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

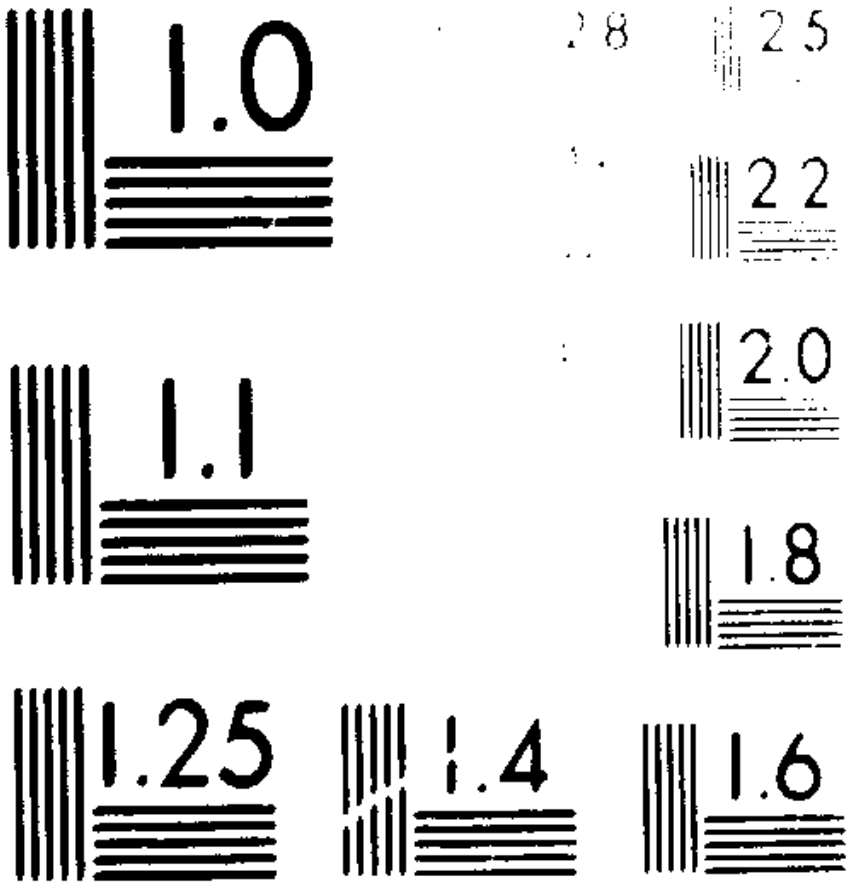
FAIR USE POLICY

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


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

RESTRICTED 12983 6 June - 7 July 1983

Brazil.

Energy Conservation and Derivative Substitution in Ceramic Industry,

DP/BRA/82/003/11-53/32.4.B

D R A F T

T E R M I N A L R E P O R T,

Prepared for the Government of Brazil by
the United Nations Industrial Development Organization,
the executing agency of the United Nations Development Programme

Based on the work of

Milan Nový, UNIDO Technical Assistance Expert and
Staff Member of the UNIDO-Czechoslovakia
Joint Programme in Pilsen

1159

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION - Vienna

ACKNOWLEDGEMENT

The expert would like to underline that the success of his mission was enabled by well conducted preparatory activities and supports of UNIDO Headquarters in Vienna and UNDP office in Brasilia. The Ministry of Industry and Commerce and all relevant institutions supported the expert by arranging meetings, field travels and providing him with necessary data and secretarial facilities needed for the successful implementation of the mission.

The expert would like to express his acknowledgement especially to:

Mr. Carlos Amorim Junior, Secretary for Industrial Technology and Co-ordinator of the Energy Conservation Project, Ministry of Industry and Commerce

Mr. Alfredo Jefferson, Assistent of Resident Representative, UNDP Brasilia

Mr. Detlev Broszehl, Junior Programme Officer, UNDP Brasilia

Mr. Paulo Cesar Leone, Technical Director, Institute for Technological Research, São Paulo

Mr. Amantino Ramos de Freitas, Director of Wood and Forest Division and International Relations Co-ordinator, Institute for Technological Research, São Paulo

Mr. Saburo Ikeda, Group Chief, Thermal Engineering Group, Institute for Technological Research, São Paulo

Mr. Fausto Furnari, Co-ordinator of Industrial Conservation Programme of the Institute for Technological Research, São Paulo

Mr. Luiz Blank, Chief, Division of Generally Applied Technologies and Assistent of General Director, National Institute of Technology, Rio de Janeiro

Mr. Jamil Duailibi Filho, Chief, Energy Saving Programmes Unit, National Institute of Technology, Rio de Janeiro

Mr. Geraldo Q. Cancado Sobrinho, Director for the Research and Development, Technological Foundation Centre, Belo Horizonte

Mr. Pompilio Furtado Filho, Chief, Energy Sector, Technological Foundation Centre, Belo Horizonte

ABSTRACT

The mission of UNIDO expert was realized under the UNIDO project DP/BRA/82/003/11-53/32.4.B with the purpose to reduce the country's dependence on foreign oil and to lower production costs by reducing energy input costs through the promotion of energy conservation and use of alternative sources of energy in ceramic industry. The expert during the 32-day mission fulfilled all the objectives of the project.

