OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

17711

Distr.
LIMITED
ID/WG.494/15(SPEC.)
21 September 1989
ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Regional Workshop on Energy
Conservation in Industry

Cairo, Egypt, 1-5 October 1989

RESULTS OF THE UNIDO PROJECT ON ENERGY CONSERVATION MEASURES IN THE EL NASR GLASS & CRYSTAL COMPANY*

Prepared by

M.A. Abd El-Kerim**
UNIDO Consultant

65/5

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

** El Nasr Glass and Crystal Company, Cairo, Egypt

V.89-59646

Industry in Egypt is known to be one of the big energy consumer sectors. It accounts for more than half of the total energy use. In most of the industrial enterprises, energy is utilized ineffeciently. Records demonstrate that a large amount of the energy supply in the industrial sector is wasted. In some cases this amount reaches 30% of the energy input. In other cases energy consumption is 3-4 times more than the international standards.

The high increase in energy consumption and the inefficient use of energy lead to a considerable growth in the energy demands in industry.

The question now is " is it profitable to achieve increase in energy productivity to compensate the growth in the energy demands?". The answer could be taken from the World Bank estimate. It states that the cost of saving one kilowatt of electric energy by improving the distribution system may be only a third as much as the cost of producing an additional kilowatt from new generation.

Applicaion of tested energy conservation technologies, using of specific examples of equipment modifications and rearrangements and introducing of the energy management systems procedures seem to be the main tools which must be used to compensate the growth of energy demand.

To implement such energy conservation measures a UNDP/UNIDO'S supported project entitled "Energy Conservation in Mrtallurgical, Glass and other Industries" was approved in 1985.

One of the project objectives was to save 2500 t oil annually from the glass melter No 2 in El-Nasr Glass and Crystal Company NGCC.

The company was choosen on the basis of the preliminary energy audit carried out by the staff of the energy conservation centre ECC within the Tabbin Institute for Metallurgical Studies TIMS. The

centre was established to provide both the private and public industries with the technical and scientific assistance in the field of energy audit montoring and conservation.

In this paper a brief description for this objective and its technoeconomical indices is given

BACKGROUND:

El Nasr Glass & Crystal Co. (NGCC) is the biggest Egyptian company producing glass. The company is a public sector Co. bleonging to the Mining & Refractories Industries Corporation (MARIC).

The annual production is about 85000 tons of different glass assortment.

The company is composed of three plants shoubra, Mostorod and El-Hadra.

Shoubra Plant is the oldest one, founded in 1932. At present this plant produces table ware, hand made and pressed, ornamental glass, reinforced ornamented glass flint and amber and sheet glass produced in five fourcault machines. There are eleven glass tanks at Shoubra plant.

Mostorod Plant. Started its operation in 1968. The annual production amounts to 45000 tons of returnable bottles, of thick wall, ranging in weight from 100 to 750 gm of flint, amber and green glass. Also wide mouth jars are produced by press blow.

El-HADPA PLANT is the third plant at Alexandria. It produces SAFETY glass and polystrene products reinforced with fibre glass.

The Mostorad Plant of el-Nasr Glass and Crystal Company (NGCC) has three melting furnaces. The average productivity of the plant is 8,5 ton/hr.

Each of the 3-melting furnaces has its own characteristics and specific energy consumption as shown in the following -

Parameter	Furnace 1	Furnace 2	Furnace 3
Type	regenerative U-Flame, sorg Co., W.Germany	Cross-flame without regenarators, Ambarl Sweden & USA	Regenerative Cross-flame, Sorg Co.W. Germany
Melting area, m^2	24	37	54
Productivity ton/day	50	50	100
Average specific energy consumption			
KWH/kg (total)	4,91	6,44	4,04
gm/kg fuel	170	400	heavy oil &
Type of energy	heavy oil	heavy oil & electric boosting system	electric boosting system

Table (1) Furnaces characteristics (this data for the calender year July 1984 - June 1983).

From the above data, it is evident that furnace No 2 has the heighest energy consumption due to the absence of waste heat recovery system. Moreover a complete thermal balance for this furnace was carried out, table (2).

It is easy to see that the largest part (about 50%) of the energy output is last with the combustion products to the atmosphere. This can be re-used to increase the furnace thermal efficiency as well as to decrease the specific energy consumption.

Table (2) The Furnace thermal balance before the project implementation.

