b) Equipment

There are those equipment mentioned below in the huge factory site.

* raw material stockyard (more than 20 kinds of raw materials),
* refining plant and firing equipment for fire clay raw materials,
* equipment for refractory production.

The equipment are maintenanced well and the level is supposed to be pretty high although the flow of production line is a little inefficient,

c) Quality control & Environmental preservation

The quality control is considered in the manufacturing process by using of charts, etc. Appearance of products is generally good.

However there is some room for improvement as follows;

* improvement of accuracy in dimension and efficiency in the process of press forming,
* deairing method for the prevention of lamination,
* local dust collector in the pneumatic powder transportation system.

We advised by using examples in Japan.

d) Others

Although the company is ambitious to manufacture new products by introduction of new technology, the actual capacity of equipments may leave problems to introduce new technology.

And also, the prompt introduction of new equipments may be difficult financially, however, it is judged that the situation to introduce them is at the level pretty good.

Therefore it would be a shortway to the development of the company to start to introduce new equipment in the possible sequence.

② IPT, Instituto de Pesquisas Tecnologicas.

a) Establishment & Organization

IPT was separated from the University of Sao Paulo in 1944. In 1976 it has become the technological institute belonging to Sao Paulo State.

It is one of the best technical research institutes in the country and consists of 9 research divisions with 2,212 staffs in all.

We visited the Ceramic Laboratory in Chemical Division and the Chemical Analysis Center of the Institute. This Institute is built in the huge site, surrounding with perfect environment.

b) Equipment, etc.

Pretty much of the equipment used in the Institute is procured by JICA. Some of them are too old to get spare-parts, however, we get impressed that they are maintained satisfactorily to use.

Also in the Ceramic Laboratory most of testing machines are old although they are furnished in all processes from crushing, forming through firing.

It is supposed that testing is emphasised on rather than research. Considering that the institutte is at the high level in research in Brasil, the improvement of researching efficiency by the introduction of automatic equipmemts would be required.

The equipments which are preferred to introduce to the Ceramic Laboratory are;

* Digital Optical Pylometer,
* Automatic Gliding and Polishing Machine of Sample for Refrection Microscope.
* Industrial Analog Recorder, etc.

(2) Effect of Training in Japan

Out of the eleven ex-participants of the group training course in Application Technology for High Temparature Refractories, we had the oppotunity to meet six of them and interviewed about the effect of training. Moreover we conducted seminar on Trends in Ceramic & Refractory Industries in Japan and one of newest research works in Japan, at IPT, one of the ex-participants' organization.

Out of the ex-participants, six ex-participants have changed the job from organizations they belonged to at the training, but it is supposed to be caused by the domestic economical situation in Brasil. Most of them works for organizations related to refractory and ceramic industries. The technology they acquired is applied well.

① Communication between ex-participants after the training.

Many ex-participants including this course ex-participants participate in the Alumini Association of JICA cooperated with JICA Sao Paulo Office (Escritorio Anexo do Consulado Geral do Japao em Sao Paulo), communicating each other actively. The Association has 3,000 members and 1,500 members among them live in Sao Paulo State.

It acts systematically, such as holding the meeting regularly to manage its activities.

On the recognition that it is important to deepen the communication with other fields (other training fields), broadening the views, we propose that these association should be supported actively in future.

② IPT; Instituto de Pesquisas Tecnologicas.
In the Institute, Technical Committee to proceed smoothly with the technocal cooperation with JICA is organized. Much cooperation has been implemented.

Actually, only one participant has participated in this course from this Institute. This participant applies the fruit of training to lectures inside and outside the Institute. Many persons has participated in other training courses related to ceramic industry. This Institute are supposed to be suitable as the organization to dispatch JICA participants.

However, concerning staff in Ceramic Laboratory, Chemistry Division, in charge of refractories which is the theme of the course (Group Training Course in Application Technology for High Temparature Refractories), it is decreasing in number, partly because of the financial reduction. The Laboratory may be afraid of the smooth implementation of works in the case of dispatdhing participants to Japan.
The equipments for research and experiment are also pretty old. Although Japan should learn good maintenance of them, the equipments are insufficient to make use of theirtechnical potential.