The programme of diagnostic measurements aiming in energy conservation in various industries has already started in all three visited institutes. Recommendations on performace and evaluation of diagnostic measurements in ceramic industries were delivered as well as suggestions on instrumentation equipment of diagnostic mobile units. The diagnostics should be extended on investigation and improvement of material thermal treatment.

It is recommended to focuse energy studies and research projects in ceramics on the research of new body compositions with lowered energy demands, on investigation of limiting and optimal conditions of material thermal treatment and on waste heat recovery from combustion products.

Local training of technicians in visited institutes was roofed up by five lectures concentrated on energy management and diagnostics in ceramic industries.

The institutes - IPT São Paulo, INT Rio de Janeiro and CETEC Belo Horizonte - will apply through UNDP Brasilia for a project proposal on twinning arrangement on non-metallics with the UNIDO-Czechoslovakia Joint Programme in Pilsen. The institutes are interested in obtaining the UNIDO-Czechoslovakia Joint Programme publications as well.

TABLE OF CONTENTS

--.....--

INTRODUCTION

The Government of Brazil requested the United Nations Industrial Development Organization Vienna, the executing agency for the United Nations Development Programme, for assistance in providing an expert dealing with the subject of energy conservation in ceramic industry. The 32-day misssion started on 6 June 1983. The programme, negotiated with representatives of Brazilian Ministry of Industry and Commerce and UNDP Brasilia, was accomplished in three institutions: Institute for Technological Research - IPT São Paulo, National Institute of Technology - INT Rio de Janeiro and Technological Foundation Centre - CETEC Belo Horizonte.

The importance of energy savings in ceramics can be documented by the fact that Brazil is one of the biggest producers of ceramic tiling materials in the world. The production of other ceramics and refractories is significant as well. The energy conservation and substitution of fuel oil can therefore positively influence the fuel balance of the country.

A large variety of producers exists in ceramic industry in Brazil, from the smallest, simple equipped manufacturers to modern production plants of high capacities. This variety together with a large scale of fuel used causes the variety of specific energy consumptions. The wood is used very often as a fuel, especially in red brick manufacture. The fuel oil is fired in production of tiling materials and refractories to a great extent. In some cases, the gas from gasifiers of charcoal is fired. Electricity is used as well but to a lower extent than desirable. The majority of production plants was constructed in the time of fuel oil competence and this is reflected by the equipment. Principally the substitution for oil by electricity is possible in many ceramic productions but this demands relatively high investments. Therefore, this substitution comes into account during

reconstructions and modernizations or in new investments.

The "CONSERVE" programme supported by the Ministry of Industry and Commerce comprehends three subprogrammes: experimental development, information and technological diffusion and technological assistance. This programme is fulfilled by the research institutes visited. The diagnostic measurements are performed within the subprogramme of technological assistance. To improve the efficiency of diagnostic measurements in ceramics, it is recommended to extend them on material thermal treatment investigation and improvement in the future. The application of diagnostic mobile units for this purpose is favourable. Individual training of technicians from Brazil on energy conservation and diagnostic measurements in the UNIDO-Czechoslovakia Joint Programme in Pilsen would be fruitful. The representatives of research institutes visited intend therefore to send their nominees from energy conservation groups to Czechoslovakia within the project of twinning arrangement between these institutes and the UNIDO-Czechoslovakia Joint Programme in Pilsen for which they will apply.

As a part of training, the UNIDO expert delivered five lectures on energy conservation, management and diagnostics in ceramic industry for technicians of the institutes during the mission. The advices on performance of diagnostic measurements and on the equipment of diagnostic mobile units were given. Seven production plants were visited. Suggestions on energy conservation measures in these plants were delivered and discussed together with heat balances previously performed.

I. FINDINGS AND RECOMMENDATIONS

1. Ceramic production plays an important role in Brazilian industry. At the beginning of eighties Brazil was the fourth largest producer of tiling materials in the world. Over 800 000 tons of refractories were produced in 1980. Energy conservation in ceramic industry can therefore contribute to the effort of Brazilian Government to reduce the import of oil.

2. A large scale of producers exists in Brazil in ceramic in - dustry - from the smallest manufacturers with simple equipment to big, modern production plants - with variety of technologies and specific energy consumptions.