Energy Input	Kcal/hr	%	Energy Output	Kcal/hr	%
1.Fuel conbustion (Q_f)	5658952	90,26	1. Useful Energy Q_u	972477,75	15,51
2.Electrical energy, (Q_e)	610600	9,74	2. Energy with waste gases($Q_{w.g}$)	3081600,70	49,15
Total Energy input (Q_{imp})	6269552,00	100,0	3. Energy lost by conduction(Q_c)	737926,27	11,77
- Coefficient of fuel utilization: 45.54%.			4. Energy lost by radiation through openings. Q_{rad} .	727268,03	11,60
- Thermal Efficiency 15,51%			5. Energy lost with unburnt gases(Q_{unb})	597089,01	9,52
- Specific Energy Consumption: 18,176 GJ/ton.			6. Unaccounted Energy losses(Q_{un})	153190 24	2,45
			Total Energy Output	6269552,00	100,00

The Object Attack:

It was necessary to attack the problem from all sides that can save energy. The required saving was expected to be achieved by the implementation of the following measures:

1. *To change the firing system with more efficient one to improve the combustion efficiency.*
2. *To install a complete automatic control system to measure and control the following parameters.*
   - *The furnace temperature in the different zones to have a good idea about the furnace thermal conditions in these zones.*
   - *The furnace pressure to prevent air infilteration.*
   - *Fuel and ain consumption to have an accurate data for the energy consumption.*
   - *Fuel/air ratio to adjust the combustion process.*
3. *To install metallic recuperator (two-tsage heat exchanger) to preheat air UP to 700°C, to minimize the heat losses with the combustion products.(fig.1).*
4. *To improve the quality of the furnace insulation in order to decrease the amount of heat losses from the furnace surfaces, Also to insulate the preheated air and mazout lines.*
5. *To increase the furnace pull by increasing the glass depth from 0,63 m to 0,73 m.*

From five tenders for the equipment supply the tender of the West German Co. "HORN" was accepted.

The air and fuel pipelines, fuel pumping station, electric wiring civil engineering lining, works and steel works were implemented locally.

The total project budget was 550000 US$.

Furnace Modification:

The furnace was subjected to an intensive changes in order to realize the main target of fuel saving. The following main equipment items were introduced to the existing construction:

1. *Two-stage radiative metallic recuperator for preheating the combustion air up to 700°C. The recuperator is made of special high thermal resistance steel and equipped with the necessary auxiliaries.*
2. *Twenty compressed air-oil atomizer for heavy oil burning of total capacity 550 kg/hr with supplementary noise and temperature insulation.*
3. *Two combustion air fans. One of them is electric powered having 6000 m^3/hr air consumption, whil the other is emergency diesel powered, with 2000 m^3/hr air consumption.*
4. *Automatic control system with the measuring instruments:*
   - *Temperature and air/fuel ratio recorders.*
   - *Mazout and air flow rate recorders.*
   - *Pressure and temperature indicators on mazout line.*
   - *Furnace pressure indicator.*
   - *Temperature control systems in the middle and the end of the melting tank, in the flue gases outlet zone and in the recuperator inlet.*
   - *Air & fuel pressure indicators for each burner.*
   - *Automatic recuperator safety device including air suction flap with magnetic opening mechanism.*
5. *Cold and hot air ducts, with insulation for the hot air duct for app. 85 m^2.*

6. Thermal insulation for the side walls of the furnace.
7. All the necessary tubes & flanges, fittings, and other minor parts.

The furnace lining works and in turn, the steel works were reconstructed to increase the glass depth.

UNIDO purchasing department made all the necessary procedure to procure the required equipment. The plant received the equipment during the years 1987 and 1988. The furnace was shut down for revamping at the end of October 1988. The furnace's modification took 30 days and the work done included the following:

1. Relining of glass tank and increasing the depth of working zone, giving an increase of production 10 tons/day.
2. Fixing the metallic recorporator its attachments, control system.
3. Steel structure and system of fuel circuit of the glass tank.
4. Electric booster attached to the glass tank.
5. Control room giving total complete automatic control of the glass tank.

Project Results & Evoluation:

The furnace energy and production data were recorded and collected beofre and after the project implementation.

The evaluation of the furnace thermal performance was made for seven months (From dec. 1988 to June 1989)in comparison with the former eleven months to the (from Jan. 88 to Oct 88) project implementation in nov. 1988.