We are also demanded the reception of individual training to pursue deeply particular theme as well as the outline, as their research works already reach at the high level in this institute.

(3) Selection of the nominee to the group training course in Application Technology for High Temparature Refractories

Each organizations select and recommend nominees with full recognition of the responsibility of selection. Application forms of candidates recommended by each organizations are sent directly from each organizations to the Division of Training, Ministry of Foreign Affairs, which checks them finally.

Ministry of Foreign Affairs esteems results of the selection in each organization, trying to recommend candidates actively as far as they are not against the qualification of applicants written in GI.

The Ministry send the General Information of this course to organizations mentioned below;

* IPT, Insituto de Pesquisas Tecnologicas,
* Technical Center, Campinas University,
* Secretary of Science and Technology,
* Secretary of Regional Development,
* SENAI,
* Secretary of International Affairs, Government of Rio Grande do Sul.
* Federal University of Pelotas, etc.

We propose that the Japanese side should be willing to seek organizations to dispatch participants in future, as the information related to the training is offered fairly in the Brasilian side.

(4) Aftercare Services to Ex-participants.

We have been asked to continue the supply of publications by JICA, such as "KENSYU-IN", for more than 2 years after the training in order to contact with the information of advancing technology, while actually it remains only for 2 years.

We would like to express sincere appreciation and gratitude to the support extended by the Government of Federative Republic of Brazil, the organizations and the people involved, and also to the contribution of the Embassy of Japan and JICA Office in Brazilia and Sao Paulo.

April 4th, 1992

Tetsuyoshi HOSHI
Leader of the Follow-up Team
for JICA Ex-participants
of the Group Training Course in
Application Technology for High
Temparature Refractories and in
Refractories Manufacturing Technology

(1) ブラジルの耐火物産業

ブラジル経済は、現在20%/月の割合でインフレが進行中であり、このように景気が低迷する中にあって耐火物業界も例外ではない。しかしながら、活発とはいえない現状ではあるものの、耐火物関連では国内鉄鋼メーカーの民営化やセメント需要の進展、経済全体ではインフレ進行率の低下傾向など将来に向けての希望が全くないわけではない。

むしろ、耐火物の需要の70% を占める日本の鉄鋼業界の状況よりは、国内需要の拡大を図ろうとするブラジルの鉄鋼業界やセメント業界の方が頼もしい感じに受けとめられる。

我々は、①耐火物生産の約1割を占めるIBAR社 ROA工場 ②ブラジル国内で最高の技術力を誇るIPTを訪問した。以下にその内容を記すこととする。

①IBAR社 ROA工場

a)生産品種

粘土質及び高アルミナ質煉瓦並びに不定形耐火物等である。

b)設備等

広大な敷地に野積の原料置場（山数20以上）、粘土質原料の精製から原料焼成設備までと耐火物生産設備を有し、生産ラインの流れについては多少の曲折はあるものの設備は良く整備されており、相当のレベルにある。

c)品質管理、環境保全等

・製造工程における品質管理については、グラフ等の利用により配慮がなされている。製品の外観についても良好であった。
・しかしながら細部については、イ)プレス成型時における寸法精度の向上並びに効率化、ロ)ラミネーション防止のための脱気方法、ハ)粉体移送の場合の局所集塵等、改善の余地があった。日本の例により改善のアドバイスを行った。

d)その他、将来問題等

・同社としては、今後先進国からの新技術の導入による新製品の製造に意欲を燃やしている。
・新技術の導入については、同社の現在の設備能力では問題が残る可能性があると思われる。
・新規設備の早期の導入には資金面も含めて困難性もあるが、同社内での受入れの体勢は、一応のレベルにあると判断される。
・従って、可能性の高いものから順次導入することが将来の同社発展のための近道であろう。