3. Wood and charcoal is fired directly in kilns and furnaces in red brick production while gas from gasification of charcoal is successfully used in one of the visited plants producing wall tiles. Fuel oil is used to a great extent.

4. The surplus of electrical energy from hydropower stations enables the substitution for oil used in production of ceramics. Due to relatively high investments necessary for a new equip - ment, it is favourable to take this substitution into account when reconstructions and modernizations are planned.

5. Waste heat from a process - especially that from cooling - is used to some extent for drying, preheating of firing air and preheating of heavy fuel oil. Combustion products draught from kilns are used as drying medium in spray driers in several cases.
   The extension of the use of waste heat from combustion products can be realized by application of heat exchangers if the direct use is impossible.

6. A great deal of work has been done in the field of energy conservation and substitution for fuel oil (in ceramic industry) by visited institutes: Institute for Technological Research - IPT São Paulo, National Institute of Technology - INT, Rio de Janeiro and Technological Foundation Centre - CETEC Belo Horizonte. The conclusion of the mission is to support energy conservation groups of these institutes to enable them to extend their activities and apply their experience in production plants as much as possible.

7. The programme of diagnostic measurements in ceramic production plants has already started in all three visited institutes. Until now, the diagnostics have been focused on investigation of heat balances of the equipment only. The extension of diagnostic measurements on the investigation and improvement of material thermal treatment will bring quality improvement, production intensification and very often energy conservation as well.

8. The extension of instrumentational equipment of diagnostic mobile units of IPT, Sao Paulo was recommended by the expert as well as the construction of one diagnostic mobile unit for each other institute to cover their regional activities. These units are the most effective implements for the performance and evaluation of diagnostic measurements.

9. The representatives of all visited institutes - IPT São Paulo, INT Rio de Janeiro and CETEC Belo Horizonte - will apply through the Brazilian Government for a project proposal on twinning arrangement with the UNIDO-Czechoslovakia Joint Programme in Pilsen as the basis for close co-operation in energy conservation, training, advisory activities and transfer of technology in the field of ceramics, building and non-metallic materials.

10. Following the request of Brazilian Government the UNIDO-Czechoslovakia Joint Programme will prepare the project proposal on exploratory mission of two experts for three weeks to Brazil

with the objective to formulate the project proposal on twinning arrangement between Brazilian institutions and the UNIDO -Czechoslovakia Joint Programme.

11. The Institute for Technological Research - IPT São Paulo, represented by Mr. Fausto Furnari, Co-ordinator of Industrial Conservation Programme, requested the publications of the UNIDO-Czechoslovakia Joint Programme through INTIB, Industrial Information Section, Division of Industrial Studies, UNIDO Vienna. (For review of requested publications see Annex 4).

12. The energy conservation studies of the visited institutes should be concentrated on:
    - investigation of limiting and optimal conditions of material thermal treatment
    - research of body compositions with lowered energy demands (lowered firing temperature, simple firing process, etc.)
    - tunnel kiln cars lining insulation

13. Capability of energy conservation groups of visited institutes allows the realization of a project for training of technicians in production plants focused on proper operation of heat consuming units.

14. Valuable manuals for energy conservation measures in various industries were prepared by the Institute for Technological Research, São Paulo. It is recommended to follow with the manuals concentrated on special types of heat consuming units and their proper operation.

15. The substitution of wood and charcoal for fuel oil in a wide range must be coordinated with the renewability of forests.

II. SUBSTANTIVE SECTIONS

1. UNDP Brasilia

2. Institute for Technological Research - IPT São Paulo

3. National Institute of Technology - INT Rio de Janeiro

4. Technological Foundation Centre - CETEC Belo Horizonte

1. UNDP Brasilia

Following regulations of the Special Service Agreement, the UNIDO expert started the mission with briefing at the UNDP Brasilia. After the meeting with Mr. Detlev Broszehl, Junior Programming Officer, and Mr. Alfredo Jefferson, UNDP Resident Representative Assistent, the programme of the mission was negotiated with Mr. Carlos Amorim Junior, Scretary for Industrial Technology and Co-ordinator of the Energy Conservation Project, System of Technological Planning, Ministry of Industry and Commerce. The programme of the mission was established as follows:

a) Institute for Technological Research, São Paulo
   8 - 10 days
b) National Institute of Technology, Rio de Janeiro
   about 8 days
c) Technological Foundations Centre, Belo Horizonte
   about 10 days

2. Institute for Technological Research - IPT São Paulo

The Institute for Technological Research is a São Paulo State public company, operating with twelve technical divisions, four specialized technical centres and two so called nucleuses. Thermal Engineering Group, concerned with energy conservation, works within Mechanical Engineering Division.