All these data were plotted in the figures (2-6), and the following analysis can be made:

1. The furnace No 2 has the heighest energy consumption compared with the other two furnaces due to the absence of waste heat recovery system (fig.2). During the eleven months period former to the

project implementation, the average specific energy consumption was found to be 466,7 gm/kg.

2. The furnace specific energy consumption decreases considerably with the pull increasing Fig.3). In the same period, and inspite of this decrease, the furnace had SEC always over 400 gm/kg.
3. During the seven months following the project implementation, the furnace No.2 began to have specific energy consumption SEC within the limit of the other two furnaces (fig.4) . In this period the furnace has an average SEC of 206 gm/kg. It is worth-mentioning that the electric energy boosting system was used in Feb. and June-1989 months, in which the furnace pull exceeded 45 ton/day (47,12 and 54,33 ton/day respectively). The electric energy consumption was 115200 kwhr and 334800 kwhr in the two months. This consumption represents 7,5 and 17 gm/kg of SEC respectively. This will result in increase of the average SEC to 210 gm/kg.
4. During the period following the project implementationm the furnace pull increased up to 55-60 ton/day. In all cases, SEC didn't exceed 230 gm/kg. (fig.5).
5. It is quite evident that the furnace had a conserderable low level of energy consumption during the period following the project implementation compared with the former period (Fig.5).

From this analysis we can come to the following conclusions:

1. A reduction of the specific energy consumption (SEC) of the furnace amounting to [100(466,7-210)/466,7]= 55 was achieved.

2. *Knowing the total fuel consumption during the period dec.1988 - June 1989 which was 1774,53 tons, the actual quantity of fuel saving, could be evaluated and was found to be 2168,87 tons.*
3. *The expected earning due to the fuel savings was found to be app. 384000 us$ annually.*
4. *The furnace productivity increased 25%.*
5. *New experience in the implementation of such types of energy conservation projects was gained by local staff.*

The El-Nasr glass and crystal Co. take this opportunity to express its high appreciation and gratitude for the big efforts and sincere role of UNIDO and UNDP office at Cairo and TIMS in the execution of this project.

We hope that the expericence abtained could be used to replicate such project in other glass tanks in Egypt and brother African Countries.

