213	72.45	12,180	75.01	10,015	74.17
H_2O	1,477	15.79	1,489	14.95	1,477	9.09	1,489	11.02
CO_2	814	8.70	820	8.23	814	5.01	820	6.07
SO_2	1	0.01	1	0.01	1	0.01	1	0.01
Exhaust gas	9,348		9,956		16,236		13,502	
Air	9,124		8,522					

(d) Enthalpy of exhaust gas

(1) Upper part of regenerator

Table 5–10–8 Enthalpy of Exhaust Gas (Upper Part of Regenerator)

	1,360°C	1,347°C	20°C	Right exhaust gas	Left exhaust gas
O_2	0.363 x 1,360	0.363 x 1,347	0.313 x 20	447.42 x 0.0341	482.70 x 0.0434
N_2	0.344 x 1,360	0.343 x 1,347	0.311 x 20	461.62 x 0.7208	455.80 x 0.7245
H_2O	0.415 x 1,360	0.414 x 1,347	0.342 x 20	557.56 x 0.1579	550.82 x 0.1495
CO_2	0.557 x 1,360	0.556 x 1,347	0.392 x 20	749.68 x 0.0870	741.09 x 0.0823
Total				502.618	494.516

Note: The exhaust gas from the upper part of the regenerator was about 1,200°C, which is too low compared with the temperature of the glass of 1,530°C in the furnace. The thermometer was not long enough to reach the center of gas flow, possibly preventing accurate measurement of the actual gas temperature. Therefore, 150°C was added to the measured value to match actual measurements example in Japan.

(2) Flue

Table 5–10–9 Enthalpy of Exhaust Gas (Flue)

	452°C	489°C	20°C	Right exhaust gas	Left exhaust gas
O_2	0.332 x 452	0.334 x 489	0.313 x 20	143.80 x 0.1087	157.07 x 0.0871
N_2	0.318 x 452	0.319 x 489	0.311 x 20	137.52 x 0.7501	149.77 x 0.7417
H_2O	0.360 x 452	0.362 x 489	0.342 x 20	155.88 x 0.0909	170.17 x 0.1102
CO_2	0.473 x 452	0.478 x 489	0.392 x 20	205.96 x 0.0501	225.90 x 0.0607
Total				143.27	157.23

(D) Table of heat balance

(a) Heat input

(1) Sensible heat of fuel

Table 5–10–10 Sensible Heat of Fuel

Constituent	Gas composition %	Specific heat at constant pressure 20°C	40.8°C	34.6°C
CH_4	91.98	0.375	0.381	0.379
C_2H_6	4.13	0.465	0.473	0.471
C_3H_8	0.82	0.726	0.746	0.740
C_4H_{10}	0.37	0.911	0.936	0.930
C_5H_{12}	0.12	1.315	1.363	1.351
C_6H_{14}	0.07	1.574	1.639	1.616
N_2	0.83	0.311	0.311	0.311
CO_2	1.68	0.392	0.397	0.396
Total, average	100.00	0.385	0.392	0.390
Entahlpy		7.70	15.99	13.49

Left combustion (15.99 – 7.70) x 712.13 = 5,904

Right combustion (13.49 – 7.70) x 718.15 = 4,158

Average 5,031 [kcal/h]

(2) Combustion heat of fuel

Left combustion 9,837 x 712.13 = 7,005,223

Right combustion 9,837 x 718.15 = 7,064,442

Average 7,034,800 [kcal/h]

(3) Sensible heat of combustion air

Left combustion

Air temperature 1,089°C

Quantity of air 8,522 – 1,600 = 6,922 [Nm^3/h] Note

Sensible heat (0.341 x 1,089 – 0.311 x 20) x 6,922 = 2,527,000 [kcal/h]

Right combustion

Air temperature 1,118°C

Quantity of air 9,124 – 1,600 = 7,524 [Nm^3/h] Note

Sensible heat (0.341 x 1,118 – 0.311 x 20) x 7,524 = 2,821,000 [kcal/h]

Average 2,674,000 [kcal/h]

Note: The quantity of air for combustion that passes through the regenerator is equal to the quantity of air for combustion calculated from the O_2 content (%) of exhaust gas minus the quantity of air drawn in through the burner and peephole and of furnace cooling air entering the furnace. The quantity of air entering through the burner was calculated in item (2) above to be about 800 Nm^3/h. Because the quantity of cooling air and air leaking through the peephole could not be calculated, however, it was assumed that there would be a total air entry of 1,600 Nm^3/h.

(b) Heat output

(1) Heat taken away by glass

3,791 x 0.29 x (1,183 – 20) = 1,278,591 [kcal/h]

(2) Batch reaction heat

3,791 x 25 = 94,775 [kcal/h]

(3) Latent heat of batch water evaporation

21 x 539 = 11,319 [kcal/h]

(4) Heat taken away by batch charger cooling water

(51.3 – 32.4) x 810 = 15,000 [kcal/h]

(5) Heat taken away by exhaust gas

Table 5–10–11 Heat Taken Away by Exhaust Gas

	Left combustion	Right combustion	Average
Upper part of regenerator			
Gas temperature [°C]	1,360	1,347	
Enthalpy [kcal/Nm^3]	502.618	494.516	
Quantity of gas [Nm^3/h]	9,348	9,956	
Heat [kcal/h]	4,699,000	4,923,000	4,811,000
Stack			
Gas temperature [°C]	452	489	
Enthalpy [kcal/Nm^3]	143.27	157.23	
Quantity of gas [Nm^3/h]	16,236	13,502	
Heat [kcal/h]	2,326,000	2,123,000	2,225,000

(6) Heat loss from furnace surface

Melter	1,513,400	[kcal/h]
Refiner	182,300	[kcal/h]
Throat, bridge cover	22,400	[kcal/h]
Port	347,300	[kcal/h]
Regenerator	740,800	[kcal/h]
Total	2,806,200	[kcal/h]

The quantity of heat radiating from the furnace walls was calculated by substituting the measured outer surface temperature in the following equations.

Coefficient of radiant heat transfer

$$hr = 4.88\,\phi\,[\left(\frac{273 + to}{100}\right)^4 + \left(\frac{273 + ta}{100}\right)^4]/(to\text{-}ta)$$

Coefficient of convective heat transfer

$$hc = \kappa\,\sqrt[4]{(to\text{-}ta)}$$

Amount of heat release

= (hc + hr) x (to-ta) [kcal/h]

where to : outer surface temperature

ta : ambient temperature ta = 40

ϕ : emissivity ϕ = 0.8

κ : coefficient Horizontal up surface κ = 2.8

Horizontal down surface κ = 1.5

Vertical surface κ = 2.2

Table 5–10–12 Heat Loss from Wall Surface (Kcal/h)

Measuring points			Average heat release per unit area	Surface temp. (°C)	Surface area (m^2)	Heat loss (kcal/h)
Bottom	Melter	Under	3,690	248	51.25	188,900
		side	1,960	164	10.95	21,400
	Throat	Under	3,180	230	0.32	1,000
		side	3,380	220	1.48	5,000
	Refiner	Under	2,670	210	9.88	26,400
		side	1,640	149	6.71	11,000
Crown	Melter		12,340	405	63.50	783,700
	Refiner		10,690	378	5.81	62,100
Side-wall	Melter	Wall	6,540	310	27.41	179,300
		Doghouse	5,130	274	2.95	15,100
	Refiner		4,950	269	10.28	50,900
Throat			7,370	329	1.48	10,900
Breast-wall	Melter		8,600	356	23.76	204,300
	Refiner		4,980	270	5.63	28,100
Doghouse	Upper structure		1,870	150	0.38	700
Tuck stone	Melter		4,560	276	5.28	24,100
	Refiner		2,920	220	1.31	3,800
Back-wall	Wall		10,210	385	6.41	65,500
	Upper		9,150	350	3.32	30,400
Bridge cover			2,140	187	2.56	5,500
Port	Crown		11,960	399	10.42	124,600
	Skew, side wall		11,940	414	15.28	182,400
	Bottom		3,180	230	9.74	31,000
	Burner block		13,510	438	0.69	9,300
Regenerator	Side	Upper	5,890	294	33.14	195,200
		Middle	2,090	170	62.93	131,800
		Lower	760	101	62.93	48,000
	Under rider arch		250	64	49.53	12,200
	Crown		11,900	398	29.72	353,600

Table 5–10–13 Heat Balance

(Heat input)

	Item	10³ [kcal/h]	Ratio/heat input by fuel alone (%)	Ratio/total heat input (%)
1	Combustion heat of gas	7,034.8	99.93	72.42
2	Sensible heat of gas	5.0	0.07	0.05
	Sub-total	7,039.8	100.00	72.47
3	Heat of combustion air	2,674.0	37.98	27.53
	Total heat input	9,713.8	137.98	100.00

(Heat output)

	Item		10^3 kcal/h	Ratio/heat input by fuel alone (%)	Ratio/total heat input (%)
1	Heat taken out by glass		1,278.9	18.17	13.17
2	Heat loss in exhaust gas (from flue)		4,811.0 (2,225.0)	68.34 (31.61)	49.53 (32.54)
3	Heat loss from wall				
	Bottom	Melter throat refiner	210.3 6.0 37.4	2.99 0.09 0.53	2.16 0.06 0.39
	Crown	Melter refiner	783.7 62.1	11.13 0.88	8.07 0.64
	Sidewall	Melter refiner	194.4 50.9	2.76 0.72	2.00 0.52
	Throat		10.9	0.15	0.11
	Breast wall	Melter refiner	204.3 28.1	2.90 0.40	2.10 0.29
	Doghouse upper structure		0.7	0.01	0.01
	Tuck stone	Melter	24.1 3.8	0.34 0.05	0.25 0.04

	Item			10^3 kcal/h	Ratio/heat input by fuel alone (%)	Ratio/total heat input (%)
	Back wall			95.9	1.36	0.99
	Bridge cover			5.5	0.08	0.06
	Port	Crown		124.6	1.77	1.28
		Skew, side wall		182.4	2.59	1.88
		Bottom		31.0	0.44	0.32
		Burner block		9.3	0.13	0.10
	Regenerator	Upper		195.2	2.77	2.01
		Middle		131.8	1.87	1.36
		Lower		60.2	0.86	0.62
		Crown		353.6	5.02	3.64
	Heat loss sub total			2,806.2	39.86	28.89
4	Batch moisture evaporation heat			11.3	0.16	0.12
5	Heat of batch reaction			94.8	1.35	0.98
6	Heat taken out by cooling water			15.0	0.21	0.15
7	Unknown			696.6	9.90	7.17
Total heat output				9,713.8	137.98	100.00

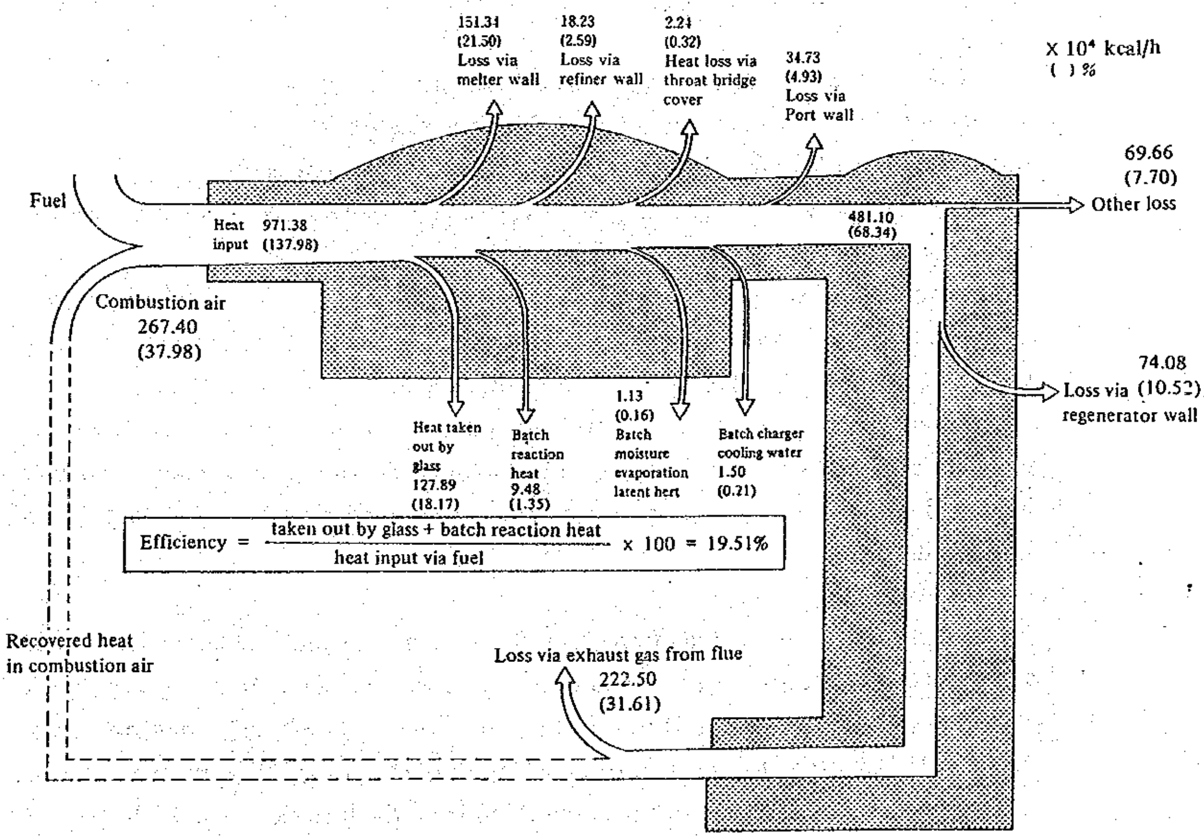


Figure 5–10–7 Heat Balance Chart for Glass Melting Furnace

(E) Evaluation of the table of heat balance

(a) Summary of the heat balance table

Table 5–10–14 Summary of the Heat Balance Table

		A	B	Rayen cura
Heat efficiency	%	34.1	35.3	19.52
Heat loss from furnace surface	%	24.68	18.87	39.86
Exhaust gas loss	%	29.03	25.10	31.61
O_2 % in upper part of regenerator	%	0.8 ~ 0.7	5.75 ~ 6.40	4.05 ~ 5.11
Furnace operating conditions	Fuel consumption 10^4 kcal/t	110.5	104.2	185.5
	Cullet %	54.1	70.4	85.0
Load	ft^2/t	6.08	5.31	5.14
	t/m^2	1.77	2.03	2.09

Note: "A" and "B" in the above table refer to end-port furnace now in operation in Japan.

(b) Heat loss from furnace surface

This factory's furnace surface loss of 5,400 kcal/(m^2.h) is very high, more than 4 times as much as 1,200 to 1,500 kcal/(m^2·h) for recent furnaces in Japan. If the furnace is heat-insulated as recommended in item (3), the furnace surface loss can be reduced to about 3,400 kcal/(m^2h)

(c) Exhaust gas loss

Exhaust gas loss is rather high. At the factory's checker volume of 57.89 m^3, [checker volume/melting area] is 4.37 (CU.FT/SQ.FT), which is lower than the recent data of 5 to 8.

The checker's effective heat transfer area per unit volume was calculated to be 12,992 m^2/m^3, or 752 m^2 in total. This is far smaller than the total effective heat transfer area of 1,200 to 1,300 m^2 for furnaces of similar dimensions in Japan.

It is necessary to either change the way of laying the checker bricks or increase the checker volume.

If the effective heat transfer area is increased to 15 m^2/m^3 by changing the bricks to the cruciform or chimney type, for example, the total effective heat transfer area can be increased to 870 m^2 without changing the regenerator dimensions.

Because it is costly to enlarge the bottom area of the regenerator, it is recommended that, when making repairs on the furnace next time, the checker volume be increased by lowering the rider arch and raising the regenerator top with the port bottom at an angle of 10°

(d) Fuel consumption

Automatic bottle making factories in Japan now consume fuel about 120 to 130 x 10^4 kcal to melt a ton of material on the average, and some of the newest bottle factories consume less than 100 x 10^4 kcal/t. This factory's fuel consumption of 185.5 x 10^4 kcal/t is too high, corresponding to the figures of 15 years ago in Japan. The greatest cause of it is much heat radiation from the furnace walls. If the heat insulation recommended in item (3) is made, the fuel consumption of the factory can be lowered to about 146 x 10^4 kcal/t. According to the data in Japan, fuel can be saved by 1.5 times as much as heat radiation decrease. Fuel saving by reduction of heat radiation:

100.9 x 10^4 x 1.5 = 151 x 10^4 kcal/h.

Expected fuel consumption:

(703 – 151)/3.791 = 145.6 x 10^4 kcal/t.

(2) Improvement of combustion air ratio and prevention of cold air suction

(A) Improvement of air ratio

The exhaust gas oxygen concentration in the upper part of the regenerator was 4.1 to 5.1 percent, which is 1.22 to 1.29 in the air ratio. Exhaust gas oxygen concentration is not measured in this factory. It is suggested that a galvanic cell type portable oxygen analyzer be purchased and be used in daily management to keep oxygen concentration within the range of 2.0 to 3.0 percent. From the data in Japan, an improvement in fuel consumption by 5 x 10^4 kcal/t can be expected from a reduction of oxygen concentration from 4 to 2 percent.

It is further desirable that zirconium type oxygen sensors be installed in the upper part of the regenerator or in the lower part of the flue to control the exhaust gas oxygen concentration at all times.

(B) Maintaining proper furnace pressure

One of the important factors for energy conservation in operating a glass melting furnace is to prevent cold air from directly entering the melter as much as possible and to make best use of the preheated air that has passed through the regenerator.

The factory's furnace pressure in the melter was –0.8 mmAq. To prevent cold air from being drawn in, it is absolutely necessary to make the furnace pressure positive. Normally, a furnace pressure of about +0.8 mmAq is considered best at the measuring port (350 mm above the glass surface near the shadow wall).

It is recommended to maintain an appropriate furnace pressure that the furnace pressure be measured and the flue damper be automatically controlled.

(C) Closing of open parts

The peephole in the melter remained open. It must be closed except when necessary so that cold air can be prevented from entering the furnace. Figure 5–10–8 shows an example of the bricks for the peephole and plug.

The space between the burner tiles and burner was so wide that much air was drawn in through that space. This needs an urgent remedy. According to the data available in Japan, there could be an air entry of 3 m^3/min through a space of 30 mm between the burner and burner tiles.