②IPT(サンパウロ州立技術研究所)

a)設立の経緯と組織

IPT は、1944年にサンパウロ州立大学より分離し、1976年にサンパウロ州立の技術研究所となって現在に至る。

ブラジル国内では最高の研究所であり、9 つの研究部門より構成され、総人員は2,212 人である。

今回は、そのうち、化学部セラミック研究室及び化学分析センターを訪問した。広い敷地に余裕をもって建物が設置されており、研究所としての環境は申し分ない。

b)設備・機器など

研究室で使用される機器には、ＪＩＣＡの供与によるものもかなり多い。相当に古いので交換部品を入手できない装置もあるが、いずれも保全を十分に実施している。各機器を使いこなしている点には感心する。

セラミック研究室においても、粉砕から成型・焼成に至る各工程での試験設備はそろっているが、古いものが主体である。研究作業より試験作業に重点が置かれているように思われる。ブラジルでは高い研究レベルを持つ試験場であることを考慮すると、自動化した機器の導入による研究効率の向上が必要であるように思われる。

セラミック研究室で導入が望ましい装置としては

デジタル式光高温計
多目的自動記録装置
反射顕微鏡用資料の自動研磨装置

などが考えられた。

(2) 研修成果の活用状況

耐火物製造技術及び高温構築材集団研修コース帰国研修員11名のうち 6名と面談し、帰国後の研修成果の活用状況についてききとり調査を行なった。また、帰国研修員所属先の 1つであるIPT(サンパウロ州立技術研究所) において、日本における窯業・耐火物産業の現状、及び日本における最新の研究成果の一部についてのセミナーを実施した。

帰国研修員11名のうち 6名が研修参加当時の所属先から転職しているものの、その原因はブラジル国内の経済状況によるものと考えられる。ほとんどが耐火物や窯業に関わりのある職務に就いており、習得技術の波及は、順調になされている。

①帰国後の、帰国研修員どうしのつながり

当コース参加者を含む多くの帰国研修員が、ＪＩＣＡサンパウロ事務所の協力により運営されるＪＩＣＡ帰国研修員同窓会（全会員数：3,000 名、うちサンパウロ州：1,500 名）に加入しており、互いの情報交換も活発である。

定期的に事業運営のための会合を開くなど、組織的な活動を行なっている。

視野を広くして、他分野（研修コース）との交流を深めることが重要であるとの認識から、こうした会の運営を今後とも積極的に支援すべきであると、調査団として提言する。

②IPT(サンパウロ州立技術研究所)

研究所内にはＪＩＣＡとの技術協力を円滑に進めるための技術委員会が組織されており、すでに多くの協力がなされている。

現在、この研究所において当コースへの参加実績のある研修員は 1名のみであるが、当研修員は研修の成果を研究所内外の講義に活用しており、当研究所から窯業関係他コースへの参加者も多く、研修員派遣機関としては適切なものの 1つであると考える。

しかしながら、当コース（高温構築材応用技術集団研修コース）のテーマである耐火物についての研究を担当する化学部の中のセラミック研究室における研究スタッフの数が財政縮減の折から減少しており、研修員を日本に派遣した場合の当研究室での業務実施に研究室としても不安を感じているようであった。

試験研究設備にもかなり以前のものが多い。メンテナンスのよさには日本としても学ぶべき面があるが、当研究所の技術的能力を発揮するには設備面での不足がある。

研修に関する要望としては、すでに研究のレベルも高いことから、概論を学ぶだけでなく特定のテーマを深く追究するための個別研修の受け入れも強く要望された。

(3) 研修員選考のしくみ

応募者の選考は、まず各所属先において、人選の責任を十分に認識しつつ確実に行われている。所属先が推薦する候補者の要請者は、各機関からブラジル外務省研修課(DFTR)に直接送られ、最終的なチェックが行なわれる。ブラジル外務省としては各所属先での選考結果を重視しており、ＧＩに記載の応募要件に外れてないかぎり、積極的に候補者の推薦に努めている。

ブラジル外務省は、ＪＩＣＡ事務所とも協調を図りつつ、以下のような機関にＧＩを送付している。

(1) サンパウロ技術研究所(IPT)
(2) カンピーナス大学技術センター(UNICAMP)
(3) ブラジル科学技術庁
(4) ブラジル地域開発庁
(5) 全国職業訓練機構(SENAI)
(6) リオ・グランデ・ド・スル州政府国際関係庁
(7) ペロータス連邦大学　　など