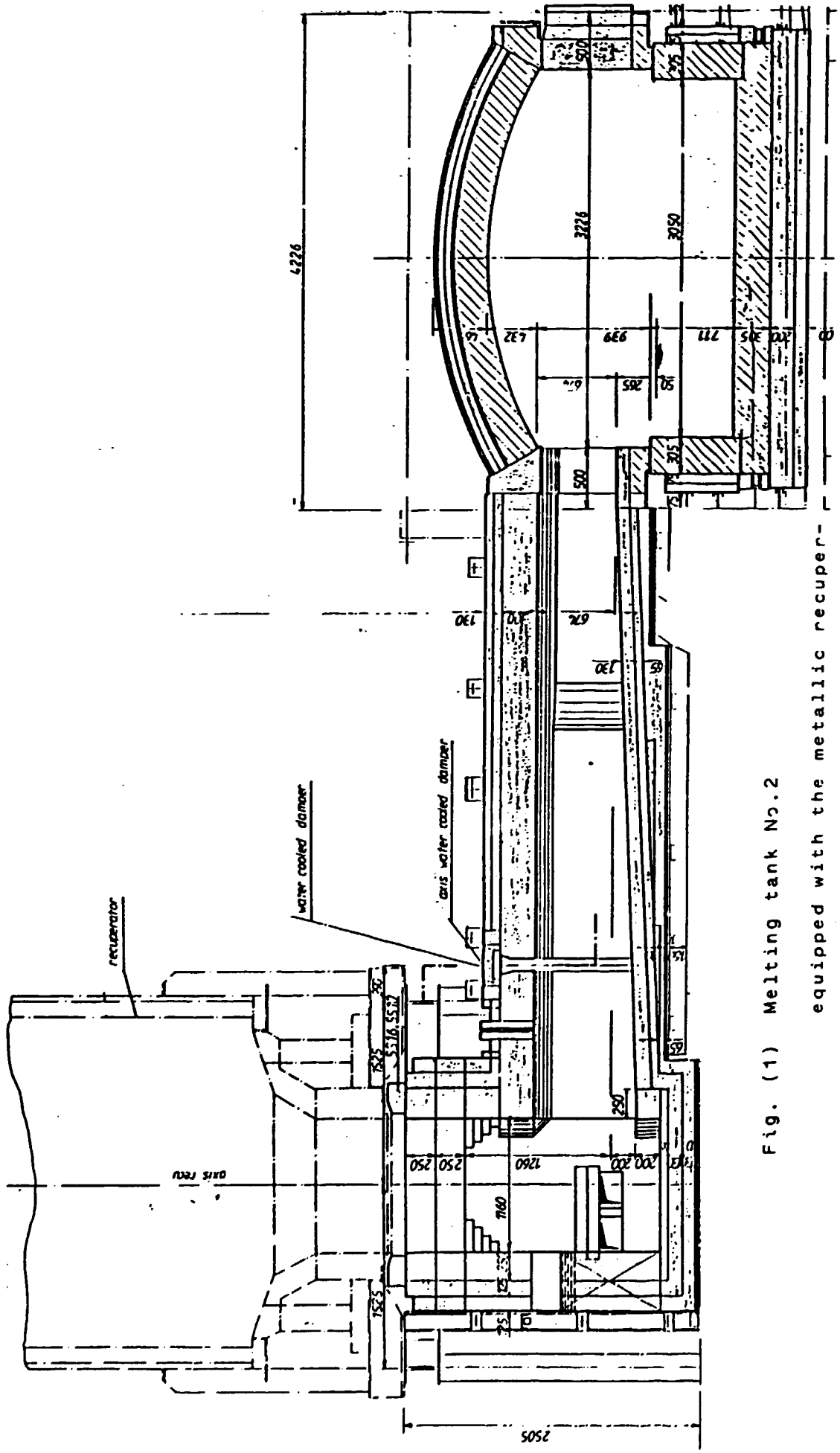

Fig. (1) Melting tank No.2 equipped with the metallic recuperator.