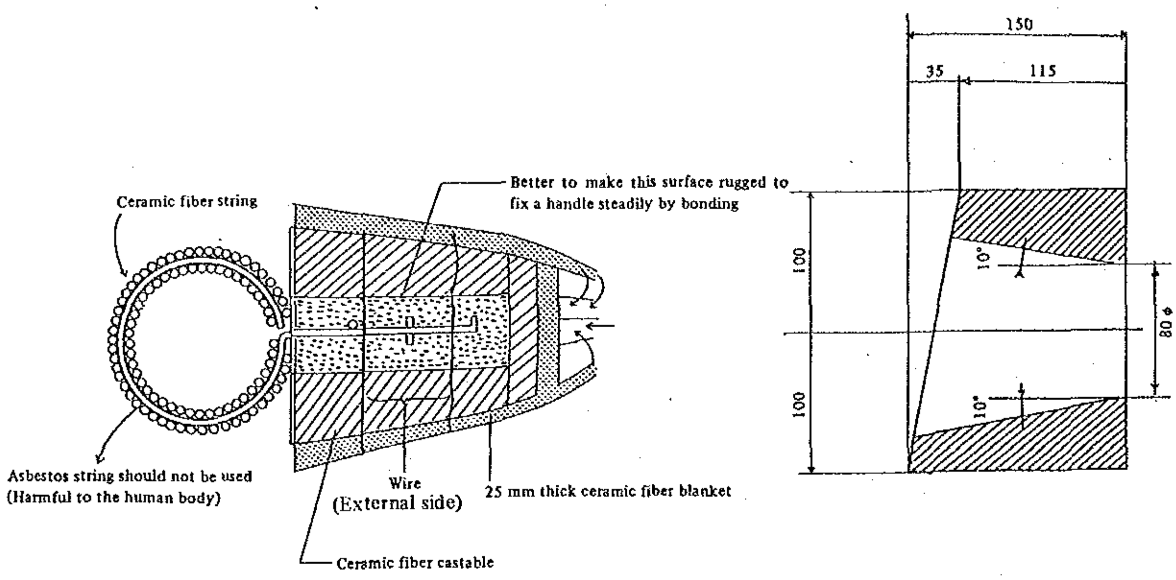


Figure 5–10–8 Sealing of Peep-Holes

(D) Improvement of burners

High-pressure gas burners were installed in the positions where oil burners had been mounted. The structure of the gas burners is such that outside air is injected in at the burners. Air suction speed was measured to be 10 to 30 m/s. As three burners are used, about 100 to 300 Nm^3/h of cold air is drawn in. The high-pressure gas burners are used at the underport, and air is drawn in presumably to prevent the flames from being too long. If the gas pressure is lowered, the flames will become shorter so that it will be no longer necessary to draw air in. If hot air from the regenerator is used instead of cold air, there will be an energy saving of about 111×10^3 kcal/h.

$(0.34 \times 1{,}104 - 0.31 \times 20) \times 300 = 110{,}748$ kcal/h.

(E) Design change of ports

The flow velocity of combustion air calculated on the basis of the present ports is 5.12 m/s, which is lower than the flow velocity of 9 to 11 m/s that is normally required for an end-port furnace. A low flow velocity of combustion air causes the wrong mixture of gas and air and flames too long. Thus it is necessary to adjust the flow velocity of combustion air to the correct level. The ports are only 53 percent of the width of the melter, compared with the normally required 70 to 75 percent of melter width. The ports must be widened and lowered to reduce the cross sectional area so that flame distribution will be improved. If the port bottom is directed down 10° toward the melter, the mixing of gas and air will be better and the regenerator capacity will increase.

Flame emissivity is lower in gas combustion than in oil combustion, so it is suggested that when making furnace repairs next time, the port structure be changed as shown in the guideline so that low-oxygen combustion will be combined with secondary combustion to generate luminous flames.

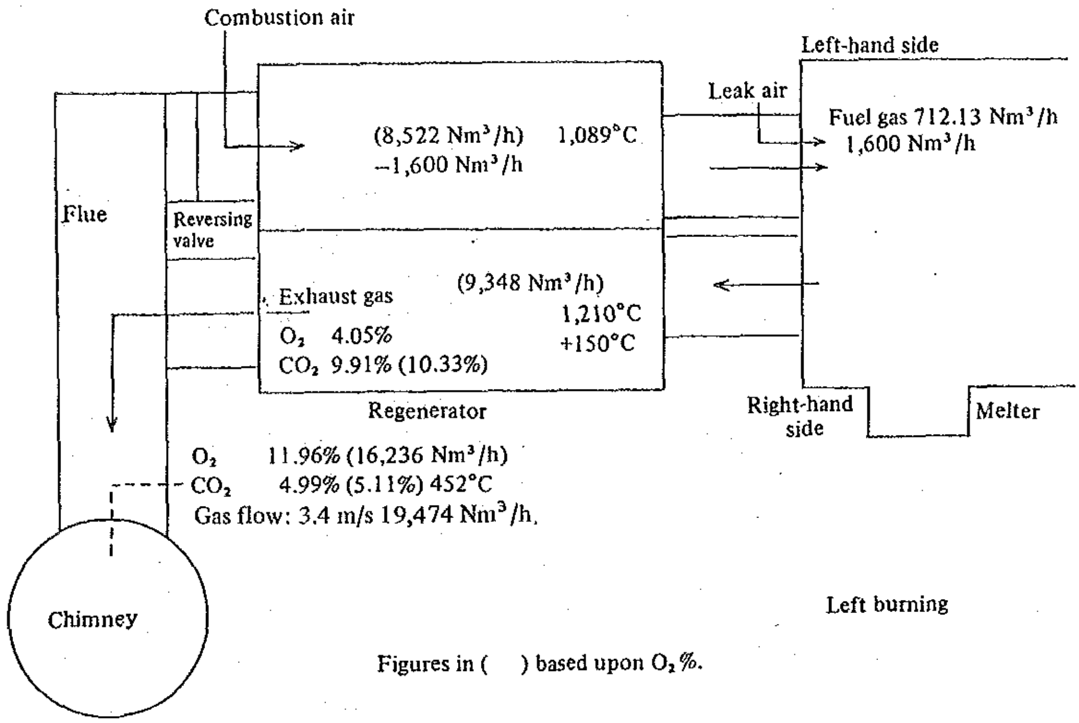


Figure 5–10–9 Combustion Air and Gas Flow Diagram (Left)

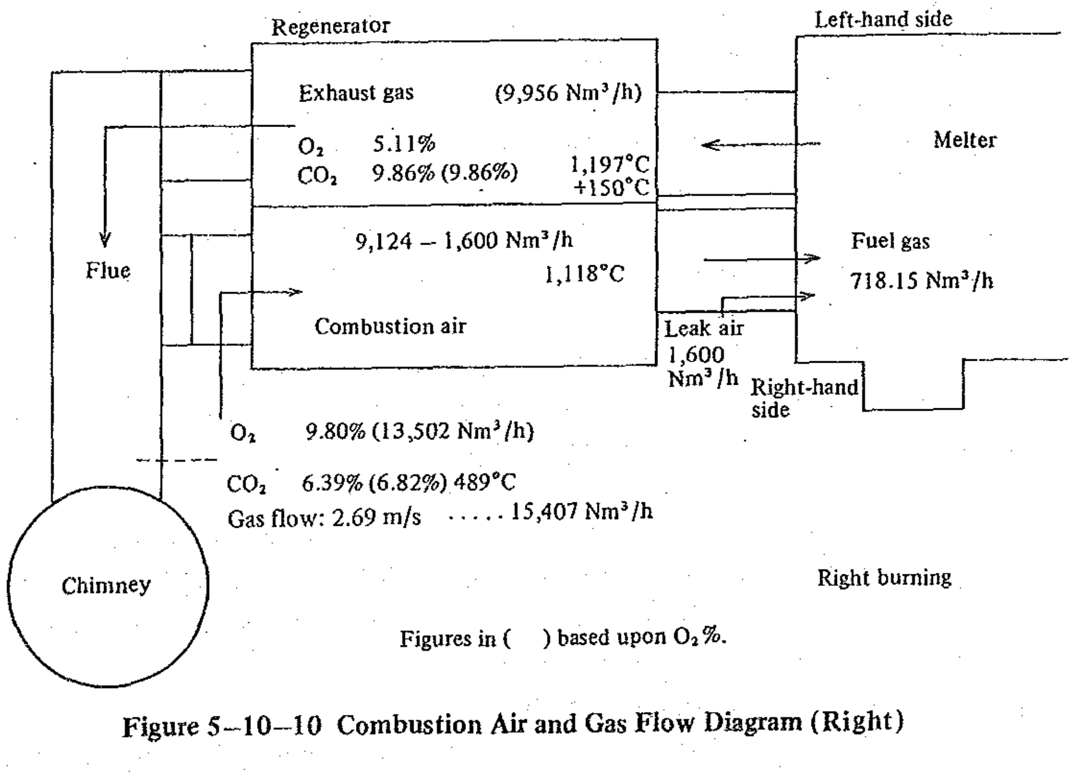


Figure 5–10–10 Combustion Air and Gas Flow Diagram (Right)

(F) Air suction into regenerator

In the right regenerator, the quantity of exhaust gas increased from 9,348 Nm^3/h in the upper part of it to 16,236 Nm^3/h in the lower flue, an increase of 6,888 Nm^3/h. The left regenerator also showed a gas increase from 9,956 Nm^3/h to 13,502 Nm^3/h. These increases are considered due mostly to air leaks through the air dampers. Because the regenerators have negative pressure inside, air leaks through the side walls are also possible. If so, cold outside air cools the checker bricks in the regenerators, thus adversely affecting heat recovery and, cut the thermal efficienty of the regenerators.

Operation is based on natural draft and there is still enough draft capacity so that air leaks through the air damper have not caused actual damage as yet, but when the checkers become clogged up in the future, there will be problems about the maintenance of furnace pressure and blower electric power. It is necessary to repair the air dampers and recoat the joints or spray rock wool in the regenerator walls, particularly the upper part of the walls.

Figure 5–10–9 and 5–10–10 show O_2 percentage, CO_2 percentage, gas temperature, and the amounts of combustion air and exhaust gas in the upper part of the regenerator and the flue. The measurements have little error because there is no significant difference between the calculated and measured amounts of exhaust gas.

(3) Heat insulation of the melting chamber and regenerator

The furnace is little heat-insulated except for that part which must be heat-insulated to provide a satisfactory environment for the workers. It is basically necessary to improve the material of the bricks to be used for the next furnace repairs, and change the furnace design to an energy saving type. The sidewalls are made of two layers of regular electrocasting of AZS, so it is difficult to heat-insulate the furnace without changing the present structure. It is necessary to replace the present two bricks with a single block to reduce joint and heat-insulate the furnace by the time it is repaired next.

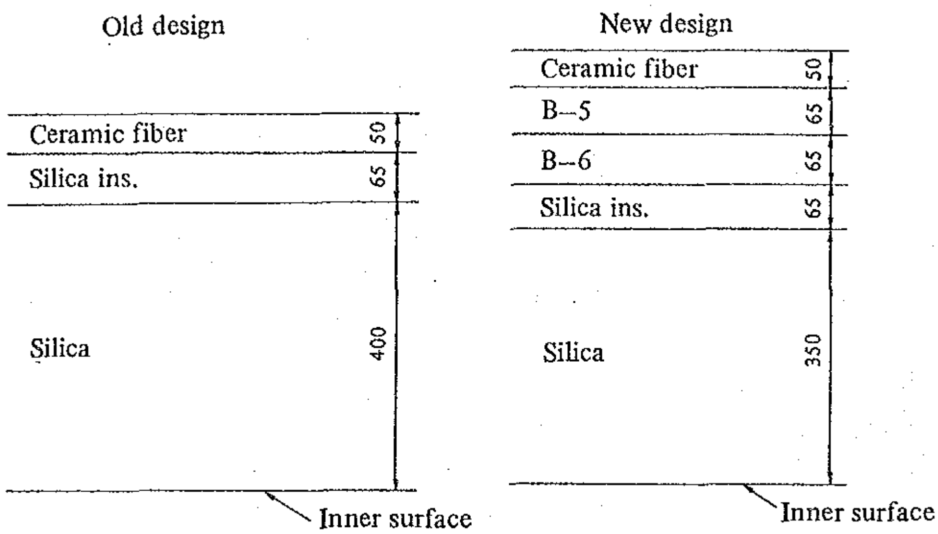
A recent heat-insulation structure is shown in the guideline. The recent heat insulation structure of the melter crown in Japan is shown for example in Figure 5–10–11. The silica bricks used in this example are a super duty type with a flux factor of about 0.14, and are ground to a final thickness of ± 1.0 mm.

Note: Flux factor = AL_2O_3% + 2 x alkali % in silica bricks

A large part of the upper structure can be heat-insulated as it is. There are several parts, such as the melter crown, the regenerator crown, the port crown, breast wall, and the upper wall of the regenerator, which radiate much heat and can now be easily heat-insulated without problems and outside help.

(A) Comparison of insulation materials

The thicknesses of various kinds of insulation materials that provide the same heat insulation effect, and the temperature at the boundary of the new and old bricks were calculated.



	Old design	New design
Inner surface temperature	1550 °C	1550 °C
Outer surface temperature	109.6 °C	83.4 °C
Amount of heat radiation	1505 kcal/m²·h	1046 kcal/m²·h

Figure 5–10–11 Latest Melter Crown-Insulation

(a) Melter crown

Table 5–10–15 Melter Crown

Measurement results Internal surface temperature 1,500°C External surface temperature 405°C
Heat radiation 12,300 kcal/m^2 h
Insulation effect

Insulation material	Thickness	Heat conductivity	Brick boundary temperature	External surface temperature	Heat radiation
Insulating firebrick	114	0.4	950	184	2,700
Insulating firebrick	130	0.4	990	176	2,500
Fiber 1400	50	0.15	1,200	154	2,000

(b) Regenerator crown

Table 5–10–16 Regenerator Crown

Measurement results Internal surface temperature 1,200°C External surface temperature 398°C
Heat radiation 11,800 kcal/m^2h
Insulation effect

Insulation material	Thickness	Heat conductivity	Brick boundary temperature	External surface temperature	Heat radiation
Insulating firebrick	114	0.4	880	175	2,500
Insulating firebrick	130	0.4	910	168	2,300

(c) Port crown

Table 5–10–17 Port Crown

Measurement results Internal surface temperature 1,250°C External surface temperature 399°C
Heat radiation 11,900 kcal/m² h
Insulation effect

Insulation material	Thickness	Heat conductivity	Brick boundary temperature	External surface temperature	Heat radiation
Insulating firebrick	114	0.4	1,070	180	3,100
Insulating firebrick	130	0.4	1,100	190	2,800
Fiber 1400	75	0.15	1,140	155	2,000

(d) Breast wall

Table 5–10–18 Breast Wall

Measurement results Internal surface temperature 1,500°C External surface temperature 356°C
Heat radiation 8,600 kcal/m² h
Insulation effect

Insulation material	Thickness	Heat conductivity	Brick boundary temperature	External surface temperature	Heat radiation
Fiber 1400	25	0.15	800	220	3,500
Fiber 1400	50	0.15	1,000	185	2,500
Insulating firebrick	114	0.4	960	195	2,700

(e) Upper wall of regenerator

Table 5–10–19 Upper Wall of Regenerator

Measurement results Internal surface temperature 1,200°C External surface temperature 294°C
Heat radiation 5,890 kcal/m² h
Insulation effect

Insulation material	Thickness	Heat conductivity	Brick boundary temperature	External surface temperature	Heat radiation
Fiber 1100	50	0.15	875	170	2,100
Silica board	50	0.10	952	147	1,600

(B) Recommended insulation methods for various parts and predicted economic effects

(a) Basis of economic calculations

Table 5–10–20 Basis of Economic Calculations

Price of Insulator

		Unit price	Thickness	Amount
Insulating firebrick	65 x 114 x 230 mm	0.3 U$S	114 mm	20.1 U$S/m²
Insulating firebrick	65 x 114 x 230 mm	0.3 U$S	130 mm	22.8 U$S/m²
Fiber 1400	25 x 1,000 x 1,000 mm	52.9 U$S	25 mm	52.9 U$S/m²
Fiber 1100	25 x 1,000 x 1,000 mm	30.3 U$S	25 mm	30.3 U$S/m²
Silica board 1000	50 x 300 x 600 mm	20.8 U$S	50 mm	116 U$S/m²

Natural gas 9,837 kcal/Nm³ 0.06 U$S/Nm³ 0.00643 U$S/1,000 kcal

(b) Melter crown

Of the surface area (63.50 m²) of the melter crown 57.02 m² except the expansion part of 460 mm will be insulated with insulating firebricks 130 mm thick.

Cost of bricks	22.8 x 57.02 = 1,300.06	[U$S]
Decrease of heat radiation	(12,300 – 2,500) x 57.02 = 558,800	[kcal/h]
Profit	558.8 x 0.00643 x 24 = 86.23	[U$S/Day]
Saving of expenses	1,300.06 ÷ 86.23 = 15.1	[Day]
Insulating method	Figure 5–10–12	

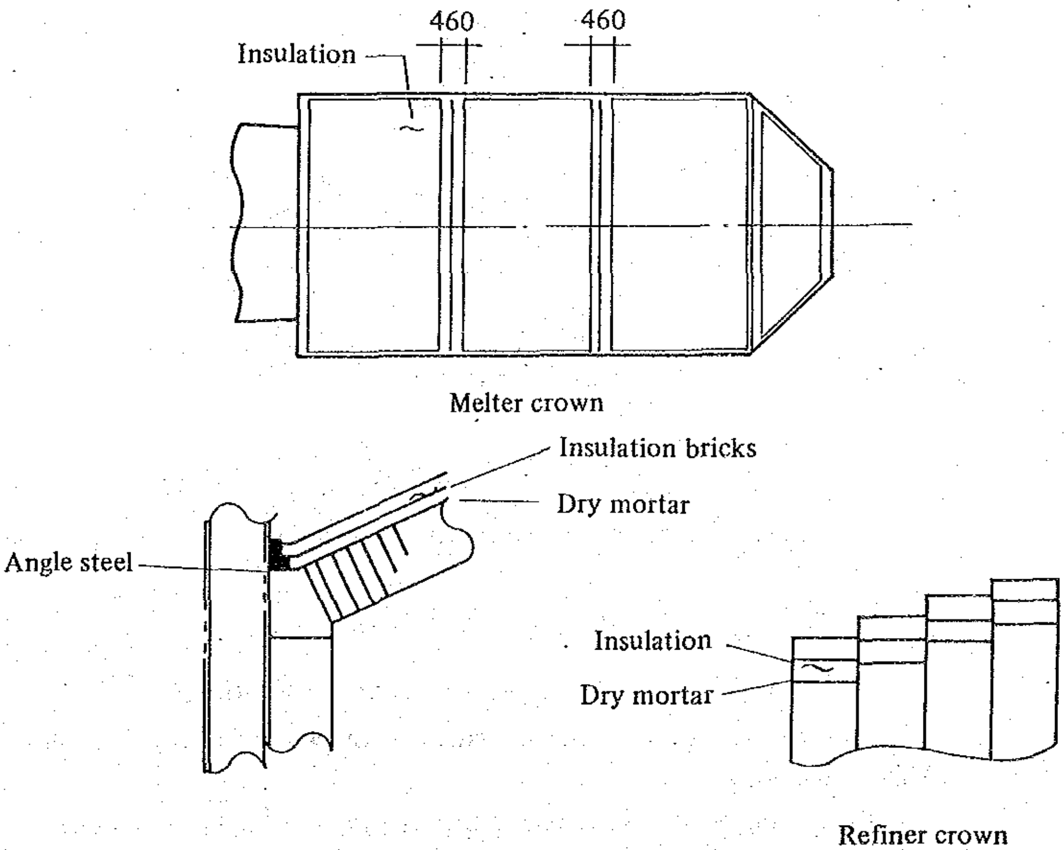


Figure 5–10–12 Melter Crown – Insulation

Coat the present silica bricks on the crown with dry silica mortar 5 to 8 mm thick, and then lay insulating firebricks on top from both ends without mortar.