調査団は、ブラジル側での研修に関する情報の提供は公正に行われており、日本側としても今後も積極的に研修員派遣機関の拡大に協力するのが望ましいと考える。

(4) アフターケアに対する要望

進歩する技術情報に帰国後もコンタクトするために、帰国後 2年間に現在とどまっている、"Kensyu-in" などのＪＩＣＡによる文献の供与をより長く続けてほしいとのコメントを受けた。

(2) メキシコ

SUMMARY REPORT BY THE FOLLOW-UP TEAM FOR THE GROUP TRAINING COURSE IN APPLICATION TECHNOLOGY FOR HIGH TEMPARATURE REFRACTORIES AND IN REFRACTORIES MANUFACTURING TECHNOLOGY

1. Introduction

Being dispatched by Japan International Cooperation Agency as part of its follow-up programme for the group training course in Application Technology for High Temparature Refractories (Refractories Manufacturing Technology), the team headed by Mr. Tetsuyoshi Hoshi, Assistant Section Chief, Ceramic Industry Section, Ceramics and Construction Materials Division, Consumer Goods Industries Bureau, Ministry of International Trade & Industry as mentioned below, arrived at Mexico on April 5, 1992, and conducted its follow-up activities for a period of 5 days.

The team has the pleasure to submit a summary report on the results of its study so that it would be referred to by the authorities concerned in the Government of United Mexican States.

2.Team Members

(1) Follow-up Team Leader, Technical Guidance;
Mr. Tetsuyoshi Hoshi
Assistant Section Chief, Ceramic Industry Section,
Ceramics and Construction Materials Division,
Consumer Goods Industries Bureau,
Ministry of International Trade and Industry.

(2) Technical Guidance;
Mr. Tsuneyuki Nabeta,
Manager, Expert Department of Technology,
Technical Research Laboratory,
Mino Yogyo Co., Ltd.

(3) Follow-up Team Coordinator;
Mr. Nobuyuki Kobayashi,
Staff, Training Division,
Nagoya International Training Center, JICA.

3. Objectives

This team are mainly dispatched for the purpose of survey about the situation of refractory and ceramic industry and the possibility to receive the participants for the group training course in Application technology for high temparature refractories, together with the need in this field in order to improve future training programmes.

4. Summary of the Follow-up Activities & General Impression

The team conducted;

- interview with managers of related organizations
- interview with the officials in the Department of Cultural Affairs, Ministry of Foreign Affairs.
- seminar on Ceramic Industry in Japan and one of the research concerned with refractory industry for related personnels.

Out of the above mentioned activities, we have confirmed the followings:

(1) Refractory Industry in Mexico

We had the impression that the country is generally lively, partly because of the recovery from economical crisis in 1982 and the start of free trading with USA.

As for steel manufacturing as the basic industry, the production of crude steel in 1990 was about 8,700,000 tons, and the production of cement was 25,000,000 tons. The demand for refractories is high. They are exported to USA or South America as well as utilized domestically.

We visited the organizations as mentioned below;

① Refractarios Green S.A. de C.V. in the suburb of Mexico City,

② Refractarios Mexicanos S.A. de C.V. in Sartillo City.

① Refractarios Green S.A. de C.V.

The company was established by AP. Green Co., Ltd. in USA and Mexican stockholder. Although actually the Group of Penoles in Mexico holds all stocks of the Company, relationship with AP. Green Co., Ltd. continues technologically. Items of production are Fire Clay, High-Alumina Refractory Bricks and Monolithic Refractories. Raw Materials are not only produced domestically but also imported from all over the world.

The process for production are arranged smoothly on crushing, mixing, forming, drying and firing. Especially the green brick formed by press machines are loaded on kiln cars and carried directly to the process of drying and firing. Besides the production process of bricks, measuring machines for raw materials of monolithics and packing machine are equipped near crushing machines at the side of raw materials' storage.