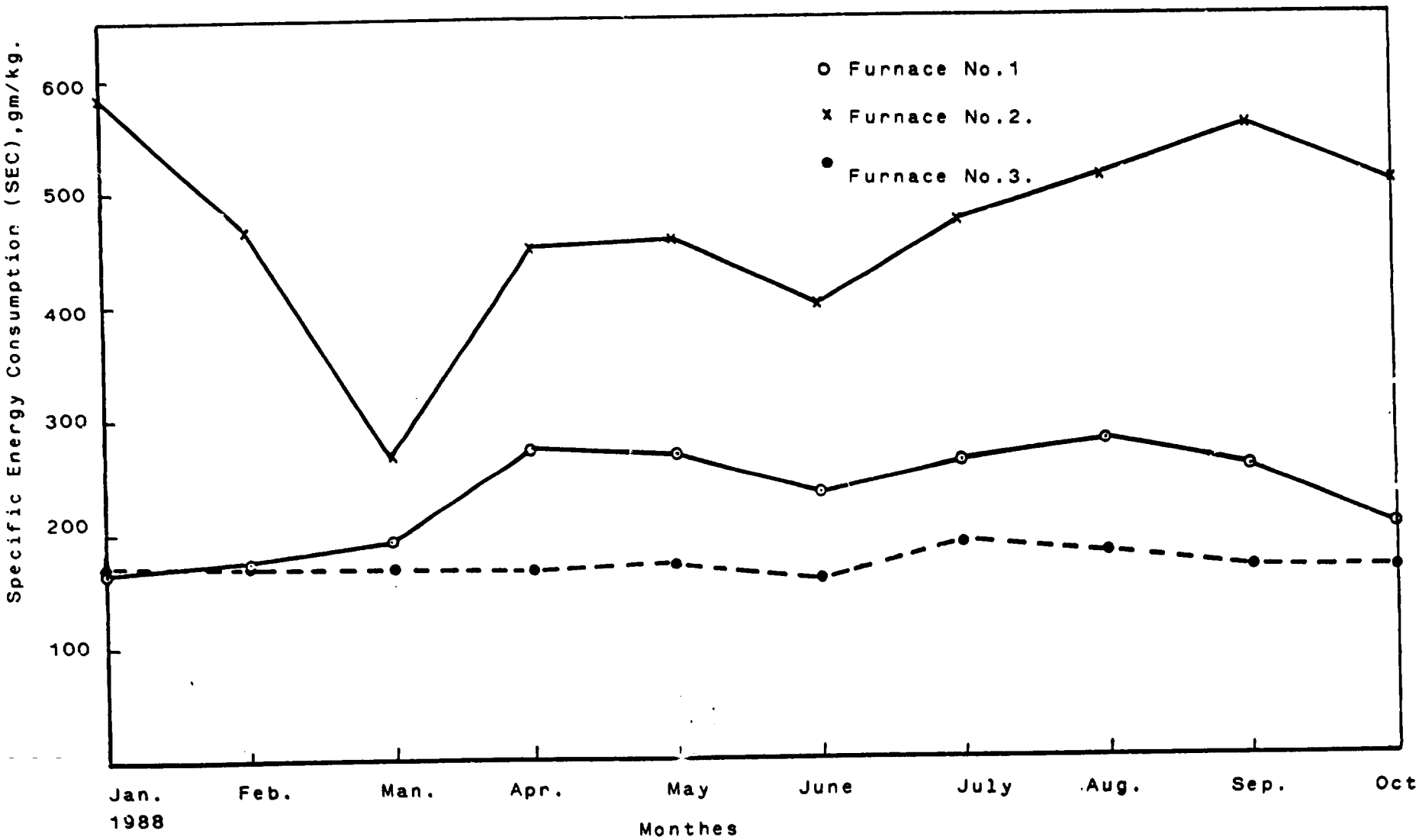

Fig.(2) SEC for the three melting tanks during the period Jan.-Oct. 1988 (directly before the project implementation).