The expansion part (whose joints are straight) should be left uninsulated 230 mm from one side of the joints.

Firebricks are required to be laid for one span within a day as far as possible.

After initially laying insulating firebricks 65 mm thick over the whole surface, proceed to the next layer.

Be sure to use insulating firebricks with a fire resistance of over 1,200°C because the lower side temperature of the insulating firebricks will be 1,000°C.

After finishing the above insulation work, pay good attention to the expansion of the silica bricks on the top and the internal surface condition.

If the quality of the existing crown bricks is questionable, the internal surface condition may be watched for about a month after insulating the first layer, and then the next layer may be insulated.

(c) Regenerator crown

Insulate the surface area (29.72 m^2) of the crown with insulating firebricks 130 mm thick.

Cost of bricks	22.8 x 29.72 = 677.62	[U$S]
Decrease of heat radiation	(11,800 – 2,300) x 29.72 = 282,300	[kcal/h]
Profit	282.3 x 0.00643 x 24 = 43.56	[U$S/Day]
Saving of expenses	677.62 ÷ 43.56 = 15.6	[Day]
Insulating method	Figure 5–10–13	

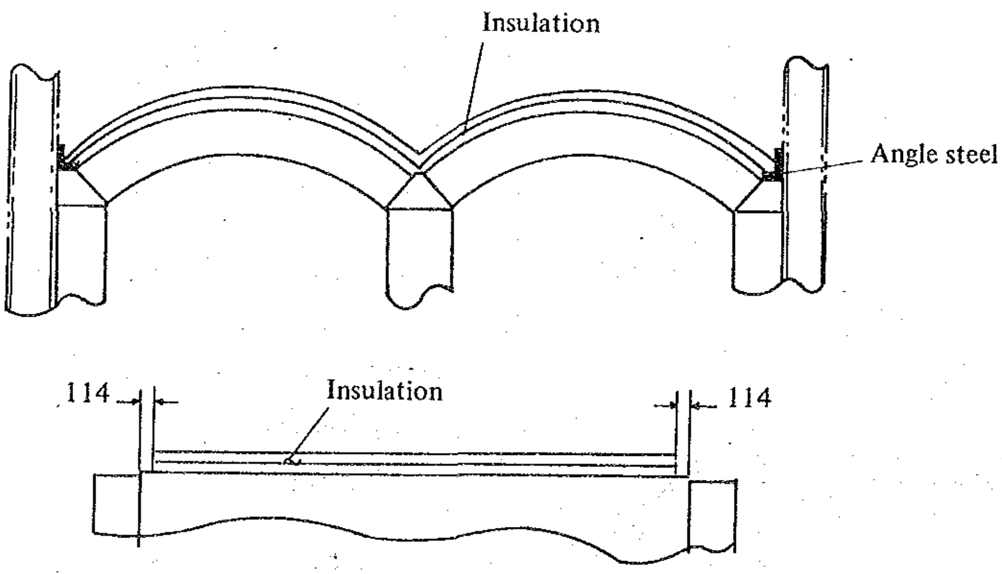


Figure 5–10–13 Regenerator Crown – Insulation

Cover the entire surface of the crown with two layers of insulating firebricks 65 mm thick using mortar.

If insulating firebricks contact a different type of bricks, be sure to use mortar of higher fire resistance. Insulating fire-mortar may be used for the second layer.

(d) Port crown

Insulate the surface area (10.42 m^2) of the crown with insulating firebricks 130 mm thick.

Cost of bricks	22.8 x 10.42 = 237.58	[US$]
Decrease of heat radiation	(11,900 – 2,800) x 10.42 = 94,800	[kcal/h]
Profit	94.8 x 0.00643 x 24 = 14.63	[US$/Day]
Saving of expenses	237.58 ÷ 14.63 = 16.2	[Day]

Insulating method

Cover the entire surface of the crown with two layers of insulating firebricks 65 mm thick using mortar.

(e) Melter breast wall

Insulate 12.32 m^2 of the surface area of 23.76 m^2 except the skew, tuckstone angles, and backstay, with insulating firebricks 114 mm thick.

Cost of bricks	20.1 x 12.32 = 247.63	[US$]
Decrease of heat radiation	(8,600 – 2,700) x 12.32 = 72,700	[kcal/h]
Profit	72.7 x 0.00643 x 24 = 11.22	[US$/Day]
Saving of expenses	247.63 ÷ 11.22 = 22.07	[Day]
Insulating method	Figure 5–10–14	

Mount insulating firebrick binding steel on tuckstone holder angles, and lay bricks with silica mortar. For the backstay part put a space of 50 mm away from the brick binding steel. After laying bricks, mount brick binding steel from the backstay.

(f) Upper wall of regenerator

Insulate the surface area of 33.14 m^2 50 mm thick with silica board 1000.

Cost of bricks	116 x 33.14 = 3,844.24	[US$]
Decrease of heat radiation	(5,890 – 1,600) x 33.14 = 142,170	[kcal/h]
Profit	142.1 x 0.00643 x 24 = 21.93	[US$/Day]
Saving of expenses	3,844.24 ÷ 21.93 = 175.3	[Day]

Either spray mortar on the external surface or apply mortar with brush to the full surface, and then fasten silica boards to it with nails.

(4) Improvement of molten glass level control accuracy

This furnace has a pneumatic type level meter installed at the forehearth entrance, and the batch charger is turned on and off to control molten glass level.

Variations of molten glass level could not be read from the existing recorder, but molten glass level seems to vary by 1 mm, assuming from the on/off time. According to test results in Japan, a 1 mm variation of molten glass level at the forehearth entrance corresponds to a variation of 1 to 1.5 percent in gob weight. This indicates that there must be a weight variation of 5 to 8 grams or more.

Product weight tends to vary toward overweight, but if variations are decreased to lower the average product weight, more products will be able to be made out of the same weight of glass. A method of controlling the charging rate by stroke or rpm (revolutions per minute) to ensure continuous charging, preferably PID control, is recommended in place of the existing on-off method.

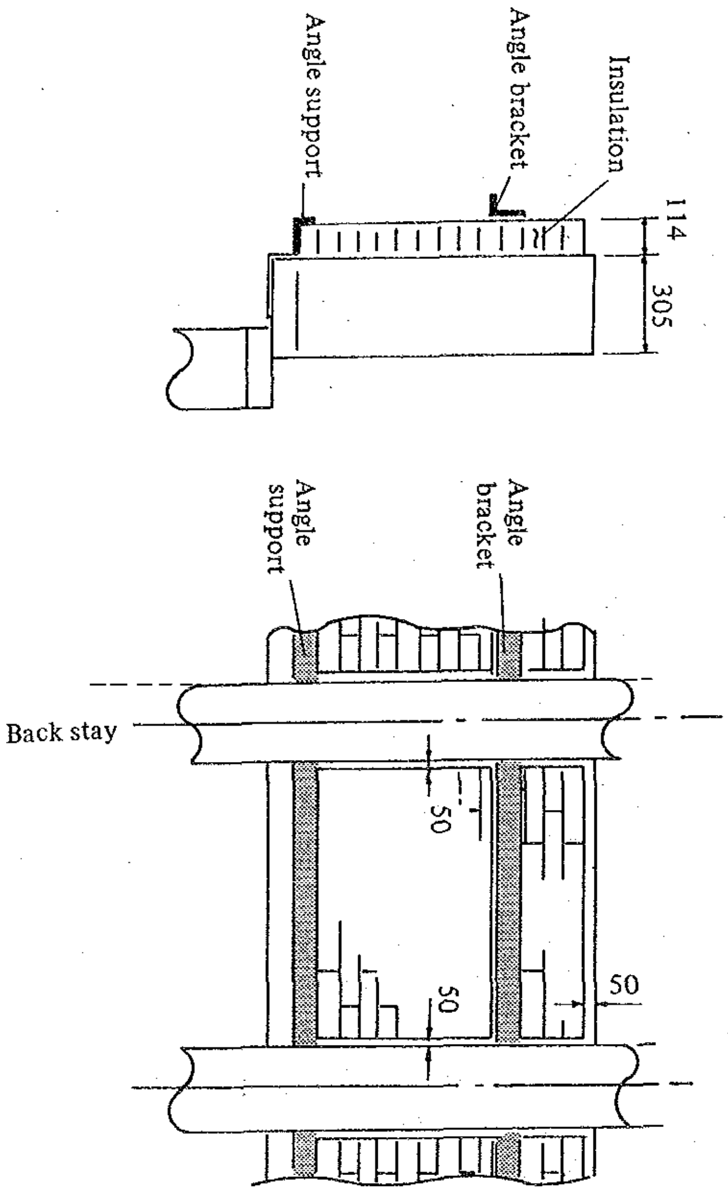


Figure 5–10–14 Breast Wall – Insulation

(5) Quality control of cullet

(A) Quality standard of cullet (Japan Glass Bottle Society Standard)

Impurities in the melting chamber cannot be removed. Such impurities not only adversely affect the quality of product bottles but also damage the furnace. Therefore, quality control on the material, particularly, cullet of a high percentage of use, is important. For reference, the cullet acceptance standard in Japan is shown in Table 5–10–21.

Table 5–10–21 Cullet Quality Standard (Japan Glass Bottle Society Standard)

Classification	Foreign matter	Standard %
Metal	Iron	0.0005
	Aluminum	0.0005
	Others (Copper, lead, brass, etc.)	0.002
Stone	Chromite and other mineral ores	0
	Refractories	0
	Others (Concrete, soil, sand, red bricks, etc.)	0.005
Ceramics	Ceramics, china	0.002
Non-soda lime glass	Crystallized glass	0.002
	Others (Crystal glass, optical glass, borosilicate glass, milk glass, etc.)	0.3
	Plastics, wooden fragments, etc.	0.01
	Plastic-coated glass bottles	0.05

Note: 0 means that none must be detected.

The above standard applies to cases where cullet is used 30 to 50 percent of all material. If a higher percentage of cullet is used, a more strict standard must be applied. This is because the absolute amount of foreign matter entering the furnace increases as the percentage of use of cullet increases. Most of the stones, 3 to 4 percent, seen at the lehr end of the factory are from the impurities in the cullet. Cullet quality must be improved also for the purpose of extending furnace life.

(B) Cullet quality inspection method

The cullet used in the factory was very poor in quality as observed on the conveyor before the furnace. It is necessary to periodically check the cullet as described below.

Take about 500 kg of cullet as sample, and weigh the total amount of the cullet sample taken. Place cardboard or plywood on the floor, spread the sample cullet on it about 10 mm thick or less. Sort out all visible foreign matter, which is found not glass, out of the cullet sample. Repeat this process until the entire cullet sample is checked. An illumination of more than 150 lux is recommended for this visual inspection.

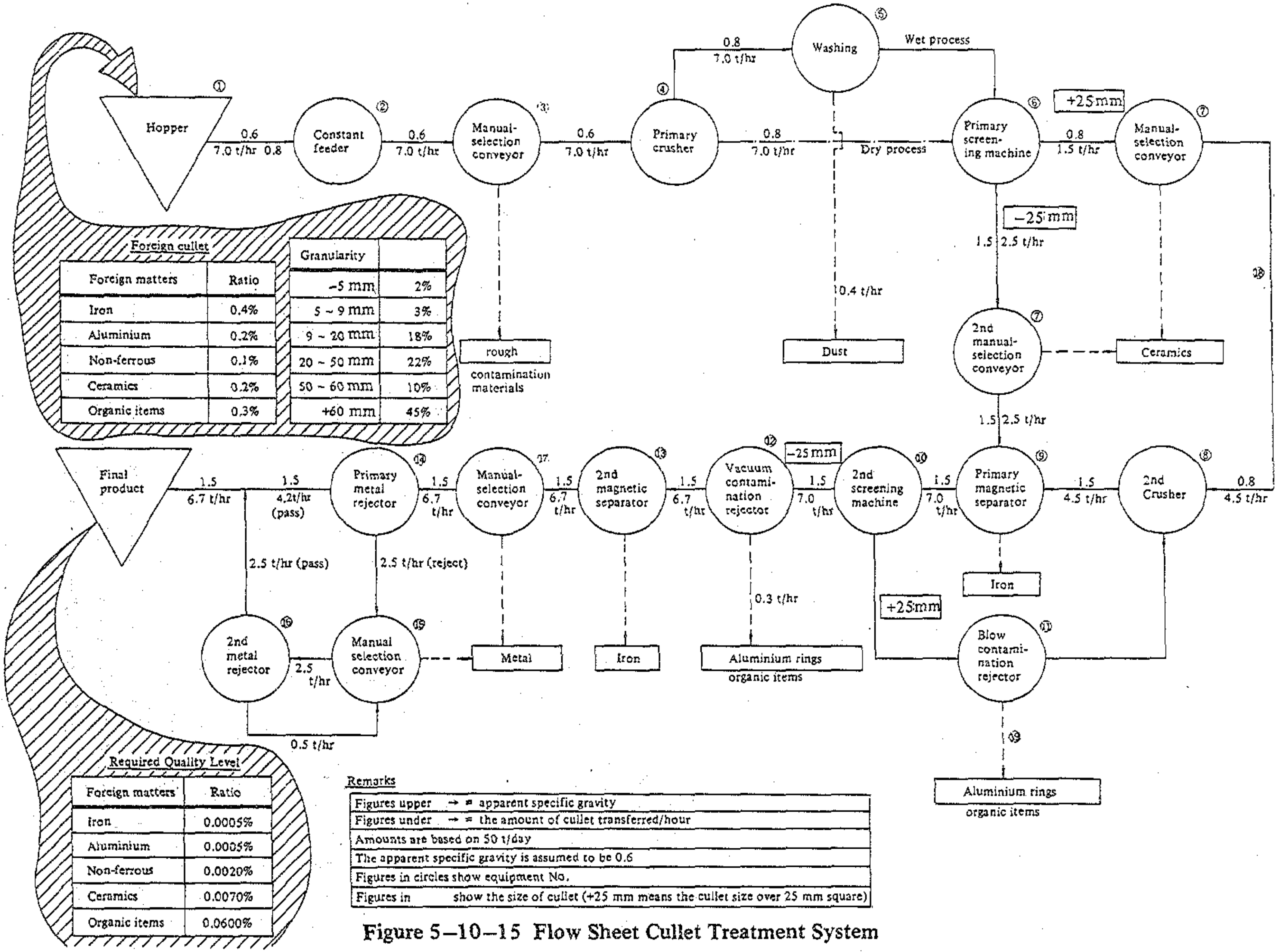
Sort the foreign matter removed from the cullet sample by property as follows. If composite foreign matter is found, break it down into individual elements if possible.

1. Magnetic object 2. Aluminum 3. Aluminum label
4. Metals other than items 1 and 2 above 5. Stone, ceramics
6. Organic matter

Weigh these kinds of foreign matter sorted out as described above, using a scale capable of weighing down to 0.2 gram, and determine the concentration of the foreign matter. Take 5 percent of aluminum labels as aluminum.

(C) Preparation of cullet

The standard of cullet preparation equipment established by the Japan Glass Bottle Society in 1983 is shown in Figure 5–10–15.



Foreign cullet

Foreign matters	Ratio
Iron	0.4%
Aluminium	0.2%
Non-ferrous	0.1%
Ceramics	0.2%
Organic items	0.3%

Granularity	
−5 mm	2%
5 ~ 9 mm	3%
9 ~ 20 mm	18%
20 ~ 50 mm	22%
50 ~ 60 mm	10%
+60 mm	45%

Required Quality Level

Foreign matters	Ratio
Iron	0.0005%
Aluminium	0.0005%
Non-ferrous	0.0020%
Ceramics	0.0070%
Organic items	0.0600%

Remarks

Figures upper	→ = apparent specific gravity
Figures under	→ = the amount of cullet transferred/hour
Amounts are based on 50 t/day	
The apparent specific gravity is assumed to be 0.6	
Figures in circles show equipment No.	
Figures in	show the size of cullet (+25 mm means the cullet size over 25 mm square)

Figure 5–10–15 Flow Sheet Cullet Treatment System

(6) Improvement of melting ratio

The present melting ratio of 5.14 ft^2/t is about the average melting ratio in Japan. It is suggested that electric boosters be used to increase production with the present furnace dimensions and without lowering quality. A booster of 100 kW can be expected to increase molten glass by 3 tons/d so that boosters with a total power of 500 to 800 kW are recommended. While quality improvement can be expected from the installation of boosters, it also means that the bottom temperature will rise. Therefore, cullet quality must be improved as a precondition to the installation of boosters. The melting rate can be increased by raising the melting temperature. However, it is necessary to slowly increase the melting rate while paying attention to product quality.

5.10.3.2 Forehearths

(1) Forehearth insulation

Table 5–10–22 Forehearth Insulation

Measurement results No. 1 electric forehearth

Cooling part	Average temperature °C	Average heat radiation [kcal/m^2 h]
Top	186	2,700
Upper part of side	214	3,200
Lower part of side	158	1,800
Bottom	125	900

Heat insulation method

If the upper surface of the top is heat-insulated with insulating firebricks 130 mm thick and with rock wool 50 mm thick on top of the bricks, heat radiation will be reduced to less than half, or 1,200 kcal/(m^2h). f the upper part of the side is heat-insulated with ceramic fiber 50 mm thick, heat radiation will be reduced to one third, or to 1,300 kcal//(m^2h).

(2) Closing of openings

The top damper was closed, but the forehearth peephole and the openings for the burner and level meter were not sealed at ail. Besides these parts have radiation heat loss, cold air entering the forehearth cools the glass surface and channel side, makes the gob temperature uneven, and causes improper distribution of bottle thickness. The openings must be completely sealed because there is no exhaust gas in electric heating.

5.10.3.3 Annealing Lehrs

(1) Heat insulation of heating part

Table 5–10–23 Heat Insulation of Heating Part

Measurement results No. 1 annealing lehr

Heating part	Average temperature °C	Average heat radiation [kcal/(m^2h)]
Top	240	4,400
Side	113	900

Heat insulation method

If the upper surface of the top is heat-insulated with insulating firebricks 65 mm thick and then with rock wool 50 mm thick on top of the bricks, heat radiation will be reduced to one fourth, or to 1,000 kcal/(m^2h).

If the side walls are heat-insulated with rock wool 50 mm thick, heat radiation will be reduced to about half, or to 500 kcal/(m^2h).

(2) Change to direct heating method

Change the existing heating method to a direct heating method for 3 meters of the lehr entrance. Mount 68 radiant cup burners of 5,000 kcal/h on the top and four line burners of 60,000 kcal/h under the net.

Mount the cup burners on the top panel, and the height from the upper surface of the net to the burner should be 100 mm longer than the maximum bottle length. A reference drawing is shown in Figure 5–10–16.