Several negotiations were held with the officials of IPT São Paulo, with Mr. P. Cesar Leone, Technical Director of the IPT, Mr. A. Ramos de Freitas, Director, Wood and Forest Division and International Relations Co-ordinator, Mr. A. Martius Craveiro, Group Chief, Group of Biotechnology, Mr. Saburo Ikeda, Group Chief, Thermal Engineering Group, and Mr. Fausto Furnari, Coordinator of Industrial Conservation Programme of IPT. The conclusions agreed:

a) The officials of the IPT are deeply interested in future co-operation with the UNIDO-Czechoslovakia Joint Programme in Pilsen. The main fields of interest are: twinning arrangements, individual training of technicians and research and advisory activities.

b) The IPT will apply through Brazilian Authorities and UNDP Brasilia for a project proposal on twinning arrangement with the UNIDO-Czechoslovakia Joint Programme in Pilsen.

c) The officials of the IPT are interested in obtaining some UNIDO-Czechoslovakia Joint Programme publications through INTIB, Industrial Information Section, Division of Industrial Studies, UNIDO Vienna. A review of these publications was submitted by Mr. Fausto Furnari, Co-ordinator of Industrial Conservation Programme, and is attached to this report as Annex 4.

During his stay in São Paulo, the UNIDO expert delivered two lectures for technicians of the IPT. The first one was concerned with the activities of the UNIDO-Czechoslovakia Joint Programme, the second one with energy management and diagnostic measurements in ceramic industries. Both lectures were followed by discussions in which the questions were answered in greater detail. The UNIDO expert also gave advices to the technicians of the IPT on performace of diagnostic measurements and on instrumentation used in a diagnostic mobile unit. It was recommended to extend the diagnostic measurements on investigation of conditions of material thermal treatment. Detailed information was given on data evaluation and especially on working out proposals and recommendations on the base of evaluated measurements. Practical examples were presented as well. Nevertheless, the practical individual training of technicians from the IPT in Czechoslovakia focused on energy conservation and diagnostic mobile unit applications would be appreciated by the representatives of the IPT.

Four production plants were visited during the stay in São Paulo, three of them producing red bricks and roofing tiles and one producing refractories. A detailed review of plants visited and recommendations elaborated can be found in Annex 1.

3. National Institute of Technology - INT Rio de Janeiro

The National Institute of Technology is a federal public company, operating with four divisions. Energy Saving Unit (together with four others) works within the Division of Generally Applied Technologies.

During the negotiations held with the INT representatives, Mr. Luiz Blank, Chief of the Division of Generally Applied Technologies and Assistent to the General Director of the INT, and Mr. J. Duailibi Filho, Chief of Energy Saving Programmes Unit, expressed their intention to join the Institute for Technological Research - IPT São Paulo and apply for a project proposal of twinning arrangement with the UNIDO-Czechoslovakia Joint Programme in Pilsen. The INT representatives are interested especially in advisory activities, individual training of technicians and transfer of technologies.

All the visited institutes participate in the technology support programme "CONSERVE" which started in 1981. This programme is supported by the Ministry of Industry and Commerce and comprehends three sub-programmes: experimental development, information and technology diffusion and technological assistance, within which the diagnostics are performed. In the INT, during the year 1981, about 80 simple energy diagnostics were realized in small-size plants. Then a metodology of diagnostics was elaborated. Following this metodology, seven diagnostics were accomplished during 1982 and the metodology was improved after practical experience with its use. Until now the conditions of material thermal treatment have not been investigated during diagnostics.

Two production plants were visited in Rio de Janeiro (see Annex 2), one producing container glass, one wall and floor tiles,

both of medium size, which were diagnozed by technicians of the INT. The diagnostics were discussed in detail and recommendations on elaboration of heat balances of tested equipment were done. Since the Energy Saving Unit intends to build a diagnostic mobile unit, the recommendations on the instrumentational equipment were discussed together with the possibilities of extension of diagnostics on measurements of firing and drying curves which are of high importance in ceramic industry. One lecture, concerned with the activities of the UNIDO-Czechoslovakia Joint Programme, with energy management and diagnostics in ceramic industry was delivered for technicians of the INT.

It was recommended to establish a close co-operation between the Energy Saving Unit and ceramic group of the INT to perform the research of limiting and optimal conditions of thermal treatment of ceramic materials most frequently used in production plants in Brazil.

4. Technological Foundation Centre - CETEC Belo Horizonte

The Technological Foundation Centre is a public company of the State Minas Gerais. The activities of CETEC are fulfilled by seven divisions. The Energy Sector works within the Division of Technological Development.