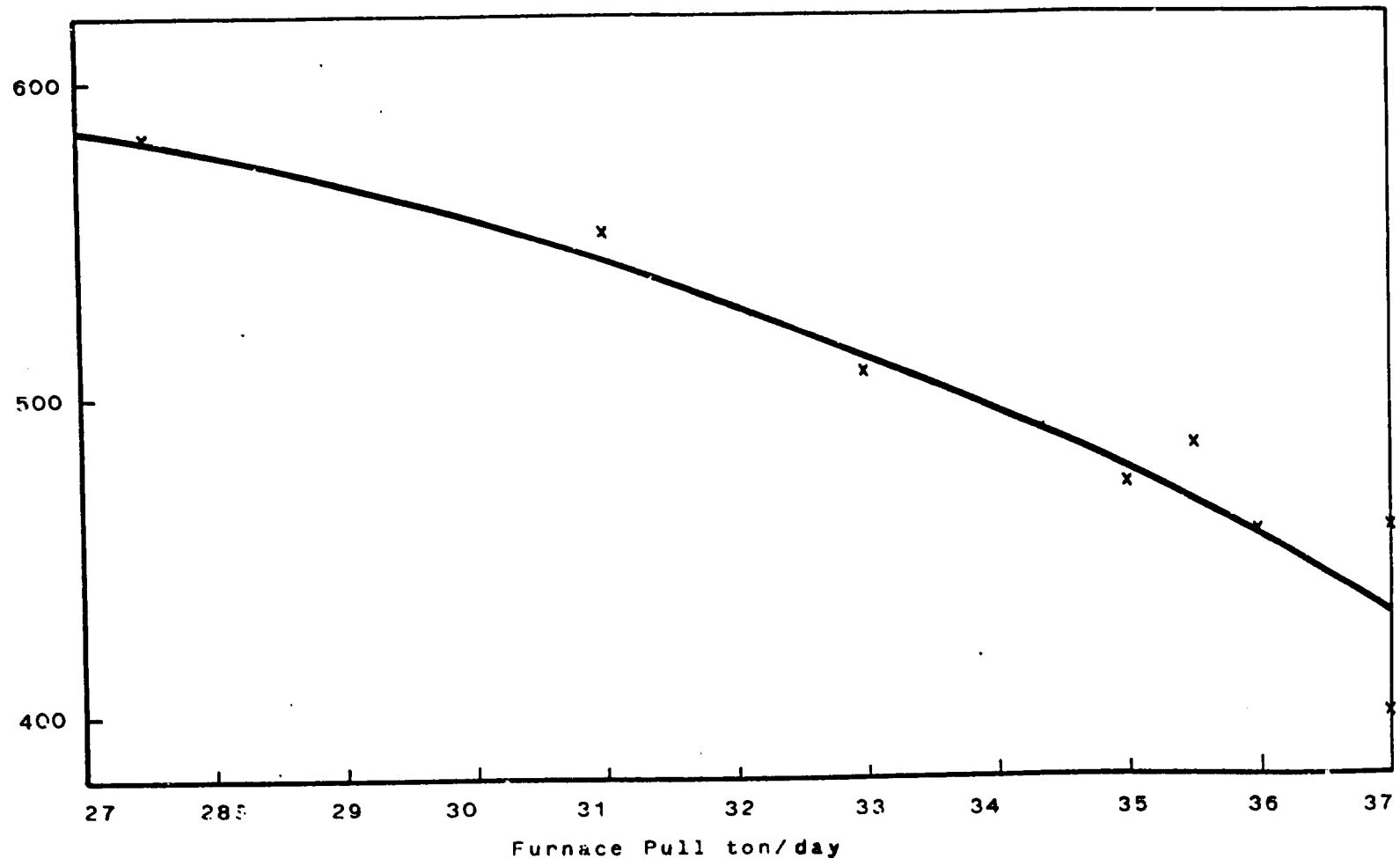

Fig.(3). SEC for the furnace No.2 VS the furnace pull during the period Jan-Oct 1988