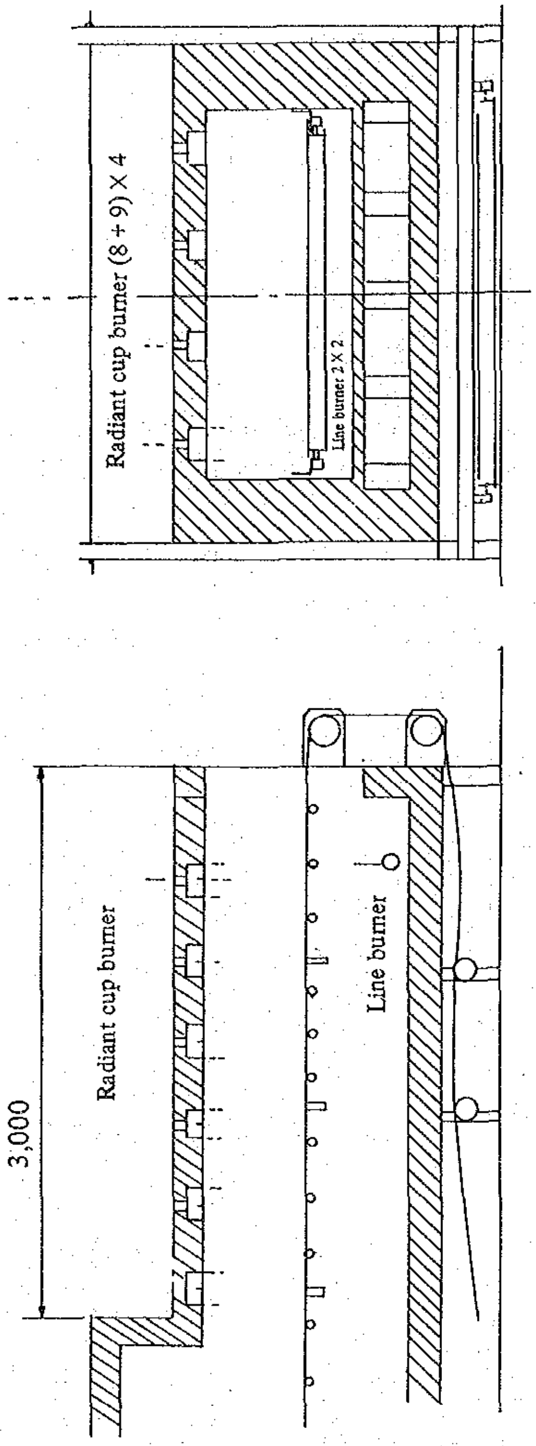


Figure 5–10–16 Direct Heating Lehr

(3) Net speed control

The proper net speed calculated from the present net speed and the number of bottles formed is as shown in Table 5–10–24 (Net width: 1,800 mm; bottle body diameter: 80 mm)

Table 5–10–24 Net Speed Control

Lehr		No. 1	No. 2	No. 3
Net Speed	mm/min	208	98	302
No. of bottled formed	bottles/min	47.2	19.6	32.8
Proper speed	mm/min	280	115	193

The No. 1 and No. 2 lehrs were observed to be congested with bottles pushing one another due to insufficient speed, and many bottles were found cracked due to contact damage. The speed must be adjusted to the proper level soon.

The coefficient of thermal expansion of bottles produced by Rayen Cura is about 93×10^{-7}, and their annealing temperature is 540°C so that about 90 minutes is necessary to pass the annealing lehrs. If the No. 1 line is adjusted to a net speed of 280 mm/min, the passing time will be 80 minutes, so care must be taken against residual strain.

5.10.3.4 Results of Product Bottle Analysis

Table 5–10–25 Properties of Products

Item \ Test piece			Rayen cure (EG) 1988.11.24 No. 3	Company T of Japan (EG) 1987.5.6	Europe (G) 1987.12
Chemical properties	SiO_2	%	70.0	71.3	73.3
	Al_2O_3	%	2.37	2.68	1.35
	Fe_2O_3	%	0.404	0.104	0.300
	CaO	%	8.88	10.63	10.50
	MgO	%	1.89	0.18	2.0
	Na_2O	%	14.9	13.4	12.0
	K_2O	%	0.80	0.92	0.40
	SO_3	%	0.14	0.21	0.07
	Cr_2O_3	%	0.144	0.127	0.17
	MnO	%	0.045		
	Cuo	%	0.006	0.042	
	Total	%	99.579	99.593	
Physical properties	S.G (g/cm^3)		2.5161	2.50	2.5014
	Seed (per/cm^3)		4.6	0.4	
	Purity (Pe %)		49.4	66.0	
	Brightness (Y %)		34.6	32.8	
	Dominant wavelength (λ dnm)		553.1	556.7	
Calculated values	F.S.P. (°C)		715.0	731.8	748.0
	Log 2 (°C)		1,432.5	1,457.6	1,479.0
	Liquidas (°C)		981.2	1,030.4	1,056.0
	Log 13.4 (°C)		537.0		
	Coefficient of expansion $\times 10^{-7}$		92.8		83.1

Thickness calculated from tone: 10 mm

The SO_3 value for Rayen Cura indicates that its glass is on the reduction side, but this is considered permissible in point of seed if there is no need to cut out ultraviolet rays. The fact that the glass of Rayen Cura is on the reduction side despite the large quantity of sodium nitrate is assumed to be due to the high percentage of organic matter in the cullet. To reduce cost, it is necessary to reduce the organic matter contained in the cullet and thus the sodium nitrate.

Dolomite is not used in Japan to avoid the possibility of flaking, but it is used in Europe. It won't pose problems with wine bottles and champagne bottles, but caution must be exercised against flaking in producing bottles for whisky, etc. having a high content of alcohol.

Soda ash can be reduced more from the figures of softening temperature (F.S.P.) and melting temperature (Log 2). A significant economic effect cannot be expected because of the high ratio (85 percent) of cullet used, and a large difference in composition between cullet and batch is undesirable in point of glass cord, but costs can be reduced by reducing soda ash slowly over a certain period of time while paying attention to bubbles and cord.

5.10.3.5 Electric Power Receiving and Distributing Facilities

One of the two underground cables of 13.2 kV receives electric power, and a supply watt-hour meter and reactive volt-ampere hour meter are installed at the power receiving point. The transformer room has a 3-phase, 1,000 kVA transformer, which steps down the received electric power to 380 V. A low-voltage distribution board is located in the next room which houses the home generator set and air compressors. The loads include the air compressors, vacuum pumps, blowers, and electric forehearths. The motors are mostly large-sized, and are kept in operation around the clock. The main motors have a condenser for improving the power factor on each of them.

The following measurements were made using watt-power factor meter (PFM-1000, PFMA-5120, and PFM-1000P), AC clipon power meter, and 12-point recorder.

(1) Load condition for the entire plant (4 lines combined)

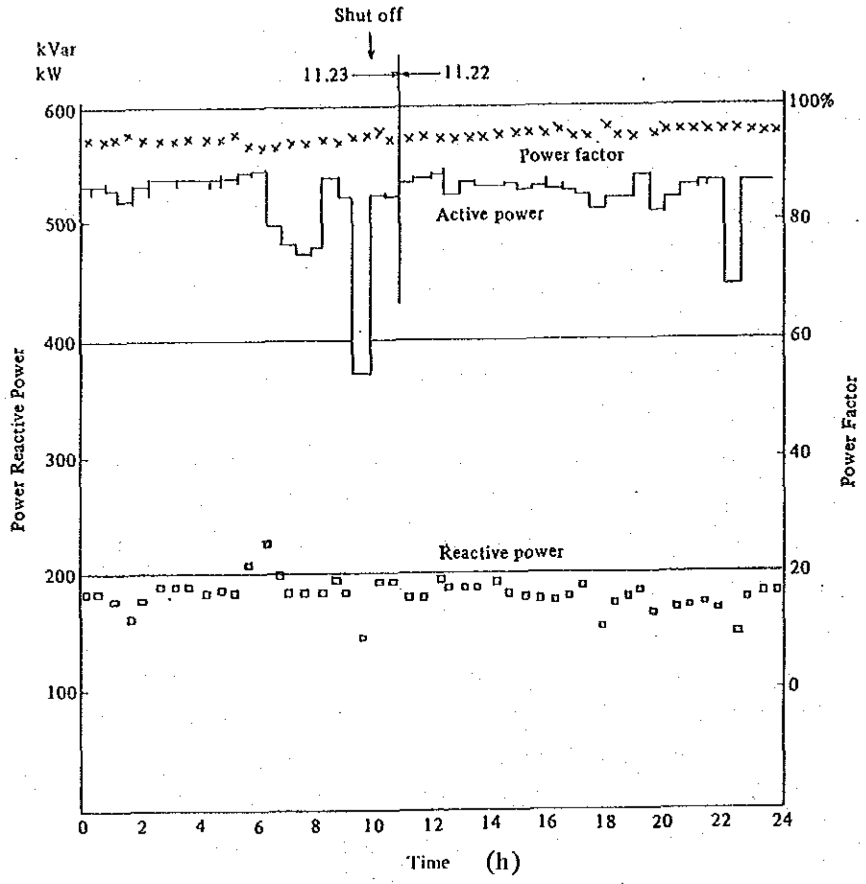


Figure 5–10–17 Total Power of Factory

(2) Power consumption of main load circuits

Table 5–10–26 Power Consumption of Equipment

	Actual power	Share
Air compressor	146 kW	28.1%
Blower	177 kW	34.0
Vacuum pump	64 kW	12.3
Elec. forehearth	75 kW	14.4
Total	520 kW	100.0

(3) Power consumption of main motors

Table 5–10–27 Consuming Power of Major Motors

For use	Rating		Actual		Load (B)/(A) X 100 %	Remark
	CV	kW (A)	kW (B)	cos φ (%)		
Ventilator	10	7.3	66 ~ 77	70 ~ 77	90 ~ 105	Turbo
Turbo fan	20	14.7	18.7	77	127	
Ventilator	25	18.4	7.8	99	42	
Ventilator (northside)	25	18.4	9.6	89	52	
Ventilator (No. 1)	100	73.6	49	93	66	
For No. 1 furnace (No. 2)	100	73.6	54	93	73	
Cooling fan	31	22.8	7.8	48	34.2	
Vacuum pump (No. 3)	50	36.8	32	92	87	
Vacuum pump (No. 4)	50	36.8	32.2	99	88	
Air compressor No. 1	50	36.8	42	99	114	
Air compressor No. 2	50	36.8	40	97	109	
Air compressor No. 3	50	36.8	38 (5)	96 (92)	103 (13.5)	(–) Unload
Air compressor No. 4	90	66.2	44	99	66	
Air compressor No. 5	75	55.2	37	94	67	

Power consumption is as shown in Figure 5–10–17. The factory consumes about 520 kW daily on the average, and the load factor is good at about 95 percent. The power factor is about 95 percent. Thus, power is used in a satisfactory way. If there is no power failure, the load factor would be still higher.

Power consumption by type of equipment is as shown in Table 5–10–26. The blowers and air compressors show high percentages of load. Because load variations are small and because the power factor is high, the supply transformer (1,000 kVA) has a load factor of 75 percent, which indicates that the transformer has more capacity than required.

(4) Improvement of operation of air compressors

Four air compressors (265 CV) were operating and one of them (50 CV) was switched on and off to keep the air pressure within the range of 3.1 to 3.4 kg/cm². The switchoff (unload) and switchon (load) of the air compressor were about 6 to 4 in time ratio. If the capacities of the other air compressors can be raised a little, the 50 CV air compressor can be left unused.

As shown in Table 5–10–27, the No. 4 and No. 5 air compressors are operating at a load level of 66 to 67 percent, and the motors have ample capacity. If these air compressors allow modification, use a larger motor pulley to raise the revolution speed of the air compressors. If their revolutions speed is raised by about 15 percent, for example, 15 percent more air can be compressed, which corresponds to more than half the capacity of the 50 CV air compressor. Thus, if the 50 CV air compressor is operating at a load level of less than 50 percent, it can be stopped altogether. This will permit a saving corresponding to the no-load operation of the 50 CV air compressor. If the load-to-unload operating time ratio is assumed to be 4 to 6, and its power consumption at no load 5 kW, power can be saved as much as calculated below.

$$\text{kW} \times \frac{6}{10} \times 24\ \text{h} \times 365\ \text{d} = 26{,}280\ \text{kWh/y}.$$

It is suggested that the air compressor to be used for load-unload operation be as small as possible because the smaller the air compressor the less will be power consumption during unload operation.

(5) Improvement of forehearth load distribution

As shown in the one-line diagram of Figure 5–10–5, one each 50-kVA transformer was connected to the S-R phase and R-T phase for the No. 1 forehearth. The No. 3 forehearth, however, had three 50-kVA transformers connected to the R-T phase only. This causes an uneven load applied to the R-T phase, resulting in unbalance among the three-phase loads. The three phases can restore balance if the No. 3 forehearth is connected to the S-T phase (instead of the R-T phase at present). The three phases must be balanced as much as possible because their unbalance will increase the iron and copper losses of the motor, generate noise and vibration, and lower the efficiency.

(6) Others

As shown in Table 5–10–27, some motors were at small load level. It is suggested that they be replaced with ones having an appropriate capacity when it comes to change some of the equipment. To deal with varying loads, such as blowers and pumps, for example, may be used to control the operating speed of the motors using inverter. A power saving effect can also be expected from it.

5.10.3.6 Summary

The following are the effects of the aforementioned improvement that can be estimated quantitatively.

Item		Possible annual amount of saving	%
Improvement of melting furnace	Gas	154,000 Nm^3	2.0
Strengthening of heat insulation of Melting furnace and regenerator		1,340,000	17.0
Improvement of burner		98,600	1.3
Total		1,592,600	20.2
Decrease of the number of air compressors operated	Electric power	26,300 kWh	0.6

Attached Data

Attached Data 1

Survey team members

No.	Name	Assignment	Work schedule
1.	Takashi NIIKURA	Leader (1987)	First Field Survey Home Office Work
2.	Mitsuo IGUCHI	Energy Management (1987) Leader (after 1988)	Preliminary Field Work First Field Survey Second Field Survey Home Office Work
3.	Issei FURUGAKI	Energy Management	Second Field Survey Home Office Work
4.	Teruo NAKAGAWA	Diagnostic Techniques Heat Management	Preliminary Field Work First Field Survey Second Field Survey Home Office Work
5.	Kaoru NAKAO	Food Process Heat Management	First Field Survey Home Office Work
6.	Takashige TANIGUCHI	Fiber Process Heat Management	First Field Survey Second Field Survey Home Office Work
7.	Akira KOIZUMI	Paper Process Heat Management	Second Field Survey Home Office Work
8.	Genzo EMA	Leather Process Heat Management	Second Field Survey Home Office Work
9.	Naoshi HONDA	Chemical Process Heat Management	Second Field Survey Home Office Work
10.	Keiji SAWADA	Plastic Process Heat Management	Second Field Survey Home Office Work
11.	Yukio NOZAKI	Steel Process Heat Management	Second Field Survey Home Office Work
12.	Shoji NAKAI	Glass Process Heat Management	Second Field Survey Home Office Work
13.	Isamu TAKI	Electric Furnace Dissolution Heat Management	Second Field Survey Home Office Work
14.	Ken-ichi KURITA	Electric Management	First Field Survey Home Office Work
15.	Toshio IIMORI	Electric Management	Second Field Survey Home Office Work
16.	Toshio SUGIMOTO	Electric Management	Second Field Survey Home Office Work

No.	Name	Assignment	Work schedule
17.	Hiroaki WAKIYASU	Promotion of Energy Conservation	First Field Survey Home Office Work
18.	Kazuto OGASAWARA	Energy Policy	First Field Survey Home Office Work
19.	Jiro KONISHI	Heat Management Metal Process	Home Office Work
20.	Masao TANAKA	Heat Management	Home Office Work
21.	Tadayasu IKAWA	Electric Management	Home Office Work
22.	Hirokazu HIRATA	Energy Conservation Policy Promotion of Energy Conservation	Home Office Work
23.	Yukio FUSE	Energy Conservation Policy Promotion of Energy Conservation	Home Office Work

INTI team members

Attached Data 2

No.	Name	Assignment
1.	Mr. Mario OGARA	Mission Leader
2.	Mr. Daniel AFIONE	Mission Leader
3.	Mr. Ernesto M. LEIKIS	Mission Leader
4.	Mr. Marcelo A. SILVOSA	Electric Power Facilities Unit Operation and Process
5.	Mr. Jorge A. FIORA	Mission Leader Unit Operation and Process
6.	Mr. Alberto BERSET	Heat and Steam using Device
7.	Mr. Anibal MONZON	Heat Area and Driver of Mobil Unit
8.	Mr. Miguel BERMEJO	Electric Power Facilities
9.	Mr. Arturo D. VERGHELET	Electric Power Facilities
10.	Mr. Hector G. CITADINO	Training Member
11.	Mrs. Patricia M. KOHLER	Training Member
12.	Mr. Ignacio F. COZZA	Training Member
13.	Mrs. Beatriz R. MARTINEZ	Training Member
14.	Mr. Oscar W. FUENTES	Training Member
15.	Mr. Pedro L. COZZA	Training Member
16.	Mrs. Maria L. GOMEZ	Training Member
17.	Mr. Roberto DOMECO	Training Member
18.	Mr. Juan C. BALMAYOR	Training Member
19.	Mr. Osvaldo H. FRANCO	Training Member
20.	Mrs. Patricia ARROSSAGARAY	Process Adviser
21.	Mrs. Patricia BARES	Process Adviser
22.	Mr. Hugo E. VELEZ	Process Adviser
23.	Mr. A. ESCUARISI	Process Adviser

Field Survey Schedule

Attached Data 3

Date	Item
Preliminary Survey (2 members)	
1987. Dec. 8 – Dec. 9	From Tokyo to Buenos Aires Explaining survey outline to JICA and Embassy of Japan
Dec. 10 – Dec. 18	Preliminary Survey of the ten factories to be audited
Dec. 19 – Dec. 21	Meeting with INTI and Bureau of Energy Signing Minutes
Dec. 21 – Dec. 23	Reporting the survey results to JICA and Embassy of Japan. From Burenos Aires to Tokyo
Team A (2 members)	
1988. Feb. 22 – Feb. 23	From Tokyo to Buenos Aires
Feb. 24	Explaining survey outline to JICA and Embassy of Japan
Feb. 25 – Feb. 28	Explaining Inception Report to INTI Preparations for survey
Feb. 29 – Mar. 18	Survey INTI, UTN, YPF, ESSO, SHELL, SEGBA, GAS DEL ESTADO, NATIONAL DEVELOPMENT BANK, AGUA Y ENERGIA, IACRE, BUREAU OF FINANCE, JAPAN CHAMBER OF COMMERCE AND INDUSTRY, JETRO, CNEA, EL CRONISTA COMERCIAL, AAPURE
Mar. 19 – Mar. 20	Signing Progress Report at INTI
Mar. 21 – Mar. 23	Reporting the survey results to JICA and Embassy of Japan
Team B (5 members)	
1988. Feb. 22 – Mar. 11	From Tokyo to Buenos Aires (First Group, 1 member) Preparation for Survey
Mar. 5 – Mar. 11	From Tokyo to Buenos Aires (Second Group, 1 member) Preparation for Survey)
Mar. 7 – Mar. 11	From Tokyo to Buenos Aires (Third Group, 3 members) Preparation for Survey
Mar. 12 – Mar. 19	From Buenos Aires to Neuquen Surveying Juice Factory
Mar. 20 – Mar. 25	From Neuquen to Mar del Plata Surveying Fish Cannery
Mar. 26 – Mar. 28	From Mar del Plata to Buenos Aires Signing Progress Report at INTI
Mar. 29 – Mar. 31	Reporting the survey results to JICA and Embassy of Japan From Buenos Aires to Tokyo