The negotiations were held with the representatives of the CETEC, Mr. Geraldo Q. Cancado Sobrinho, Director for the Research and Development, and Mr. Pompilio Furtado Filho, Chief of Energy Sector, with following results:

The CETEC will apply together with the IPT São Paulo and the INT Rio de Janeiro for a project proposal on twinning arrangement with the UNIDO-Czechoslovakia Joint Programme in Pilsen, focused especially on training of technicians of the CETEC in Czechoslovakia and on advisory missions of experts from the UNIDO-Czechoslovakia Joint Programme in Brazil.

Energy Sector of the CETEC has just started with the programme of diagnostics in ceramic industry. Series of measurements are planned with the aim to obtain a review of representatives of ceramic production plants to be able to plan and apply energy saving measures in ceramics.

The diagnostics of a wall tile production plant already performed by the Energy Sector of the CETEC were discussed in detail. Recommendations on performace of measurements were given as well as recommendations on data evaluation and computations of thermal units heat balances.

One lecture was delivered for students and professors of the Federal University of Minas Gerais, Belo Horizonte, focused on the UNIDO-Czechoslovakia Joint Programme activities and energy management in ceramic industries. The second lecture was presented for technicians of the CETEC. It was concerned with diagnostic

measurements of heat consuming units in ceramic industry. The system of firing curves measurements and the working-out recommendations was explained in detail, together with contributions reached by improvements realized on the base of recommendations.

The production plant in which the diagnostic measurements were accomplished by the CETEC was visited (see Annex 3). The equipment operation of visited plant was evaluated and possible improvements were suggested. Recommendations on energy conservation measures to be applied were presented and discussed with the technicians of the Energy Sector. Suggestions on future studies leading to energy savings in ceramics were done and discussed, mainly the studies on:

- application of new body compositions with lowered energy demands
- kiln car linings optimization
- investigation of limiting and optimal conditions of material thermal treatment
- extension of diagnostics on material thermal treatment
- installment of a pilot plant on verification of ification processes and firing conditions of fuels

Recommendations on applied instrumentation of diagnostic mobile unit were done as the Energy Sector of the CETEC intends to build such a unit.

ANNEX 1 Production Plants Visited During the Stay in IPT, São Paulo

1. Red brick production plant in Itu

Product: red bricks and roofing tiles

Annual production: 55 000 t

Equipment (thermal units):

Kilns: 1 Hoffman kiln
3 beehive kilns
1 tunnel kiln under construction

Driers: 8 chamber driers
2 channel driers under construction

Fuel: wood
charcoal - in the future for tunnel kiln

Consumption of wood: 35 m^3/day

Description of thermal treatment:

Extruded bricks and roofing tiles are dried in chamber driers, each of them consisting of two boxes connected by channel above ceiling and two pairs of mixing fans in a wall between boxes. Heat is supplied by furnace firing wood through channel under the floor. Firing process in Hoffman kiln and three beehive kilns controlled visually only; no temperature measurements are installed. Firing temperature (estimated by producer) about 900°C. Drying temperature about 60°C.

Improvements suggested:

a) to perform diagnostic measurements of temperature distribution in kiln during firing,
b) to install operating thermometers on the base of the diagnostics to be able to control firing process more exactly,
c) to optimize linings of kiln cars for new tunnel kiln,
d) to install a sheet of metal (approx. 0.4 x 0.4 m) in front of mixing fans in driers to avoid high air flow velocity and cracking of products.

2. Red brick production plant

Product: red bricks

Annual production: 100 000 t

Equipment (thermal units): 1 tunnel kiln
2 channel driers

Fuel: wood - for drying
fuel oil - for firing

Consumption: 0.21 m^3 of wood per 1 t of produced bricks
30 kg of fuel oil (43 540 kJ/kg) per 1 t of bricks

Description of thermal treatment:

The bricks are after extrusion dried in channel driers heated by waste heat from cooling zone of the kiln and by combustion products of fired wood. Firing is accomplished in tunnel kiln firing fuel oil in burners in the kiln roof. Firing temperature is 850°C.

Recommendations:

a) optimization of the setting on kiln cars to reach better heat transfer from kiln atmosphere to the setting and back
b) optimization of the kiln car lining with improved flatness

3. Red brick production plant near Sorocaba

Product: red bricks and roofing tiles

Annual production: 50 000 t

Equipment: 1 Hoffman kiln
5 chamber kilns
2 chamber kilns under construction
6 chamber driers

Fuel: wood and oil combined

Consumption: for firing 18 kg of fuel oil (43 540 kJ/kg)
plus 0.12 m^3 of wood per 1 t of products

Description of the mal treatment:

Extruded bricks are dried in driers, roofing tiles in space under the roof near chamber kilns and in driers. Wood and oil are turned in

in six firing chambers round each chamber kiln and combustion products are draught through the bottom of the kiln. Higher consumption of oil occurs during wet seasons since the wood is stored in a free space. No thermocouples are installed to control the temperature.