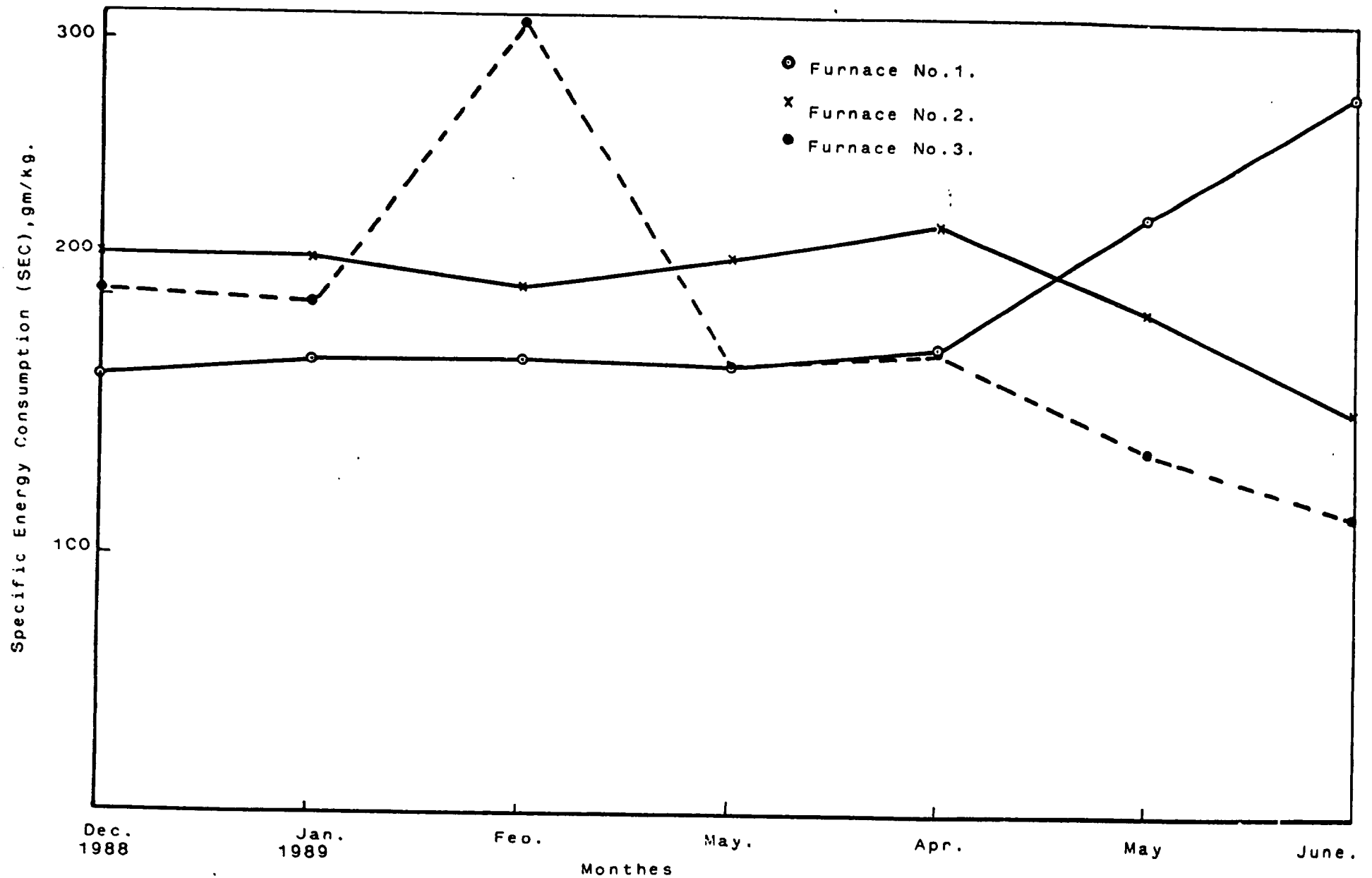

Fig.(4) SEC for the three melting tanks during the period Dec.1988-June 1989 (directly after the project implementation).

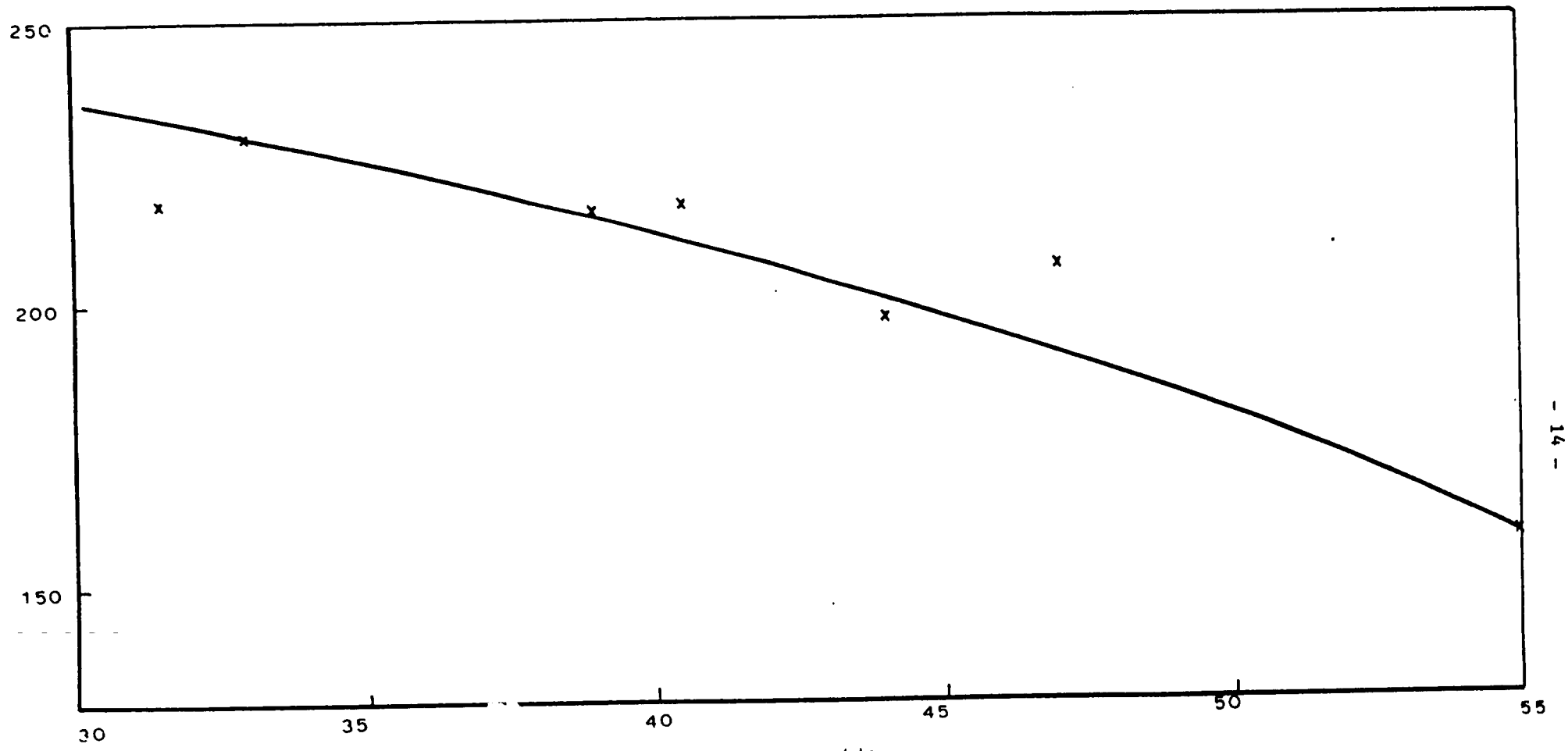

Fig.(5) SEC for the furnace No.2. VS the furnace pull during the period Dec. 1988-June 1989.