Date	Item
Second Survey Team A (6 members) 1988. Sept. 26 – Sept. 28	 From Tokyo to Buenos Aires Explaining survey outline to JICA, Embassy of Japan and INTI
Sept. 29 – Oct. 2	Meeting with INTI Preparations for Survey
Oct. 3 – Oct. 8	Surveying Fiber Factory (Buenos Aires)
Oct. 9 – Oct. 15	Surveying Paper and Pulp Factory (Buenos Aires)
Oct. 16 – Oct. 21	From Buenos Aires to La Plata Surveying Leather Factory (La Plata)
Oct. 22 – Oct. 23	From La Plata to Buenos Aires Preparation of progress report and arrangements with Team B
Oct. 24 – Oct. 26	Reporting the survey results to JICA and Embassy of Japan From Buenos Aires to Tokyo
Team B (5 members) 1988. Oct. 20 – Oct. 23	 From Tokyo to Buenos Aires Preparation for Survey and Arrangements with Team A
Oct. 24 – Oct. 29	Surveying Chemical Factory (Buenos Aires)
Oct. 30 – Nov. 4	Surveying Plastic Factory (Buenos Aires)
Nov. 5 – Nov. 6	Preparation of progress report and arrangements with Team C
Nov. 7 – Nov. 9	Reporting the survey results to JICA and Embassy of Japan From Buenos Aires to Tokyo
Team C (6 members) 1988. Nov. 3 – Nov. 6	 From Tokyo to Buenos Aires Preparation for Survey and Arrangements with Team B
Nov. 7 – Nov. 11	Surveying Cast Steem Factory (Buenos Aires)
Nov. 12 – Nov. 18	From Buenos Aires to Cordoba Surveying Metal Processing Factory (Cordoba)
Nov. 19 – Nov. 25	From Cordoba to Mendoza Surveying Glass Factory (Mendoza)
Nov. 26 – Nov. 28	From Buenos Aires to Tokyo Submitting Progress Report to INTI
Nov. 29 – Nov. 30	Explanation of Interim Report Maintenance of Survey Equipment
Dec. 1 – Dec. 3	Reporting the survey results to JICA and Embassy of Japan From Buenos Aires to Tokyo

Attached Data 4

SCOPE OF WORK
FOR
THE STUDY
ON
THE RATIONAL USE OF ENERGY IN INDUSTRY
IN
THE ARGENTINE REPUBLIC

AGREED UPON BETWEEN

INSTITUTO NACIONAL DE TECHNOLOGIA INDUSTRIAL

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

March 24,1987

Ing. Enrique Mario Martínez
Presidente de INTI

Embajador Oscar Yujnovsky
Subsecretario de Cooperación Internacional
Ministerio de Relaciones Exteriores y
Culto.

Mr.Keiichi Takeda
Leader of the Preliminary
Survey Team
The Japan International
Cooperation Agency

1. Introduction

In response to the request of the Government of the Argentine Republic(hereinafter referred to as "Argentina"), the Government of Japan has decided to conduct a study on the rational use of energy in industry in Argentina (hereinafter referred to as "the Study") in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Argentina.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the echnical cooperation programs of the Government of Japan, will undertake the Study, in close cooperation with authorities concerned of the Government of Argentina.

The present document sets forth the scope of work with regard to the Study.

2. Objective of the Study

The objective of the Study is to contribute to the promotion and strengthening of rational use of energy in the field of manufacturing ndustry in Argentina by (a) studying the technical and managemental applicability of rational use of energy in selected manufacturing industry (b) and formulating the report for the promotion of rational use of energy in industry.

3. Scope of the Study

In order to achieve the above objective, the Study will cover the following items:

(1) Literature survey on the energy situation in Argentina

①To survey the energy situation in Argentina

②To survey the situation of energy use in the field of whole manufacturing industry in Argentina

(2) Study on the promotion of rational use of energy in the manufacturing industry

①To investigate current program for rational use of energy

②To study and evaluate the INTI's activities

ⓐthe current activities for promotion of rational use of energy

ⓑthe achievements of past activities

ⓒthe future plan/program for promotion of rational use of energy

(3) Study on the situation of energy use in the selected factories of each industry

①To survey the situation of energy use in each factory

ⓐthe outline of the factory

ⓑthe situation of energy management

ⓒenergy flow chart

ⓓthe situation of major energy consuming equipment

ⓔthe problems found in each factory and countermeasures without changing the existing production process

ⓕthe estimated effects of the countermeasures

②To prepare the reference to formulate the technical guideline for the promotion of rational use of energy in industry

(4) Recommendation for the promotion of the rational energy use in Argentina

①To recommend with measures to promote rational use of energy in the field of small and medium sized manufacturing industry

②To recommend with activities of INTI for rational use of energy

4. Steps and Schedule of the Study

(1) Steps

Step 1:Preparatory field work in Argentina

Step 2:Preparatory work in Japan

Step 3:First field work in Argentina

Step 4:Home office work in Japan

Step 5 ①:Second field work in Argentina

②:Presentation of and discussion on the interim report

Step 6:Home office work in Japan

Step 7:Presentation of and discussion on the Draft Final Report

(2) Schedule

Schedule of the Study is shown in Annex.

5. Reports

JICA shall prepare and submit the following reports written in English to the Govenment of Argentina within the time periods indicated below:

) Inception Report at the commencement of the Step 3: 10 copies

(2) Progress Report at the end of the Step 3 and 5①: 10 copies

(3) Draft Final Report and its summary within 15 (fifteen) months after the commencement of the Step 3: 15 copies

(4) Final Report and its summary within 3 (three) months after the receipt of comments on the Draft Final Report from the Government of Argentina: 30 copies

6. Undertaking of the Government of Argentina

(1) The Government of Argentina shall accord privileges, immunities and other benefits to the Japanese study team (hereinafter referred to as "the Team") in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Argentina.

(2) In order to facilitate the smooth implementation of the Study, the Government of Argentina shalll take necessary measures:

①To secure the safety of the Team,

②To permit the members of the Team to enter, leave and sojourn in Argentina for the duration of their assignment therein , and exempt them from alien registration requirements and consular fees,

③To exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into Argentina for the implementation of the Study,

④To exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emolument or allowance paid to them for their services in relation to the implementation of the Study,

⑤To provide the members of the Team with necessary facilities for remittance as well as utilization of the funds introduced into Argentina from Japan in the course of the implementation of the Study,

⑥To secure the permission for the members of the Team to enter into private properties and restricted areas for the implementation of the Study,

⑦To secure the permission for the members of the Team to take all data and documents (including photographs and maps) related to the Study out of Argentina to Japan.

⑧To provide medical services as needed and its expenses will be chargeable on the members of the Team.

(3) The Government of Argentina shall bear claims, if any arises against the members of the Team resulting from, occuring in the course of, or othewise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

4) INTI shall act as counterpart agency to the Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

(5) INTI shall, at its own expense provide the Team with the following, in cooperation with other relevant organization:

①Available data and information related to the Study

②Counterpart personnel

③Suitable office space with necessary equipment

④Identification cards

7. Undertaking of JICA

For the implementation of the Study, JICA shall take the following measures:

(1) To dispatch, at its own expense, the Team to Argentina

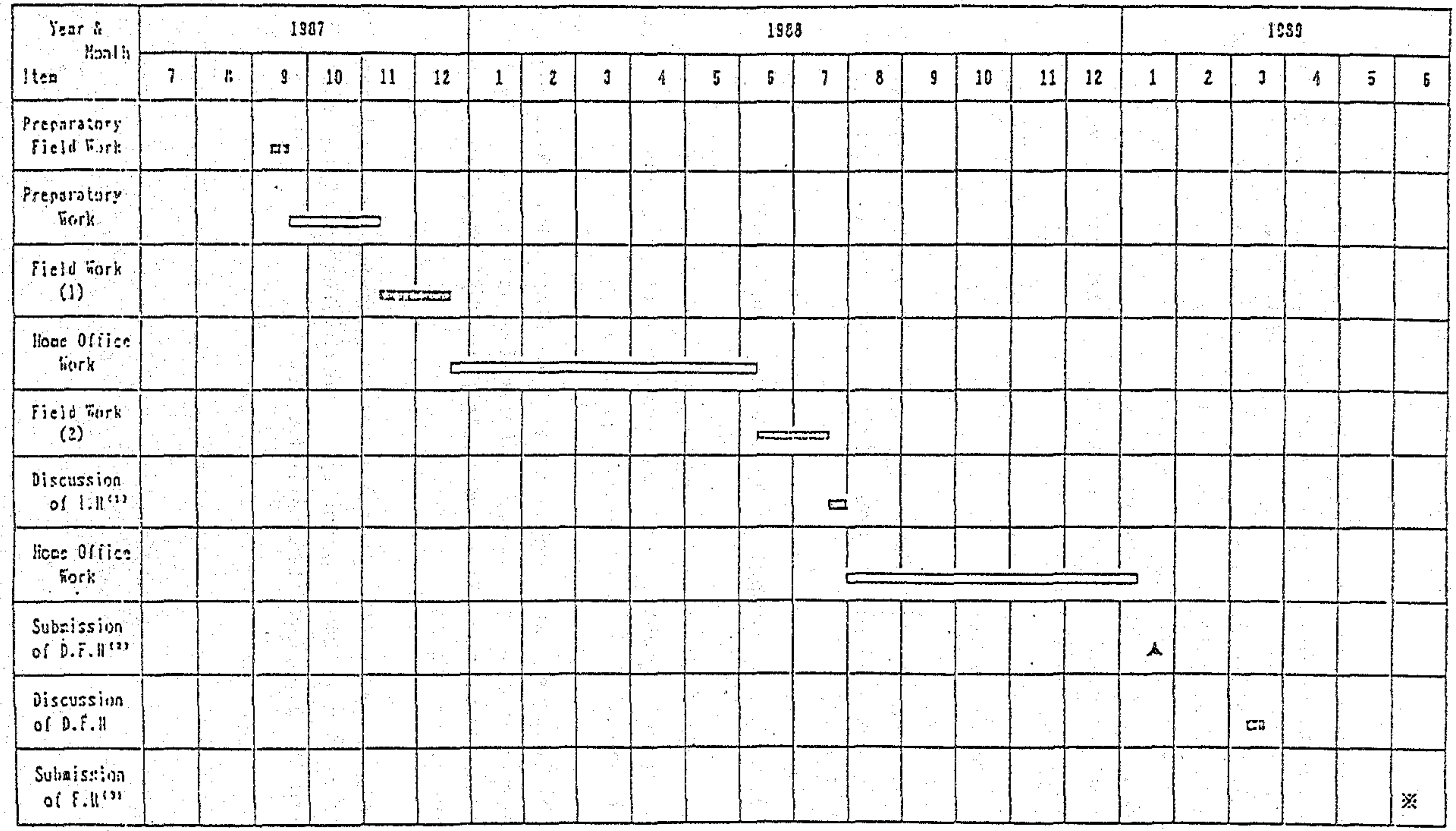
(2) To pursue technology transfer to Argentine counterpart personnel in the course of the Study

8. Consultation

JICA and INTI shall consult with each other in respect of any matter that may arise from or in connection with the Study.

<Annex>

Tentative Schedule of the Study



In Japan ▭   In the Argentine Republic ▭

[1] I.R :Interim Report [2] D.F.R :Draft Final Report [3] F.R :Final Report

The Minutes of Discussions

The preliminary survey team of the Japan International Cooperation Agency, headed by Mr. Keiichi Takeda, visited the Argentine Republic from March 17 to 25, 1987 and had discussions with the Instituto Nacional de Tecnología Industrial and the Secretaría de Energía and other agencies concerned on the scopes of work and the methods of implementation of the Study on the Rational Use of Energy in Industry in the Argentine Republic.

Through the discussions and consultations, both parties agreed upon the matters as follows:

I - The sub-sectors and the number of factories to be surveyed in the Study are:

a) Sub-sectors:
(1) Metal; (2) Glass; (3) Iron & Steel; (4) Chemical; (5) Paper & Pulp; (6) Food; (7) Textile; (8) Leather and (9) Plastic.

b) Number of factories: Aproximately ten (10)

II - The selection of small and medium sized factories in each sub-sector of industry shall be done by INTI based upon the criteria agreed upon between both parties.

III - The Japanese side suggested INTI to finish the questionnaire survey toward the selected factories before the arrival of the preparatory field survey team in September 1987, and INTI agreed to it.

IV - INTI requested the Japanese side to provide the equipment listed in the attached paper upon the completion of the said study, and the Japanese side agreed to it.

V - The Japanese side asked INTI to forward the A-4 Form for the above mentioned equipment through the proper channel of the Argentine side, and INTI agreed to it.

VI - The Argentine side emphasized the importance of technolo gy transfer to the Argentinian counterparts in the field of factory energy audit and data analysis through either the implementation of the field survey in Argentina or counterpart training in Japan, and the Japanese side took a good note of it.

March 25, 1987

Ing. Enrique Mario Martínez
Presidente de INTI

Mr. Keiichi Takeda
Leader of the Preliminary Survey Team
The Japan International Cooperation Agency

ATTACHED PAPER

Equipment List
for
Factory Energy Audit

page 1

No	Item	Numbers
1	Equipment Carrying Veheicle with Rack and Lifter	1
2	Portable Type Equipment for Heat Audit	
	1) Ultrasonic Flow Meter for Fuel Oil	1
	2) Ultrasonic Flow Meter for Water	1
	3) High Temperature Anemometer	1
	4) Heat Flow Meter	1
	5) Pocketable Oxygen Meter	1
	6) Zirconia Type O2 Analyzer	1
	7) CO2 and CO Gas Tester	1
	8) Gas Sampling Tube	1
	9) Surface Thermometer	1
	10) Sheath Thermo Couple (CA)	10
	11) Compensated Cable for Thermo Couple	10
	12) Digital Thermometer for Thermo Couple	2
	13) Waer Conductivity Meter	1
	14) pH Meter	1
	15) Digital Low Pressure Meter for Gas	1
	16) 12-Channels Hybrid Recorder	2
	17) 3-Channels Pen Recorder	1
	18) Infrared Radiation Thermometer (-50 to 1000 C)	1
	19) Infrared Radiation Thermometer (600 to 3000 C)	1
	20) Infrared Radiation Thermal Video System with Personal Computer	1
	21) Voltage Stabilizer of Supply Power	2
	22) Steam Trap Checker	1
	23) Desk Size Wagon	2
	24) Power Supply Cord and Reel	1
	25) Pocket Computer	1
	26) Stop-Watch	1
	27) Glass Thermometer	1
	28) Cobalt Glass for Eye Protect	1
	29) Heat Resisting Gloves	1
	30) Camera	1
	31) Flow Mater for Gas and Steam	1

No	Item	Numbers
3	Portable Type Equipment for Electricity Audit	
	1) Clamp-on Type Watt-Power Factor Meter (6-Channels)	1
	2) Clip-on AC Power Meter	1
	3) DC Volt-Ammeter	1
	4) Watt-Hour Meter	1
	5) 12-Channels Hybrid Recorder	1
	6) 3-Channels Pen Recorder	2
	7) Power Line Transducer (A,V,kW,kVar,PF)	2
	8) Circuit Tester	1
	9) Tachometer	1
	10) Lux Meter	1
	11) Voltage Stabilizer of Supply Power	1
	12) Desk Size Wagon	1
	13) Power Supply Cord and Reel	1
	14) Pocket Computer	1
	15) Frequency Meter	1
	16) Voltage Detector	1
	17) Insulation Gloves	1

Secretaría de Industria y de Comercio Exterior
INSTITUTO NACIONAL DE TECNOLOGIA INDUSTRIAL

INTI

Laboratorios: Parque Tecnológico Miguelete - Av. Gral. Paz e/ Albarellos y Constituyentes - C.C. 157 - 1650 San Martín - Prov. de Buenos Aires - Tel.: ● 755-6161/6212/6314/6365/6416/6467/6518 y ● 752-5281/5101/5201/5251/5351. Sede Central: Leandro N. Alem 1067, 5º, 6º y 7º piso - 1001 Cap. Federal - República Argentina - Tel.: ● 313-3013/3093/3253/3403 - Telegramas: INTIBAIRES - Télex: 021859 INTIAR.

PREPARATORY FIELD WORK TEAM FROM JICA

December 9-21 1987

MINUTES OF DISCUSSIONS

Lic. Mario OGARA, Head
Department of Energy
INTI

Mr. Teruo NAKAGAWA
Leader of Preparatory
field Work Team
The Japan International
Cooperation Agency

Dr. Enrique GRUNHUT, Head
Department of International
Relations and Projects
INTI

The Minutes of Discussions on Study on Rational Use of Energy in Industry in the Argentine Republic

The preparatory field work team of the Japan International Cooperation Agency (JICA) visited the Argentine Republic from December 9 to 21,1987. The team had preparatory survey and discussions with the Instituto Nacional de Tecnología Industrial (INTI).

Through the discussions and consultations, both parties agreed upon the matters as follows:

1.- The Japanese team had the preparatory survey of ten factories selected by INTI in nine industries. As the result of the survey, the Japanese team approved the factories suitable to be surveyed in the first and second field work.

Name, type of industry, and address of each factories are as follow:

1) JUGOS S.A.
Food Industry
Parque Industrial Reginense, Villa Regina C.C., 156 Prov. de Río Negro.

2) DARSENA S.A.
Food Industry
José Hernández 145 ,Mar del Plata ,Prov. de Bs.As.

3) CADAFE S.R.L.
Iron and Steel (foundry) Industry
Agüero 4860, Villa Dominico, Prov. de Buenos Aires

4) TIFEC S.A.I.C.y F
Metal Industry
Cno. San Carlos km 2.5, Ciudad de Córdoba

Secretaría de Industria y de Comercio Exterior
INSTITUTO NACIONAL DE TECNOLOGIA INDUSTRIAL

INTI

Laboratorios: Parque Tecnológico Miguelete - Av. Gral. Paz e/ Albarellos y Constituyentes - C.C. 157 - 1650 San Martín - Prov. de Buenos Aires - Tel.: ● 755-6161/6212/6314/6365/6416/6467/6518 y ● 752-5281/5101/5201/5251/5351. Sede Central: Leandro N. Alem 1067, 5º, 6º y 7º piso - 1001 Cap. Federal - República Argentina - Tel.: ● 313-3013/3093/3253/3403 - Telegramas: INTIBAIRES - Télex: 021859 INTIAR.