Recommendations:

a) storage of wood in a covered space to keep it dry and improve its burning,
b) partical coverage of openings to the draught in the central part of kilns to reach better temperature distribution by even flow of combustion products in the kiln,
c) to install operating thermocouples to be able to control the process of firing.

4. Refractory plant in Poá

Product: refractories for general use as well as special refractories (castables, mortars, etc.)

Annual production: 74 000 t

Equipment: 2 rotary kilns
3 tunnel kilns
4 periodical kilns
2 boilers
2 rotary driers
3 tunnel driers
2 chamber driers

Fuels:			
	fuel oil	15 300 t	- consumption per annum
	diesel	8 m^3	
	charcoal	390 t	
	wood	1 444 m^3	

Description of thermal treatment:

Clays and material used as a grog are dried first in rotary driers. Grog is then calcinated in rotary kiln. After mixing and pressing, the bricks and stones are dried in driers and fired either in continuous (tunnel) or intermittent kilns. The plant operates at present under 50% of its full capacity due to low demands for refractories in the market. Two of the three tunnel kilns were therefore put out of operation. Heat from cooling zones of tunnel kilns is used for drying and preheating of primary firing air.

Recommendations:

a) to use the waste heat of combustion products from the rotary kiln No. 2 in rotary driers. The amount of the waste heat would be sufficient for both driers,
b) to use the waste heat from cooler of rotary kiln No. 1 for heating of fuel oil,
c) to diagnose the tunnel kiln in operation (firing curve, heat balance, combustion gases analyses) and on this base, to adjust the kiln optimally. At present, kiln cars with products leave the kiln at the temperature of about 400°C.
d) to optimize kiln car linings.

ANNEX 2 Production Plants Visited During the Stay in INT, Rio de Janeiro

1. Glass making plant in Rio de Janeiro

Product: container glass - bottles and glasses

Annual production: bottles: 83 000 t
glasses: 5 000 t

Fuels: fuel oil - 17 700 t/year
city gas - 5 million m^3/year
electricity - 8.10^6 kWh/year

Specific consumption: bottles: 9 GJ/t
glasses: 28.5 GJ/t

Kilns for melting of glass consume over 80% of total consumption of the plant while heating of heavy oil about 1%. The equipment of this plant was already diagnosed by technicians of INT and recommendations were elaborated by them. They were found appropriate. One additional measure can be realized: to cover the arch of a kiln with steel sheet insulated by fibre from outside with air space between this sheet and the arch of the kiln. Heated air from this space can be draught out and used as combustion air.

2. Production plant for tiling materials, Rio de Janeiro

Product: wall tiles 15 x 15 cm and 10.8 x 10.8 cm
floor tiles 15 x 15 cm and 20 x 20 cm
refractories used in the plant (kiln furniture)

Annual production:: wall tiles: 5 400 000 m^2
floor tiles: 1 800 000 m^2

fuels: fuel oil
town gas
electricity

Average specific consumption: 12 GJ/t

Equipment: spray driers
channel driers
tunnel kilns

Description of thermal treatment:

Slurry (35% of water) is dried in spray driers using fuel oil and waste heat from kilns for glaze firing. Dried products: 7 - 8% of water content. Channel driers are utilizing waste heat from cooling zones of kilns. Firing temperature in the kiln for the first firing is about 1100°C, the glaze is fired at about 1000°C. The equipment was diagnosed by INT (heat balances only) and useful recommendations were worked out. To improve specific consumptions in the future, it will be necessary to lower the firing temperatures by the use of new body compositions. The UNIDO-Czechoslovakia Joint Programme is highly experienced in this field and is ready to assist with the matter. Better adjustment of firing curves, particularly cooling zones, is also desirable to reach lower temperature of products in the exit.

ANNEX 3 Ceramic Plant Visited During the Stay in CETEC, Belo Horizonte

Product: wall tiles 15 x 15 cm, 11 x 11 cm, 15 x 20 cm

Annual production: 4 800 000 m^2

Fuels: fuel oil
gas from gasification of charcoal
electricity

Specific consumption: First firing: 4000 kJ/kg
Second firing: 5500 kJ/kg

Equipment: spray driers
channel driers
tunnel kilns

Description of thermal treatment:

The slurry is dried in two spray driers, one of them utilizing waste heat of combustion products from tunnel kilns only, the second one uses waste heat plus fuel oil. Channel driers are operating with waste heat from cooling of kilns only. Firing temperature for the first firing is 1080°C, for glaze firing 970°C (measured by operating thermocouples). One kiln for glaze firing operates successfully with clean gas from gasifier of charcoal, installed in the plant.

Recommendations:

a) to reduce the mass of kiln car linings,
b) to reduce the temperature in the exits of kilns (about 400°C at present) by better adjustment of cooling zones; for this purpose, to accomplish measurement of firing curves and pressure curves,
c) to reduce the heat radiation in firing zones by improved closings of sight holes (the first firing - kilns with opened fire) and by closing of holes after removed burners (the muffled kiln for glaze firing).