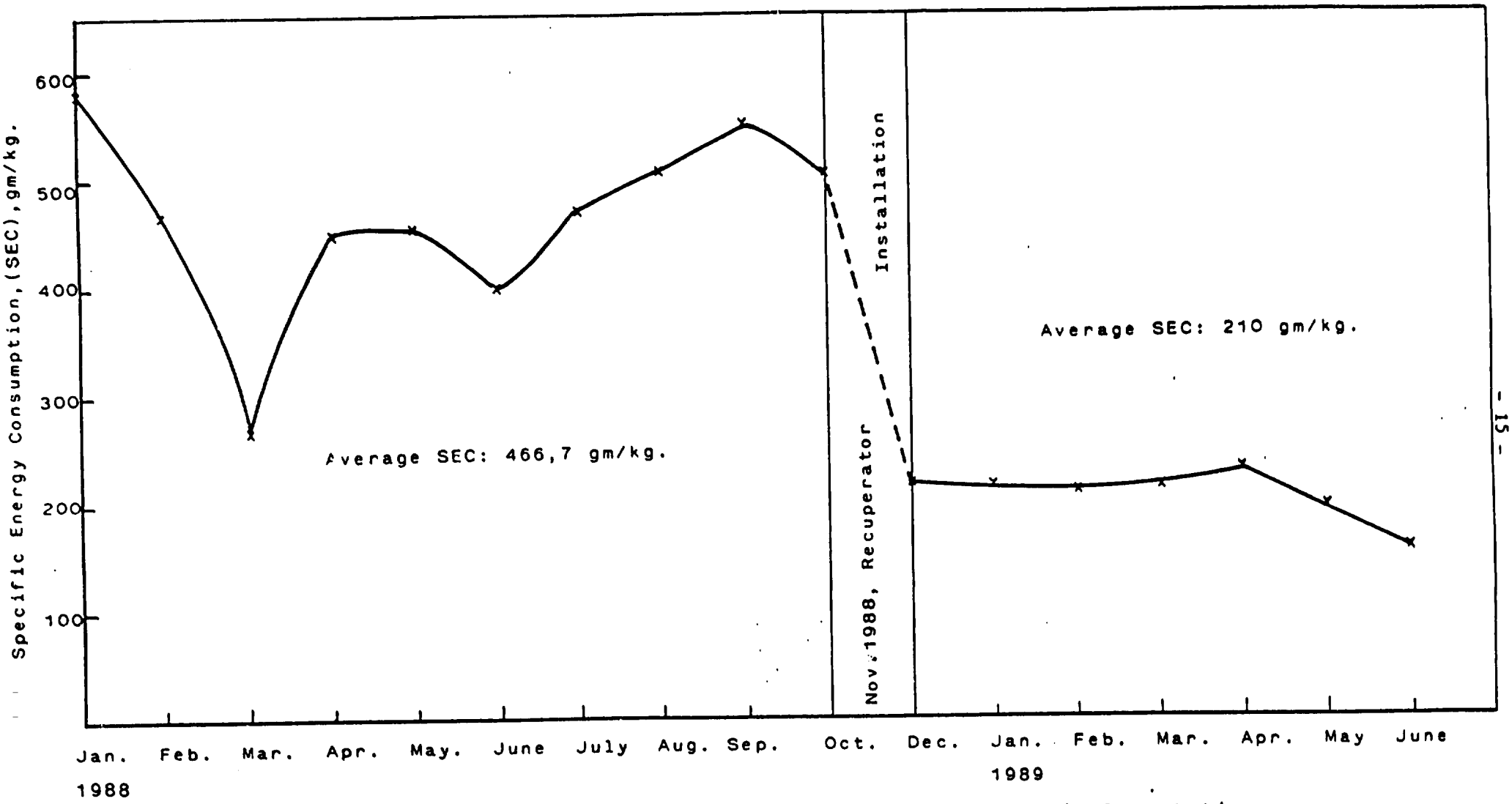

Fig.(6) SEC for the furnace No.2 before and after the project implementation.