5) ANSABO S.C.A.
Paper and Pulp Industry
Isidoro Iriarte 1257 Villa La Florida, Prov. de Bs.As.

6) WELLS S.A.
Textile Industry
Inglaterra 231, San Martín, Prov. de Bs.As.

7) VENTURA HNOS.
Leather Industry
Ruta Provincial 11 km 43, Magdalena Prov. de Bs.As.

8) RAYEN CURA S.A.
Glass Industry
Carril Nacional 6070, Rodeo de la Cruz, Prov.de Mendoza

9) NOREN PLAST S.A.
Chemical Industry
Ruta Nac. N° 3 km 35.4, Gonzalez Catán, Prov. de Bs.As.

10) PLASTIMET S.A.
Plastic Industry
Pampa 515, Bella Vista, Prov. de Bs.As.

2.- The Japanese team showed the following draft of survey schedule of ten factories to INTI, and asked INTI to make appointments with factories, and INTI agreed to it

Secretaría de Industria y de Comercio Exterior
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1st STAGE

1st GROUP

1) JUGOS S.A.	1988.2.29	3.4
2) DARSENA S.A.	1988.3.7	3.11
3) WELLS S.A.	1988.3.14	3.18

2nd STAGE

2nd GROUP

4) ANSABO S.C.A.	1988.10.10	10.14
5) VENTURA HNOS.	1988.10.17	10.21

d GROUP

6) NOREN PLAST S.A.	1988.10.24	10.28
7) PLASTIMET S.A.	1988.10.31	11.4

4th GROUP

8) CADAFE S.R.L.	1988.11.7.	11.11
9) TIFEC S.A.I.C.y E.	1988.11.14	11.18
10) RAYEN CURA S.A.	1988.11.21	11.25

The dates of the second stage will be confirmed not later than the first week of June, considering the visiting groups of experts.

INTI asked the Japanese team to inform the necessary preparatory tasks to be carried out in the factories before the second stage, not later than the first week of June.

Secretaría de Industria y de Comercio Exterior
INSTITUTO NACIONAL DE TECNOLOGIA INDUSTRIAL

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3.-The Japanese team asked INTI to prepare the following members as Argentinian counterpart who will work together with the Japanese team at the first and second field work, and INTI agreed to it.

1) Numbers of the Argentinian counterparts for factories survey at the first and second field work.

Heat engineer	2 or more
Electric engineer	1 or more

2) Numbers of the Argentinian counterparts for the survey of energy policy and energy conservation dissemination at the first field work.

Counterpart	1 or more

4.-The Japanese team showed the attached survey schedule for energy policy and energy conservation disemination and asked INTI to make appointments with visiting organizations, and INTI agreed to take all steps within its reach to satisfy this request.

ATTACHED SURVEY SCHEDULE

Schedule plan of research on energy demand & supply and energy conservation

DATE			Companies to be visited	Main issues
1988 Feb.	25	Thu	INTI	Explanation of details of research
	26	Fri	INTI	Reconfirm of the schedule
	29	Mon	INTI	INTI's policy and activity for energy conservation
Mar.	1	Tue	Bureau of Energy	Long term energy plan, energy prices, details of energy consumption
	2	Wed	Bureau of Energy	National energy conservation policy
	3	Thu	UTN	UTN's activities on energy conservation
	4	Fri	YPF	Development plan, middle and long term market forecast and policy on oil
	7	Mon	Esso, Shell	Development plan, middle and long term market forecast and policy on oil
	8	Tue	Gas del Estado	Development plan, middle and long term market forecast and policy on gas
	9	Wed	SEGBA	Development plan, middle and long term market forecast and policy on electricity
	10	Thu	CNEA	Middle and long term development plan
	11	Fri	Agua y Energia	Details of energy consumption
	14	Mon	JETRO, Japanese chamber of commerce and industry	General research on energy
	15	Tue	Bureau of Budget	Tax policy for energy conservation, international accounts
	16	Wed	National Development Bank	Budget policy for small and medium-sized companies and for energy development and energy conservation
	17	Thu	LRA, Clarin	Public information on energy conservation
	18	Fri	Bureau of Energy	National energy policy

QUESTIONNAIRE

Reply by (Name)________________, (Division)____________________________, (Date)____________

1. General

1	Name of Factory	
2	Address	Telephone
3	President Factory manager Energy Manager	
4	Type of Industry	
5	Capital	
6	Annual Sales Amounts	
7	Number of Employees	
8	Number of Engineers	(Electricity) (Heat)
9	Organization Chart	

2. Production of Major Products

No.	Name of Products	Production Capacity	1983			1984			1985			1986		
			Annual Operat-ing Hour	Produc-tion Amount	Sales Amount	Annual Operat-ing Hour	Produc-tion Amount	Sales Amount	Annual Operat-ing Hour	Produc-tion Amount	Sales Amount	Annual Operat-ing Hour	Produc-tion Amount	Sales Amount

3. Annual Utility Consumption

No.	Name of Utility	Lower Heating Value	1983			1984			1985			1986		
			Consu-mption	Unit Price	Purchase Amount	Consu-mption	Unit Price	Purchase Amount	Consu-mption	Unit Price	Purchase Amount	Consu-mption	Unit Price	Purchase Amount
1	Fuel Oil (kl)													
2	Diesel Oil (kl)													
3	Kerosene (kl)													
4	Gasoline (kl)													
5	LPG (t)													
6	Natural Gas (m3)													
7	Others													
8	Coal (t)													
9	Electricity (kWh)													
10	Sea Water (t)													
11	River Water (t)													
12	Well Water (t)													
13	City Water (t)													

4. Electric Power Receiving

1	Receiving Voltage	
2	Maximum Demand	
3	Power Factor	
4	Transformer Capacity per unit	
5	Number of Transfomers	
6	House Generation Capacity	

5. Boiler

No.	Type	Built year	Nominal Capacity		Kind of Fuel	Operating Period							
			Steam Press. (kg/cm2G)	Evaporating Volume(t/h)		1983		1984		1985		1986	
						hrs/day	day/y	hrs/day	day/y	hrs/day	day/y	hrs/day	day/y

6. Major Energy Consuming Facilities

No	Name of Facility	Built year	Products	Name of Energy	Nominal Output	Operating Period and Output											
						1983			1984			1985			1986		
						hr/d	day/y	Output	hr/d	day/y	Output	hr/d	day/y	Output	hr/d	day/y	Output

7. Flow-chart of Producing Process of Major Products

8. Energy Flow Chart

9. Electric Skeleton Diagram

10. Plant Layout

11. In case you have any problem(s) in your course of promoion of energy conservation, please circle the number(s) of applicable item(s) among the following: (maximum 5 items)

(1) Uncertainly of energy price prospect

(2) Less impact of energy cost to the whole cost of enterprise

(3) Expectation of cancelling the incremantal cost to the raising price

(4) Little possibility of energy shortage

(5) Little room for promoting further energy conservation

(6) Shortage of engineers

(7) Difficulty in obtaining good energy conservation equipments

(8) Unreliable results from energy conservation equipments

(9) Uncertainty about return on investment in energy conservation facilities

(10) Difficulty in obtaining good information such as active case

(11) Insufficient system of research and development

(12) Shortage of fund for facility improvement

(13) Superannuated facilities

(14) Low consciousness of employees

(15) Lack of personnel who can educate the employees

(16) Shortage of measuring equipments

(17) No time to analyze energy consumption rate

(18) Shortage of information on government's measures

(19) Shortage of government's subsidiary measures

(20) Others

12. Measures carried out for Energy Conservation and those effects

13. Planning Measures for Energy Conservation and these prospects

Attached Data 6

Equipment List for Factory Energy Audit

No	Item	Numbers
1	Equipment Carrying Veheicle with Rack and Lifter	1
2	Portable Type Equipment for Heat Audit	
	1) Ultrasonic Flow Meter for Fuel Oil	1
	2) Ultrasonic Flow Meter for Water	1
	3) High Temperature Anemometer	1
	4) Heat Flow Meter	1
	5) Pocketable Oxygen Meter	1
	6) Zirconia Type O2 Analyzer	1
	7) CO2 and CO Gas Tester	1
	8) Gas Sampling Tube	1
	9) Surface Thermometer	1
	10) Sheath Thermo Couple (CA)	10
	11) Compensated Cable for Thermo Couple	10
	12) Digital Thermometer for Thermo Couple	2
	13) Waer Conductivity Meter	1
	14) pH Meter	1
	15) Digital Low Pressure Meter for Gas	1
	16) 12-Channels Hybrid Recorder	2
	17) 3-Channels Pen Recorder	1
	18) Infrared Radiation Thermometer (-50 to 1000 C)	1
	19) Infrared Radiation Thermometer (600 to 3000 C)	1
	20) Infrared Radiation Thermal Video System with Personal Computer	1
	21) Voltage Stabilizer of Supply Power	2
	22) Steam Trap Checker	1
	23) Desk Size Wagon	2
	24) Power Supply Cord and Reel	1
	25) Pocket Computer	1
	26) Stop-Watch	1
	27) Glass Thermometer	1
	28) Cobalt Glass for Eye Protect	1
	29) Heat Resisting Gloves	1
	30) Camera	1
	31) Flow Mater for Gas and Steam	1

No	Item	Numbers
3	Portable Type Equipment for Electricity Audit	
	1) Clamp-on Type Watt-Power Factor Meter (6-Channels)	1
	2) Clip-on AC Power Meter	1
	3) DC Volt-Ammeter	1
	4) Watt-Hour Meter	1
	5) 12-Channels Hybrid Recorder	1
	6) 3-Channels Pen Recorder	2
	7) Power Line Transducer (A,V,kW,kVar,PF)	2
	8) Circuit Tester	1
	9) Tachometer	1
	10) Lux Meter	1
	11) Voltage Stabilizer of Supply Power	1
	12) Desk Size Wagon	1
	13) Power Supply Cord and Reel	1
	14) Pocket Computer	1
	15) Frequency Meter	1
	16) Voltage Detector	1
	17) Insulation Gloves	1

7 Preferential measure for facility investment for energy conservation in Japan at 1988

7.1 Loan for rational use of energy by the Japan Development Bank

1. Subjective enterprises

Those enterprises which utilize such facilities that are remarkably effective for rational use of energy and installation of them is regarded to be extremely necessary for materialization of energy conservation in Japan or those lease companies which lease same.

2. Subjective facilities

Those facilities listed in Table 7-1, Table 7-2 or Table 7-3 which are to be added to the existing facilities in order to recover energy which was otherwise exhausted without being used such as waste heat, etc. or those facilities which improve energy utilization efficiency. And it is provided those of Table 7-1 meet either conditions (i) or (ii) noted below, those of Table 7-2 meet conditions (i) and (iii) and those of Table 7-3 meet conditions of (iii) and (iv).

(i) A facility that improves energy consumption efficiency by over 10% and it can save over 50 kiloliters per year of petroleum equivalent

(ii) A facility that improves energy consumption efficiency by over 5% and it can save over 1,000 kiloliters per year of petroleum equivalent.

(iii) A facility that improves energy consumption efficiency by over 20%.

(iv) A facility that enables to shift over 5% of electric load consumed in day time for air conditioning and/or heating to night time.

Note: The finance is also available for interindustry common energy consumption facilities (those facilities for effective utilization of exhaust energy such as waste gas, waste steam or others by multiple enterprises).

Table 7-1 **Japan Development Bank's Finance System for More Effective Use of Energy (taken charge of by MITI)**

Applicable facilities and equipment	Outline
1) High efficiency industrial furnaces	Industrial furnaces whose fuel consumption rate is rather low, such as those furnaces which are equipped with preheating zones for pre-heating raw materials by utilizing waste heat combustion.
2) Heat exchangers for preheating air	Heat exchangers for preheating combustion air by utilizing waste heat of combustion.
3) Waste heat boiler equipment	Boiler equipment to generate steam by recovering heat of waste gas to be exhausted from a production process.
4) Waste gas-utilizing equipment	Equipment to collect and utilize waste gas to be exhausted from a production process.
5) LNG cold heat-utilizing equipment	Equipment to recover and utilize cold heat of LNG.
6) Waste pressure-recovering equipment	Equipment to recover waste pressure of a gas to be generated in a production process.
7) Heat pump-utilizing equipment for industrial use	Equipment of recover low-temperature waste heat from waste vapor to be exhausted from a production process and to utilize as heat source by heating that waste heat through a compression-type or a absorption-type heat pump.
8) Gas separating equipment	Equipment to separate a high-purity gas out of gases generated in a production process and to be based on a cold separation method, pressure swing absorption method (PSA method), or membrance separation method.

Applicable facilities and equipment	Outline
9) Other equipment similar to those described above and the necessity to promote their installation is especially high.	

Note: Equipment for common utilization of energy between industries are those which meet the items 4), 5), or 7) above.

(Taken charge of by Ministry of Construction)

Applicable facilities and equipment	Outline
1) Heat pump-type heat source units	Restricted to heat pump-type heat source units (including exclusive pipes, ducts, pumps, air blowers, regenerators, and auxiliary heat source units).
2) External heat insulation system	Heat insulation materials, coverings, and mounting fittings to be applied on external walls of and external roof surfaces of buildings.
3) Group-of-buildings management and control equipment	Equipment to effect automatic network management and control of air-conditioning, illuminating, and other facilities and equipment of more than one small- or medium-sized building by using a host computer (including detectors, main unit terminals, and other controls).
4) Air-conditioner	Air-conditioning equipment in which a hygrothermographic sensor and other sensors, air-supplying/circulating fans, heat exchangers, and other components are systematized in a compact way (including detectors, main unit terminals, and other controls).
5) Group-of-elevators management and control system	System to effectively manage and control more than one elevator by making use of micro-computers, sensors, and other electronic technology.

Table 7-2 Japan Development Banks's Finance System for More Effective Use of Energy

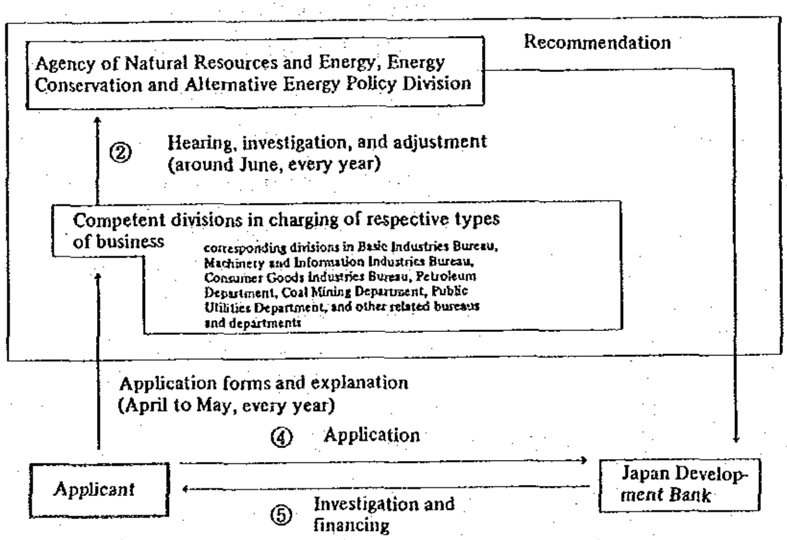
Applicable facilities and equipment	Outline
1) Improved continuous casting equipment	Restricted to such equipment as produces steel pieces under a continuous casting method and is simultaneously provided with casting facilities, bulgeing-protective units, and slow cooling units (limited to those which are provided with an automatic water regulating unit), and including an exclusive automatic regulator which is to be installed simultaneously therewith.
2) Vertical crushing equipment	Restricted to such equipment as possesses a structure to use a roller for crushing raw materials of cement, cement clinker, or mixed raw materials of cement, and is simultaneously provided with a vertical crusher incorporating a classifier, a collector, and an induction fan, and including an exclusive hot air pipe to be installed simultaneously therewith.
3) Dyeing equipment with low bath II ratio	Restricted to such dyeing equipment as is capable of dyeing with a dyeing solution whose volume is less than eleven times that of textile fabric or knitted fabric in a dyeing process, and has the dyeing speed more than 200 m/min., and including a chemical suppling unit, a heat exchanger, an automatic regulator, or a pump which are to be exclusively and simultaneously installed therewith.
4) Liquid film flowing-type evaporator	Equipment limited to an evaporator for concentrating waste solutions after processing pulp or after distilling unrefined rice or beans by flowing them with the gravity along a heating plate while keeping liquid films 4 mm or thinner, and including an automatic regulator, pump, or pipe exclusively designed for this use and simultaneously installed therewith.

Applicable facilities and equipment	Outline
5) Roll press equipment	Equipment for pressing and crushing cement clinker or mixed raw materials of cement by using a roller, as a preliminary pretreatment of a crushing process using a crusher.
6) High-speed multi-yarn reeling equipment	High-speed reeling equipment based on melt spinning method, restricted to that which is provided with a take-up unit incorporating an automatic winder to enable to simultaneously wind more than one yarn at a time, and including a polymer melting unit, a spinning head, a spinning tube, and an automatic regulator exlusively designed for this use and and to be simultaneously installed therewith.
7) Electrolyzing equipment based on an ion exchange film method	Restircted to such equipment as an electrolytic vessel for producing caustic soda and chlorine by means of an ion exchange film, and including a saline refining unit, an evaporating unit, a deoxidizing unit, a rectifier, or an automatic regulator exclusively designed for this use and and to be simultaneously installed therewith.
8) Continuous digesting equipment	Digesting kettles and their ancillary equipment for continuously digesting wood chips and collecting pulp at a time.
9) Energy-saving equipment for business	Restricted to air-conditioning equipment, hot water supply units, and freezing/refrigerating show cases together with waste heat recovering equipment and to be simultaneously installed therewith.

Table 7-3 Japan Development Bank's Finance System for More Effective Use of Energy

Applicable facilities and equipment	Outline
Heat pump-utilizing equipment with heat accumulator	Restricted to such heat pump-type equipment as equipment (with the rated power consumption being 10 kW or more in total at the heat source units) and is simultaneously provided with a heat accumulating vessel and including a waste heat recovery unit exclusively designed for this use and and to be simultaneously installed therewith.

3. Financing ratio
   40% or less
4. Interest (as of May 1, 1988)
   For those types of equipment which are listed in Table 7-1
   1) If efficiency to use energy is enhanced by 20% or more: Special interest No. 3 (5.3%)
   2) Other than the item 1) above — Ordinary interest (5.5%)
   For those types of equipment which are listed in Table 7-2
   1) If efficiency to use energy is enhanced by 40% or more: Special interest No. 3 (5.3%)
   2) Other than the item 1) above — Ordinary interest (5.5%)
   For those types of equipment which are listed in Table 7-3 — Special interest No. 4 (5.0%)
5. Outlined procedures for applying for finance
   Ministry of International Trade and Industry



Remarks: Financing procedures for the equipment that is under the control of the Ministry of Construction are similar to those under the control of the MITI.