ANNEX 4 The UNIDO-Czechoslovakia Joint Programme
Publications Requested from INTIB, UNIDO Vienna

The request was submitted by IPT, São Paulo, represented by Mr. Fausto Furnari, Co-ordinator of Industrial Conservation Programme of IPT. /See the following pages/

ENERGY CONSERVATION

- GATZKE, H. & ELSTNER, I. Optimation of product mixing in vlow of kiln and firing requirements. UNIDO Nº ID/WG. 179/12-1974 40p.

A pratical experience is presented in how to economize firing of refractories in a factory where a wide assortment is produced. It is possible to mix the settings of various products within each of the following groups: fireclay products, high alumina products basic bricks, acidic refractories and special qualities. Apart from similar firing cycles, some principles are advised to be preserved. Special chapters deal with setting technics and drying.

- PRABHU, K. Development of refractory kilns. UNIDO Nº ID/WG. 179/13-1974. 57p.

A detailed description of fuels and their applications in firing refractories is given. The main phases of the firing processes are described, the dependance of the firing cycle on the type of kiln, the nature of product and the applied fuel are discussed. The major chapter describes the most commonly used types of kilns for firing refractories.

- KUNÆ, L. & GROTTE, M. The past, present , future trend of energy savings in the non-metallic minerals based industry. 15p. Ref. Nº 7/79.

Savings both in energy generation and energy consumption are presented jointly with the application of refractory insulation materials.

- DIEVO, J. et al. Energy conservation in no-metallics (Mobile Diagnostic Unit). Ref. Nº 10/79. 80p. incl. tables, graphs.

  Basic information on the mobile diagnostic unit, two practical examples of its application in the field and the evaluation of diagnostics are presented.

- ENGELTHALER, Z. A. et al. Non-metallic raw materials - source of energy conservation. Ref. Nº 21/79. 44p.

  Reducing energy consumption in technological as wall as in thermal processes. Emphasis is put on selected non-conventional ways of energy conservation.

- DREVO, J. et al Energy conservation in no-metallic minerals based industries. Ref. Nº 27/80. 217 p. incl. tables, graphs

  The comprehensive study is geared to energy conservation in ceramic glass and coment industries. It presents practical examples in the phase of the heat processes proper and successful technological measures.

- ENERGY conservation. Ref. Nº 33/80

  An instructive technical leaflet on the applicability of the mobile diagnostic unit giving a summary of the main activities and functions of the mobile diagnostic unit in the silicate industries.

- NEMECEK, M. Simulating of thermal processes in silicate industries Ref. Nº 46/80. 34 p. incl. tables, fig.

  Analytical models, comples processos simulating techniques and optimation are characterized. Examples of application are presented

- KOUT, J. & NAVRÁTIL, P. Heat consuming units in ceramic industry Ref. Nº 55/80. 56p. incl. tables, fig.

  Various types of ceramic kilns, applied refractories, fuel economy and selection of kilns are analyzed.

- ENGELTHALER, Z.A. Non-traditional ceramic raw materials enabling saving in energy. Ref. Nº 78/81 22p.

  Non-traditional ceramic raw materials such as tuffs, tuffites, nepheline, phonolite, perlite, limestone, marls and basalts are described and a considerable reduction of sintering temperature is proved if proved if these raw materials are applied as fluxes in bady composition.

- ENGELTHALER, Z. A. Non-metallic raw materials - source of energy conservation. Ref. Nº 80/81. 12p.

  Selected non-metallics may become one of the most important sources of energy conservation. The up-to-date firing kilns of ever shorter firing time and lawer firing temperatures need new types of raw materials ehich werw not applicable in the traditional technological processes. Non-metallics having been properly dressed may become good insulating materials to prevent heat losses by conduction. They are also applicable as fillers into polymers which are the crude all products.

- BABUREK, J. Recent advances in crude oil saving systems in petroleum industry. Ref. Nº 90/81. 70p. incl. tables.

  The application of mineral fillers in the manufacture of polymer increases product properties and reduces crude all consumption. An account of the progress in the application of feldspar, silica, calcium carbonate and koolin filters is given.

- ENGELTHALER, Z. A. Ceramic industry - reducing the energy requirements in technological processes. Ref. Nº 91/81. 60 p. incl. tables, pictures.

  The role of fluxes, application of non-traditional raw materials and ceramic glazes with regard to potential energy savings are dealt with. Practical examples are geared to body compositions, simplified technologies and application of sultable refractories.

- ENGELTHALER, Z. A. Industrial exploitation of phonolites. Ref. Nº 94/81. 5p.