7.2 Japan Development Bank's financing system for promoting diffusion of cogeneration systems

1. Applicable enterprises
   Enterprises engaging in installation and/or leasing of cogeneration system equipment whose promotion and diffusion are especially needed for realizing efficient utilization of energy.
2. Applicable facilities and equipment
   Cogeneration system equipment and its ancillary one as listed in Table 7-4 with the *primary energy efficiency of 60% or more.*

Table 7-4 Cogeneration system equipment to which Japan Development Bank's finance is applicable

1)	Gas turbine type
2)	Dual-fuel gas turbine type
3)	Spark-ignition gas engine type
4)	Compression-ignition gas engine type
5)	Dual-fuel gas engine type
6)	Direct-injection diesel engine type
7)	Double-cell diesel engine type
8)	Dual-fuel diesel engine type
9)	Other types similar to above and supplying heat and electricity or other types of power

3. Financing ratio: 40%
4. Interest (as of May 1, 1988)
   Special interest 4% (5.0%)
5. Outlined procedures for applying for finance
   Similar to those described in the financing system for effective use of energy

7.3 Small Business Finance Corporation's loan system on promotion of effective use of energy (energy-saving funds)

1. Objectives
   This system aims at financing funds necessary for small enterprises to obtain energy-saving equipment.
2. Subject of finance
   Small enterprises as defined in the Law of Small Business Finance Corporation
3. Description of funds
   Funds necessary for obtaining energy-saving equipment as listed in Tables 7-5 and 7-6

(including those for renewing and modifying it)

4. Financing methods

   Direct financing or proxy financing

5. Financing requirements

   1) Financing limits

      a) Direct financing: ¥420 million in addition to ordinary financing

      b) Proxy financing: ¥50 million except for ordinary financing

   2) Financing interest (as of May 1, 1988)

      Basic interest (5.5% per annum) except the maximum amount of ¥270 million to be financed by March 31, 1991 for the energy-saving facilities and equipment as listed in Table 7-6, for which the interest of 5.3% per annum shall apply.

   3) Financing period

      Fifteen (15) years or less

   4) Period of deferment

      Two (2) years or less

Table 7-5 Energy-saving equipment (having energy-saving effects of 10% or higher)

Name of equipment	Outline
1. Equipment to enhance boiler efficiency (restricted to equipment meeting one of the requirements shown in the right column)	1) Equipment to reduce blow rate of boiler water for the purpose of adjusting its concentration and to prevent heat loss by eliminating impurities in advance to supplying water to the boiler (pure water generating equipment). 2) Equipment to stabilize variation in boiler loads which may be produced as a result of changes in steam volume to be used, for the purpose of protecting boiler efficiency from being lowered (steam accumulator).
2. Automatic combustion controlling equipment	Restricted to equipment which automatically controls flow ratio between combustion air and fuel in accordance with changes in furnace temperature or combustion volume.
3. Water heater or cooler utilizing waste heat	Absorption-type water heater or cooler restricted to those which utilize waste heat for regenerating lithium bromide or other absorbents.

Name of equipment	Outline
4. Two stage blosting cupola	Restricted to cupolas with double blasting tugere for the purpose of expanding melting zones.
5. Wate pressure-reocovery equipment	Restricted to such equipment as recovers and utilizes waste pressure of gases (including liquefied ones) to be generated in production processes.
6. Heat-insulating equipment	Restrict to heat-insulating coverings, and heat-insulating equipment for reducing heat loss in production facilities (including transportation and storage facilities to be used for production).
7. Operation unit number controlling equipment	Restricted to such equipment as controls the number of transformers and motors to be operated so that the operating efficiency may be maximized as a whole.
8. Rotational number controlling equipment	Restricted to such equipment as controls rotational numbers of motors in accordance with changes in motor loads.
9. Energy-saving combustion equipment	Restricted to such combustion equipment as is capable of burning at low excess ratio of air.
10. Heat pump-type heat source equipment	Restricted to heat pump-type heat source units (including exclusive pipes, ducts, pumps, air blowers, regenerators, and auxiliary heat source units).
11. Automatic solar beam preventive equipment	Restricted to such equipment as automatically controls openings of buildings in accordance with changes in solar beams (including detectors and regulators).

Name of equipment	Outline
12. Variable air-volume air-conditioning equipment	Restricted to such equipment as controls air volume of an air-conditioning unit in accordance with changes in air-conditioning loads by using either a rotational number control unit or a speed-change unit (including detectors and terminal control units).
13. Other facilities and equipment	Other energy-saving facilities and equipment similar to those described above with the energy-saving effects of 10% or higher and approved by the Director-General of the Small and Medium Enterprise in response to the recommendation by the Director-General of Natural Resources and Energy as equipment whose promotion is especially needed.

Those items which have been approved as "Other energy-saving facilities and equipment" as of May 1, 1988 are as listed below:

1. Automatic temperature regulator
2. Energy-saving automatic printing paper developer
3. Energy-saving yarn-producing equipment
   1) Single-spindle driving-type ring yarn twisting machine
   2) Up twister
   3) Conical end winding governing machine
   4) Italian-type yarn twisting machine
   5) Composite yarn twisting machine
   6) Double twister
4. Energy-saving circular knitting machine
5. Energy-saving molding machine
   1) Cold-box molding machine
   2) Frameless molding machine
   3) High-pressure molding machine

Table 7-6 Energy-saving equipment (having energy-saving effects of 20% or higher)

Name of equipment	Outline
1. Steam condensate recovering equipment (steam trap, condensate pump, condensate tank, and so on)	Restricted to such equipment as recovers and utilizes steam condensate.
2. Waste heat boiler	Restricted to such equipment as utilizes waste heat in a production process to generate steam.
3. Heat exchanger (restricted to equipment meeting one of the requirements shown in the right column)	1) Equipment to preheat fuel, combustion air, or raw materials by utilizing waste heat coming out of combustion or a production process. 2) Equipment to utilize cold heat to be discharged while liquefied natural gas is discharged.
4. Energy-saving industrial furnaces (restricted to equipment meeting one of the requirements shown in the right column)	1) Furnaces in which a preheating zone which preheats raw materials by using waste heat of combustion is incorporated in a heating zone of a furnace. 2) Furnaces in which more than 50% of the area of their internal walls, except the bottom section, is constructed with heat-insulating materials. 3) Furnaces which possess a mechanism to automatically control flow ratio between combustion air and fuel in accordance with changes in furnace internal temperatures or combustion volumes. 4) Furnaces which effect heating based on a jet heating method.
5. Cold-box molding machine	Restricted to such equipment as hardens molding sand by means of chemical hardening reaction of organic binding materials with amine gases working as catalysts, rather than using combustion heat.

Name of equipment	Outline
6. Clean cupola	Resticted to such cupolas as have a mechanism to directly blow combustion gas made of liquid fuel into a portion just above the tuyere.
7. Dyeing equipment with low bath ratio	Restricted to such equipment as is capable of reducing ratio between heated dyeing solution and materials to be dyed (bath ratio).
8. Water-saving washing machine	Restricted to such equipment as is capable of saving heated washing water by enhancing cleaning effects.
9. Skylight with natural illumination	Restricted to such equipment as a skylight made of reinforced glass which is to be mounted on a roof so that day light may enter through the roof.
10. Waste gas-utilizing equipment	Restricted to such equipment as recover and utilizes waste gas to be produced in a production process (including waste gas-collecting unit, pipes, and storage units).
11. Solar heat-utilizing cold/hot heat equipment	Cold/hot heat equipment that utilizes solar heat (including heat collectors, accumulators, auxiliary heat source units, automatic control units, pipes, pumps, air blowers, and exclusive freezers or refrigerators).
12. Energy-saving management and control equipment	Equipment to automatically control air-conditioning, illumination, and other units by means of a computer (including such control units as detectors and main unit terminals).

Name of equipment	Outline
13. Other facilities and equipment	Other energy-saving facilities and equipment similar to those described above with the energy-saving effects of 20% or higher and approved by the Director-General of the Small and Medium Enterprise in response to the recommendation by the Director-General of Natural Resources and Energy as equipment whose promotion is especially needed.

Those items which have been approved as "Other energy saving facilities and equipment" as of May 1, 1988 are as listed below:

(Only the names of facilities and equipment are listed.)

1. Waste heat-utilizing heating equipment
   1) Vacuum type
   2) Raw material-preheating type
   3) Waste gas-purifying/recycling type
   4) Flash dryer
2. Energy-saving baking units
3. High-frequency induction heating units
4. Heat exchangers
   1) Total heat exchangers
   2) Heat pipe-type sensible heat exchangers
5. Direct power supply-type heating units
6. Vapor-recycling vacuum evaporator
7. Energy-saving dryers
   1) Electromagnetic wave irradiating type
   2) Air-preheating type
   3) Waste gas-recycling type
   4) High boiling-point heating medium type
   5) Dehydrating/drying type
   6) Waste gas-purifying/recycling type
   7) Infrared irradiation type
8. Energy-saving dyeing and tinishing units
   1) Dehydrator
   2) Continuous high-pressure steamers
   3) Equipment to add small amounts of chemicals
   4) Heat setters
   5) Microwave dyeing machines
   6) Cheese dryers

7) Continuous normal pressure steamers

9. Energy-saving paper container-making machines

1) Pattern-molding machines

2) Paper pasting machines

3) Automatic box-making machines

10. Ultraviolet irradiating units for metal plates

11. Energy-saving book-making machines

1) Sheet-gathering machines

2) Seamless binding machines

12. Separate-type rolling machines

13. Microwave vulcanizing units

14. Continuous coating/vulcanizing units

15. Energy-saving molding machines

1) Extrusion molding machines

2) Foaming molding machines

3) Injection molding machines

16. Energy-saving automatic film developer

17. Improved double-effect absorption-type cold/hot water suppliers

18. Motor-driver feeder metal-machining tools

19. Ultrafiltration units

20. Energy-saving presses

1) Hydraulic presses

2) High-speed automatic-feeding presses

3) Continuous machining presses

21. Shuttleless automatic weaving machines

22. Energy-saving die-casting machine

1) Machines with a piston-type accumulator

2) Machines with more than one hydraulic pump

3) Machines with a heat-insulating structure

23. Printer/slopper

24. Energy-saving printing machines

1) Simultaneous perfecting offset machines

2) Double-body perfecting offset machines

3) Two-color offset printing machines

4) Multi-printing automatic gathering form printing machines

25. Automotive working machines and facilities

1) Excavating machines, stamping machines, loading machines, cranes, motor graders, concrete machines, and drilling machines

2) Tractors

3) Machines for foundation work

26. Blast dehumidifier for industrial turnaces

1) Moisture-absorbing type

2) Cooling type

3) Moisture-absorbing/cooling type

27. Energy-saving electric furnaces

1) High-frequency melting furnaces

2) High-sensibility are furnaces

3) High-performance electrolytic furnaces

28. High-performance dewatering units

1) Belt-press type

2) Filter-press type

29. Heat-pipe wrapping machines

30. Process-saving composite meat choppers

31. Energy-saving automatic smoking machines

32. Energy-saving instantaneous sterilizing machines

33. High-performance separators

1) Liquid film flowing-type evaporator

2) Vapor-Recompression evaporator

3) Pure water-producing units

34. Steam-adjustable automatic bean boilers

35. Energy-saving noodle-producing machines

1) Noodle band-forming machines

2) Automatic noodle-steaming/forming machines

3) Noodle boiling/forming machines

36. Steam heat exchange-type frying machines

37. Energy-saving baking/roasting ovens

1) Waste heat-circulating ovens

2) Exhaust gas-controlling ovens

3) Automatic temperature-controlling ovens

4) Far-infrared continuous baking oven

5) Continuous baking ovens with a quick-heater

6) Heat-reflecting baking ovens

38. Energy-saving fruit juice centrifugal separators

39. Gyro dryers

40. High heat-efficiency continuous rice steamers

1) Steam-recycling continuous rice steamers

2) Steam-diffusing continuous rice steamers

41. Filtrating press with an automatic controller

42. Energy-saving roasting machines

43. High-efficiency pneumatic conveyers

44. Energy-saving yarn-reeling machines

1) Card machines

2) Roller-type drawing frames

3) Automatic doffing machines

4) Ring spinning frames

5) Pneumatic spinning frames
6) Automatic reeling machines
7) False twisting machines
8) Concentrated air blowers for automatic reeling machines
9) High-performance twisting machines

45. Energy-saving bread pattern extractors
46. Energy-saving heaters/mixers
47. Energy-saving pulpers
48. Energy-saving refiners
49. Energy-saving photoengravers
    1) High-speed full-automatic block copying machines
    2) Photoengraving cameras with an auto-focusing unit
50. Energy-saving forged material cutting machines
51. Energy-saving casting sand kneading machines
    1) Water-controlling casting sand kneading machines
    2) Self-setting sand kneading machines
    3) Casting sand chargeability-controlling kneading machines
52. Die-forging machines
53. Energy-saving shot blast units
    1) Curved-vane shot blast units
    2) Double-rotation shot blast units
54. Energy-saving cast gate remover
55. Energy-saving warping/sizing units
    1) Partial warping units
    2) Sizing machines with a high-pressure squeezer
    3) Bobbin sizers
56. Energy-saving circular knitting machines
    1) Garment length circular knitting machines
    2) Seamless stocking knitting machines
57. Energy-saving nonwoven fabric-making machines
    1) Forced recycling dryers
    2) Dry heat processors
58. Energy-saving casting sand cooling units
59. Energy-saving waste paper wrapping machines
60. Screw press dehydrator
61. Solar-heat water heaters
62. Power factor-improving units
63. Energy-saving boilers
64. Energy-saving arc welders
65. Continuous steaming/boiling units
66. Automatic temperature-regulating fermenting units
67. Ring barkers for small-diameter lumbers

68. Energy-saving glass melting furnaces
69. Gypsum board dryers
70. Energy-saving vacuum annealing furnaces
71. Vertical-type bottle cleaners
72. Continuous steaming/cooling units for corn
73. Thermal forming machines
74. Compression forming machines
75. High-vacuum sealing units
76. Centrifugal dehydrators/dryers of plastic vessel
77. Rotary forging machines
78. Precision dieing-out presses
79. Wicket dryers
80. Energy-saving plywood dryers
81. Energy-saving forklift trucks
    1) Forklift trucks that use a thyristor to control hydraulic pump motors for loading/unloading jobs
    2) Fork lift trucks that use an exhaust turbo charger for supercharging
82. Special double-glass sashes
83. Long taper tube-producing machines
84. Energy-saving vacuum generating units
85. Sealed-type rice steamers with a steam discharge hole
86. Waste distilled solution concentration units
87. Low-temperature waste heat using heaters
88. High-efficiency radiation heaters/dryers
89. Energy-saving grain regulators
90. Energy-saving mixers
91. Energy-saving meat slicers
92. High-efficiency continuous bean jam wrapping machines
93. Energy-saving high-speed constant-volume feeder
94. Energy-saving industrial furnaces that is capable of charging regulated atmosphere after vacuum discharging
95. High-pressure molding machines
96. Multi-stage formers
97. Hot forging presses
98. High-efficiency aeration units
99. Pure water-producing distillers
100. Automatic controllers of water circulation
    1) Cooling water quality control units
    2) Centralized controllers of circulation of cooling water
101. Pumping power recovery unit
102. High-frequency cheese drying units
103. External heat-insulating systems

104. Energy-saving rotary presses
105. Energy-saving jaw crushers
106. Concrete block continuous-curing units
107. Energy-saving warp knitting machines

7.4 Tax system for promoting investments to reinforce economic and social energy bases

1. Structure

When an enterprise obtains a facility which contributes to reinforcement of energy bases and put it to business use within one year after obtaining it, the enterprise is allowed to select either of the following two systems for applying to the year (or fiscal year, if the enterprise is incorporated) in which the facility is put to business use:

1) Tax credit system in which the enterprise is allowed to deduct an amount equivalent to seven percent (7%) (or 3.5% for mining rights related to overseas production of oil wells) of the basic acquisition cost(Note) of the said facility from an income tax or corporate tax amount (with the limitation of an amount equivalent to 20% of the income tax or corporate tax amount), or

2) a special depreciation system in which the enterprise is allowed to depreciate an amount equivalent to maximum 30% of the basic acquisition cost of the said facility (or 15% for the mining rights related to overseas production of oil wells) in addition to ordinary depreciation.

If the said facility is an imported one, the tax reduction ratio of 1.2 times applies, respectively.

This tax benefit may be carried over for one year in either case.

(Note) The basic acquisition cost shall be 75% of the actual acquisition cost for "Manufacturing facilities for reinforcing energy bases" listed in Table 7-7-1(1) and "Facilities for more intensive application of petroleum resources" listed in Table 7-7-3(1), respectively.

2. Those persons to whom this system applies

Individuals and corporations who install any of the facilities listed in Tables 7-7-1 to 7-7-3 and file a returns for business (Table 7-7-3(4) is applicable only to corporations)

Small and medium enterprises which install any of the facilities listed in Table 7-7-4.

3. Application period

This system shall apply to those objective facilities and equipment which are to be acquired within the application period (two years from April 1, 1988 to March 31, 1990).

4. Laws and acts concerned

Omitted

Refer to Tables 7-7-1(1), 7-7-1(2), and 7-7-4(1) for energy saving equipment.