  Czechoslovak phonolites are reviewed and docreased firing temperatures shown after their application in the manufacture of ceramic tiles.

- LOSTAK, A. Czechoslovak ceramic works, their development, structure and energy management. Ref. Nº 101/81. 51 p. incl. diagrams, schemes.

  Scope of production assortment, science-research-development cycle and energy management of the trust embracing nine companies are described.

- LAHOVSKY, J. Cement industry - reducing the energy requirements in the technological processes and heat consuming units. Ref. 102/81. 126p. incl. figures.

  Main principles of cement technology and energy consevation with regard to fuel and electric power saving are described and heat consuming units are reviewed.

- KHOL, V. Energy savings in the glass industry. Ref. Nº105/81
  66p. incl. tables, fig.
  The efficiency of various fuels and potential savings in all stages of the glass manufacturing process are discussed. A list of measures to be taken is an executive summary for energy conservation and heat recovery.

- SLOUKOVÁ, H. et al. Pozzalanas and their application in binding material manufacture. Ref.114/82. 37p. incl. tables
  The application of these raw materails as additives in the manufacture of lime and cement for the achievement of some specific properties and considerable energy savings is discussed. Developing countries possessing these raw materials are extremely interested in these technologies.

- LOSTAK, A. Czechoslovak ceramics - development and energy conservation. Ref. Nº 124/82.
  Development of selected industries manufacturing red bricks, refractories, structural ceramics and fine ceramics: main principles for optimization of energy consumption.

- BABUREK, J. Non-metallics - Their contribution to energy conservation. Ref. Nº 125/82
  The role of non-metallic raw materials in different industries in in energy conservation: application as fluxes, fillers, insulating and deficient materials.

- KUNA, L. Energy managemnt in a ceramic plant. Ref.126/82.
  Application of main principles in selected plants producing red bricks, refractories, structural ceramics and fine ceramics.

- Energy and material flows in the manufacture of selected ceramic products.

  Red bricks, refractories, structural ceramics and fine ceramics. The lecture will be based on uniform comparative diagrams.

- ENGELTHALER, A. Z. Energy savings in composing ceramic bodies. Ref. Nº 128/82.

  Classification of ceramic products, basic principles for composing ceramic bodies from the viewpoints of products, physical, chemical and technological properties (incl. decreasing of firing temperatures of body and glazes).

- STANEK, J. Calculations in ceramics. Ref. Nº 129/82.

  Technological parametric and thermal calculations incl. optimization of thermalprocesses.

- NAVRATIL, P. Progressive kilns and driers - source of energy conservation. Ref. Nº 130/82.

  The lecture deals with introduction of modern kilns in selected ceramic industries (red bricks, refractories, structural ceramics and fine ceramics) and reviews their contribution to energy conservation.

- KACIN, J. Measuring instruments installed in ceramic plants. Ref. Nº 131/82.

  Review of instrumentation installed in selected ceramic plants (red bricks, refractories, structural and fine ceramics), their function, location and use for energy management (embracing instruments ranging from simple recorders to microprocessors for control of firing processes).

- DREVO, J. Investment and operation costs of industrial units. Ref. 134/82

  Classification and characterization of investment and operation costs for establishment of ceramic plants and field experience in collecting primary data.

RESEARCH AND ADVISORY ACTIVITIES

- DREVO, J. Profiles of brick plants. Ref. 17/79. 54p. incl. tables.

  Technical and economical parameters of a series of brick plants sultable for developing countries are demonstrated.

- DREVO, J. Simple ceramic manufacturing equipment. Ref. Nº68/80 65p.

  The publication shows that ceramics can also be made on handicraft scale with simple equipment and under initial assistance of field expert only and consequently at low investment cost.

- BARES, M. et al. Testing institute and plant laboratories for testing non-metallic raw materials and products. Ref. Nº81/81. 131p.

  A series of preliminary projects for the establishment of testing laboratories for non-metallic raw materials and products is presented
  - On central level - the project of the Testing Institute for Non-metallic Raw Materials and Products.
  - On plant level - three projects of plant laboratories oriented to a kaolin washing plant, a plant producing ceramic products and a plant for the manufacture of refractories.

- VOCABULARY for ceramic industry and non-metallic raw materials. Ref. Nº 120/82. 3800 entries.

  The edition of the vocabulary was initiated by the pressing need of experts and upon the request of trainees in group and individual training and participants from developing coutries in technical workshops organized by the Joint Programme in Pilsen.

- The Bulletin Nº1, Issued in January 1981, was dealing with the publications of the Joint Programme, main contemporary assignments, future programme and international co-operation.

- The Bulletin Nº2, issued in April 1981, was concerned with the publications of the Joint Programme, focus point of activities and the extent of possible assistance to developing countries.