Table 7-7-1 Facilities for reinforcing energy bases (69 types)

(1)	Manufacturing facilities for reinforcing energy bases (31 types)
1.	Direct-contact continuous automatic freezing units
2.	Intermittent germ-free charging units
3.	Automatic blowing machine
4.	High-speed automatic winding machines
5.	High-performance dyeing/finishing units
1)	Jet-type dyeing units
2)	Units to dyeing with low amount of dyeing solution
3)	Counter current-type washing units
6.	High-performance paper pulp manufacturing units
1)	Pre-immersing continuous digesting units
2)	High-performance pulp cleaning units
3)	Substitution breaching units
4)	High-performance sizing presses
7.	Liquid film flowing-type evaporator
8.	High-performance ion exchange film electrolytic units
9.	High-performance decomposition/reaction units
10.	High-performance gas-phase polypropylene-plant
11.	High-performance chemical fiber-making units
1)	Automatic continuous polymerization and spinning units
2)	High-speed multi-yarn spinning units
12.	Germ-free high-purity water producing units
13.	High-speed molding machines
1)	High-discharge extrusion molding machines
2)	Pressure-controlled foaming molding machines
14.	Roller-type vertical crushers
15.	High-performance steel-making/rolling units
1)	High-temperature continuous casting units
2)	Waste heat-utilizing continuous annealing units
3)	Arc furnaces with water-cooled walls
16.	High-efficiency gas-separating units
17.	High-performance heating units
1)	Paint combustion-type baking/drying units
2)	High-performance high-frequency melting furnaces
3)	High-performance high-frequency induction heaters
18.	Power generating units utilizing vessel propelling shaft power
19.	Inert-gas arc welders
20.	High-performance forklift trucks

(2)	Additional facilities for reinforcing energy bases (35 types)

1. High-performance surface press dewatering units for paper
2. High-effieincy compressors
3. Insulated wall of thermo-static reservoir
4. Roll presses
5. Dry-type waste pressure-recovering units
6. Sealed-type waste gas-collecting units
7. By-product gas storing units
8. Ladle-heating combustion units
9. Raw material preheaters for electric furnaces
10. Hot air blasting cupolas
11. Maritime diesel engines
12. Maritime sailing units with engines working as main and sails as auxiliary sailing power
13. Waste heat-utilzing boilers
    1) Waste heat boilers
    2) High-efficiency boilers
14. Heat exchangers
    1) Heat exchangers for preheating combustion air
    2) High-efficiency total heat exchangers
15. Heat pump-type heat source units
    1) Industrial heat pumps for recovering heat
    2) a) With heating capability of 65,000 kcal/hr. or more
       b) Operation number control type
16. High-efficiency industrial furnaces
    1) Furnaces for preheating raw materials
    2) Furnaces with controllable air/fuel ratio and furnace pressure
    3) Furnaces with reinforced heat insulation
    4) Furnaces with a vacuum discharging system
17. Oxygen-enriching units
18. Dehumidifyed air blasting unit for industrial furnaces
19. Units to reduce or more rationalize water consumption
    1) Anaerobic sewerage treatment facilities
    2) Super-deep aeration sewerage treatment facilities
    3) Low-pressure reverse osmotic membrane units
20. Gas turbine power generators for more than one purpose
21. Heat-supplying power generating units
22. Rotational number control units
23. 400V-class wiring facilities
24. High-performance time-sharing communicating path facilities
25. Image-compressing units

26.	Time-sharing multiplying units
27.	Floor-heating units
(3)	Local heat supply facilities (3 types)
1.	Heat supply facilities
1)	Heat supply ducts
2)	Heat source water pipes
2.	Heat receiving facilities

Table 7-7-2 Petroleum-alternative energy-utilizing facilities (22 types)

1.	Coal-utilizing facilities
1)	Intensive coal burning units
2)	Coal-burning boilers
3)	Coal/water slurry-producing units
4)	CCS coal-producing units
5)	Coal ash-utilizing units
2.	Coal-related pollution control units
1)	Dust-removing units
2)	Exhaust gas desulfurizing units
3)	Waste gas denitrifying units
4)	Coal ash recipients
3.	Units to replace local gases with natural gases
1)	Natural gas-supplying ducts
2)	Natural gas-receiving ducts
3)	Liquefied natural gas storage units
4)	Calorific value-changing units
4.	Storage units for containing more than one type of liquefied natural gas
5.	Hydraulic power units for power generation use
6.	Geothermal heat-utilizing units
1)	Geothermal heat-utilizing units for power generation
2)	Hot air generating units for house horticulture by utilizing geothermal heat
7.	Solar heat-utilizing units
1)	Solar heat-utilizing heat-collecting/storing units
2)	Units to accumulate solar heat in the ground for air curtain-type house horticulture
8.	Industrial waste-recycling units
1)	Wooden chip-burning boilers
2)	Wooden chip-burning hot air generators
3)	Lignin-burning boilers

Table 7-7-3 Other facilities (14 types)

(1)	Facilities for utilizing petroleum resources more effectively (5 ypes)
1.	Fluid catalytic cracking units
2.	Fluid catalytic cracking units for residual oil
3.	Catalytic dewaxing units
4.	Alkylation units
5.	Hydrocracking untis
(2)	Power supply-stabilizing units (2 types)
1.	Multiple wiring units
2.	Uninterrupted power supply units
(3)	Units for leveling demands for power and gas supply (6 types)
1.	Accumulator-type air-conditioning water-heater units
2.	Mid-night power-utilizing electric water heaters for office use
3.	Mid-night power-utilizing accumulator-type heating units
4.	Gas air-conditioning units
1)	Units with freezing capacity more than 30,000 kcal/hr.
2)	Units with a system to control number of operating units
5.	Industrial furnaces utilizing gas
6.	Gas-utilizing boilers
(4)	Assets for stabilizing supply of petroleum resources (1 type)
1.	Mining right concerned with oil wells working overseas

Table 7-7-4 Facilities for small and medium enterprises

(1)	Facilities for small and medium enterprises for reinforcing energy bases (90 types)
1.	Green house facilities for horticulture
2.	Self-driven working machinery
1)	Caterpillar trucks
2)	Caterpillar hydraulic shovels
3)	Wheel loaders
4)	Telescopic truck cranes
5)	Rough terrain cranes
6)	Lattice-type crawler cranes
7)	Motor graders
8)	Concrete-pumping vehicles
9)	Crawler drills

3. Meat slicers
4. Heaters/mixers
5. Mixers
6. Far infrared continuous baking units
7. High-speed constant volume supplying units
8. Boiled noodle-producing units
9. Heat pipe-type wrapping units
10. Vertical-type bottle cleaners
11. Steam-recycling continuous rice steaming units
12. Continuous steaming/cooling units for corn
13. Automatic filters/compressors
14. Distilled solution-concentration units
15. Yarn-spinning units
    1) High-speed card machines
    2) High-speed roller-type drawing frames
    3) High-performance automatic doffing machines
    4) High-speed ring spinning frames
    5) High-speed pnumatic spining frames
    6) High-speed automatic winders
    7) High-performance double twisters
16. High-pressure squeezing/sizing machines
17. Shuttleless automatic weaving machines
18. Dyeing/finishing units
    1) Jet-type dyeing units
    2) Units to dyeing with low amount of dyeing solution
    3) Washing units
    4) High-speed continuous high-pressure steamers
    5) Continuous normal-pressure steamers
    6) Heat setters
    7) Microwave dyeing machines
    8) Winding cheese dryers
19. Board dryers
    1) Vertically arranged shelf-type board dryers
    2) Reinforced insulation-type board dryers
20. Auto-focusing photoengraving cameras
21. Band dryers by dehumidified air utilizing waste heat
22. Forming machines
    1) Pressure-controlling foaming formation machines
    2) Thermal forming machines
23. Forging material cutters

24. Casting sand kneading machines
   1) Self-controlling self-setting casting sand kneading machines
   2) Casting sand chargeability-controlling kneading machines
25. Temperature-controlling die-casting machines
26. Plane-type high-pressure molding machines
27. Setting-type molding machines using sulfur dioxide
28. Pattern-disappearing molding machines
29. Shearing machines
30. Multi-stage formers
31. Rotary forging machines
32. Shot blast units
33. Automatic – cast gate removing machines
34. Deburring machines
35. Automatically controlled castings/casting sand cooling units
36. High-performance diecast machines
   1) Those provided with a piston accumulator or similar devices
   2) Those with reinforced insulation properties
37. Presses
   1) Hydraulic presses
   2) High-speed automatic feeding presses
   3) Multi-action presses
   4) Hot forging presses
38. Automatic temperature regulating units
39. Automatic power factory regulating units
40. Hydraulic elevators
41. Waste-paper wrapping units
42. Wash-finishing units
   1) Full-automatic continuous washing machines
   2) Full-automatic washing machines
43. High-efficiency heat exchangers
   1) Moisture-proof sensible heat exchangers
   2) Gradient-controlled, heat pipe-type sensible heat exchangers
44. Waste heat-recovery boilers
   1) Waste heat-recovery boilers
   2) High-efficiency boilers
45. Industrial furnaces
   1) Those with reinforced insulation
   2) Furnaces for preheating raw materials
   3) Furnaces with a system to control air/fuel ratio and furnace pressure
   4) Furnaces capable of charging regulated atmosphere after vacuum discharging

46.	Electric furnaces
1)	High-speed heating high-frequency melting furnaces
2)	High-speed heating high-frequency inductions heating furnaces
47.	Industrial-use heat pump-type heat source units
48.	High-efficiency radiation heaters/dryers
49.	Belt press-type dewatering units
50.	Sewerage treatment facilities
1)	Rotary disk-type sewerage treatment facilities
2)	High-efficiency aeration units
51.	Pure water-producing distillers
52.	Automatic water circulation controlling units
1)	Cooling water quality-controlling units
2)	Centralized controlling units for cooling water circulation
53.	Pump power recovery units
(2)	All the facilities that utilize alternative energy sources in lieu of petroleum

7.5 System to certify use of facilities designated in the tax deduction system.

(1) Outline of a certification system

From the viewpoint of promoting application of tax benefits to promote investments in reinforcement of economic and social energy bases a system to certify uses of such facilities has been established certification is effected by the related business associations (such as manufacturers associations) of enterprises (manufacturers and so on) which engage in production, installation, and construction of those facilities which reinforce energy bases (namely, manufacturing facilities for reinforcing energy bases, additional facilities for reinforcing energy bases, and those facilities for small and medium enterprises for reinforcing energy bases to which the tax system for promoting investment for reinforcing economic and social energy bases [hereinafter called "facilities for reinforcing energy bases"]).

If submitted together with final tax returns or similar returns, certificates to be issued under this system will be taken into consideration by tax authorities. In this sense, it may be a convenient one for users.

Since attaching the certificates is not required by laws, however, no users will be treated in an unfavorable manner only for the reason that they have not been attached this to the returns.

(2) Certifying procedures

1 The above-mentioned manufacturers' association or similar ones will issue certificates in a format previously determined, in accordance with request by manufacturers or other persons for them.

2 When manufacturers and other persons deliver facilities for reinforcing energy bases to users, they should prepare a "certificate of specifications of facilities for

reinforcing economic and social energy bases" which certifies the specifications of such facilities (so that the manufacturers may act as a certifying party) and submit the original certificate and its copy in duplicate to the said manufacturers' association or similar ones.

3 The said manufacturers' association or similar ones should check the certified contents of the specifications related to facilities for reinforcing energy bases prepared by the manufacturers and send related certificates to users.

(3) Mechanism of the certification system

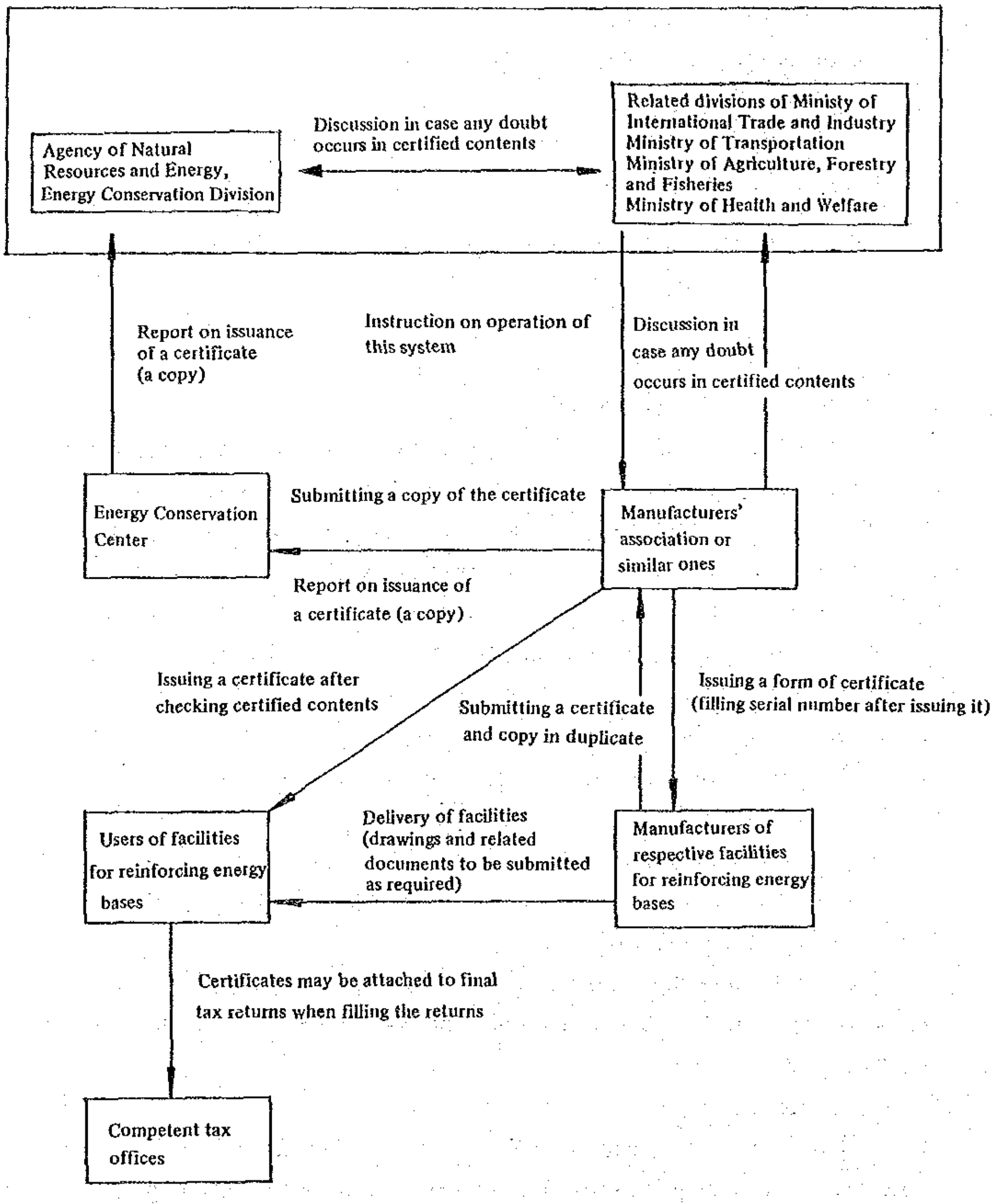


Fig. 7-3 Mechanism of the certification system

7.6 Special system on tax deduction of real estate tax concerned with facilities for reinforcing energy bases

1. Mechanism

Tax bases of real estate tax concerned with facilities for reinforcing energy bases may be reduced to 5/6 for three years.

2. Persons to whom this system applies

Private persons or corporations filing tax return for business and installing the facilities listed in Table 7-8 below:

3. Laws concerned

Omitted

4. Application period

This special system is applied to real estate taxes from 1987 on, if facilities for reinforcing energy bases are obtained within the objective period (two years starting from April 1, 1986 and ending on March 31, 1988) specified for those facilities.

Table 7-8

1. Heat exchangers
   1) Heat exchangers for preheating combustion air
   2) Heat exchangers utilizing cold heat of liquefied natural gases
   3) Total heat exchangers
   4) Heat pipe-type sensible heat exchangers
2. Waste heat-utilizing boilers
   1) Waste heat boilers
   2) High efficiency boilers
3. Waste pressure recovery units
4. Dehumidified air blast unit for industrial furnaces
   1) Moisture-absorbing type
   2) Cooling type
   3) Moisture-absorbing/cooling type
5. High Efficiency industrial furnaces
   1) Industrial furnaces for preheating raw materials
   2) Industrial furnaces with reinforced heat insulation
   3) Industrial furnaces provided with an automatic air/fuel ratio controller
   4) Jet condensate recovery
6. Steam drain-collecting units
7. Steam accumulators
8. Improved dual-effect absorption-type water heaters/coolers
9. Cold box molding machines
10. Heat-pump heat source units
11. Heat-insulating walls for reservoirs
12. Medium/low-temperature waste heat-utilizing power generators
13. High-performance radiation heaters (utilizing irradiating pipes)
14. Power load regulators
    1) Demand-controlling type
    2) Rotational number-controlling type

8.1 Commendation of Factories

(1) Purpose

To encourage further energy conservation by commending model factories which have obtained excellent results from their constant efforts to rationalize energy use and contribute to the effective use of fuel resources.

(2) Promoter

Ministry of International Trade and Industry (MITI)

(3) Subjects of screening

Factories which have attained excellent results concerning each of the following items and have been recommended by directors of regional bureaus of MITI, the Energy Conservation Center, Committee for Rationalizing Electric Use and other relevant organizations.

a. Energy management organization and its operation

b. Measures taken to rationalize the use of energy at the factory.

c. Training of energy management engineers.

d. Actual results of rationalization of the use of energy.

(4) Screening

a. Items to be mentioned in the application papers (Items with a "*" represent data for the past three years.)

1 Outline of the factory

Number of certified energy manager, number of employees, main products and their output, etc.

2 Production facilities

- Flow chart of manufacturing process
- Energy balance
- Kinds of energies and amounts of their use
- Principal energy consuming equipment
- *Energy consumption rate for each of the main productes and reasons for their increase or decrease

3 Energy management organization and its operation

- Chart of organization for energy management
- *Basic policy and goal for energy conservation
- Priorites in energy conservation
- Implementation of events concerning energy conservation
- Number of persons making up the energy management organization
- Sessions of the energy conservation committee

4 Training of energy management engineers and their activities outside the factory

- *Employees' participation in the national training course and the examination for energy managers
- *Employees' participation in outside seminars
- *Education in the company

5 Actual results of rationalization of the use of energy

- *Number of cases of improvement and energy conservation effect
- Details of cases of major improvement

6 Measures taken for rationalization of the use of energy (for each equipment)

- Establishment of standards for management
- Implementation of measuring and recording
- Implementation of maintenance and inspection
- *Measures for improvement

b. Methods of screening

In addition to judgment based on documents, on-the-spot survey is made.

(5) Commendation

a. Kinds and number of prizes

The following prizes (testimonial and extra prize) are awarded to the factories (thermal and electrical sectors, respectively) which have been judged excellent.

1 Minister of International Trade and Industry Prize (11 factories or less for each sector)

2 Agency of Natural Resources and Energy Director General's Prize (16 factories or less for each sector)

3 International Trade and Industry Ministry Regional Bureau Director's Prize (less than 2 percent of the number of designated factories in each bloc)

b. Data for commendation

Once every year, at an open awarding ceremony during the Energy Conservation Campaign Month (February)

(6) Announcement

Announcements are made through the Energy Conservation Center's organ and newspapers.

8.2 Commendation System for Excellent Energy Saving Equipments

(1) Purpose

Promotion of dissemination and development of excellent energy saving equipments.

(2) Promoter

The Japan Machinery Federation

(3) Subject of commendation

a. Subject equipments

Excellent energy saving equipments for use in industry developed and put in practical application approximately within 3 years.

Here the term "equipments" include the following:

– Devices, facilities and systems

– Meters, etc. contributing to energy conservation

– Waste, refuse, methane gas, rice hull, etc. – applying equipment

b. Subject enterprises

Enterprises or enterprise groups which have developed and put to practical use the above equipments, and are recognized to be contributing to promote effective use of energy.

(4) Method of screening

a. Selection will be made at a screening committee from among the equipments recommended by the following organizations:

- Mechanical industry-related organizations and institutes
- Energy-related organizations and institutes
- Energy equipments user's organizations
- Public testing and research organs

b. Evaluations will be made for each of the following evaluating factors, and the results will be considered synthetically to lead to the final judgement:

- Having originality
- Promoting effective use of energy
- Being excellent in the economic aspect
- Being prospective in a considerable amount of propagation
- Ensuring safety

(5) Method of commendation

a. Kind of commendation

The Minister of International Trade and Industry Prize (Reserved only for exceptionally excellent ones)

The President of Japan Machinery Federation Prize

b. Time of commendation

February, every year (Energy Conservation Month)

In addition to the above, the Energy Conservation Center commends the equipments acknowledged to be exceptionally excellent from among those displayed at the Energy Conservation Exhibition held by the Center in February every year.