Equipments of the factory are old on the whole. It is supposed that the products contain many coarse grains and are not sintered well because of less bonding force or less mixing amount of the clay in use.

Testing room are also under improvement, and X-ray diffractmeter and X-ray fluorescence spectrometer are installed and operated for test. It is judged, however, that the production with better quality is difficult unless the quality of them are controlled more severely.

The company desired to participate in Group Training courses of JICA.

② Refractarios Mexicanos S.A. de C.V.

The company was established by the investment of General Refractories Co., Ltd. in USA. Actually it is invested completely by Penoles Group in Mexico. Items of production are basic bricks and monolithic refractories.

Magnesia-Clinker produced at other companies under Penoles Group as well as that imported from China is utilized as raw materials for magnesia. Crome ore is imported from South Africa and Philippines. The company exports some of products to USA and South America.

As for production technology of bricks, by judging from the facts that they are producing and selling good quality products by introducing the Japanese technology, we suppose that they could apply to the latest Japanese technologies.

As concerned with products fired in high temparature, however, the company has to seek the optimum condition in various points such as raw materials, mixing and firing, etc.

It is needed to give a guidance about the measures suited for actual condition.

We recognized that the company is positive to participate in Group Training Courses of JICA.

Although the manufacturing technique of refractories in Mexico reaches the proper level, we suppose that some guidance is needed to produce the higher qualities.

(2) Selection of the nominee to the group training course in Application Technology for High Temperature Refractories

General Informations (hereinafter described as GI) of Group Training Courses sent for JICA to the Department of Cultural Affairs, Ministry of Foreign Affairs of Mexico are distributed to organizations mentioned below, which try to recommend candidates. The Ministry also looks for candidates in public through national newspapers.

* Local Branch of the Ministry of Foreign Affairs,
* Local Government in Mexico,
* Related organizations, such as private companies,
* Organizations of the industry, such as National Association for Manufacturing, etc.

All of application forms submitted until the closing day are passed to JICA from the Ministry, so far as they suit for qualification of applicants described in GI.

The content of GI is considered well and mostly fine. At the present the result of selection is informed about one month before start of training. They say that there is not any problem in this point.

All participants are obliged to present reports about training after completion of it.

Mexican side has the impression that Group Training Course by JICA is highly reliable because at least one person can participate whenever some candidates are nominated. On recognition that the Ministry looks for candidates actively and fairly and that refractory industry is needed in this country with large industrial areas, we judge that the Ministry do the best in seeking the candidate in case that Mexico is allocated for this course.

Japanese side should consider to send GI at early stage to keep enough time for application, which needs one month at least, and to receive more than 2 participants from 1 country for some courses.

We would like to express sincere appreciation and gratitude to the support extended by the Government of United Mexican States, the organizations and the people involved, and also to the contribution of the Embassy of Japan and JICA Mexico Office.

April 4th, 1992

星 徹美

Tetsuyoshi HOSHI
Leader of the Follow-up Team
for JICA Ex-participants
of the Group Training Course in
Application Technology for High
Temparature Refractories and in
Refractories Manufacturing Technology

(1) メキシコの耐火物産業

メキシコでは1982年の経済危機より立直り、米国との自由貿易の開始等の事もあって全般的に国が活気を帯びているように感じられた。基礎産業の鉄鋼は粗鋼生産が約 870万トン(1990 年) 、セメント生産量は 2,500万トンといわれている。耐火物の需要も、国内はもちろん米国や南米にも輸出をしている状況である。

我々は、①メキシコシティー郊外の Refractarios Green 社 ②サルティヨ市にある Refractarios Mexicanos 社を訪問した。

① Refractarios Green 社

米国の AP.Green 社及びメキシコの株主で設立された会社で、現在はメキシコのペニョレスグループが 100% 株を持っている。しかし技術的には AP.Green 社との関係が続いている。

生産品種は粘土質・高アルミナ質れんがと不定形耐火物で、原料は国内産のものの他に世界各国より輸入している。生産の工程としては、粉砕から混練・成形・乾燥・焼成と、ほぼ直線的に流れるように配置される。特に、プレスで成形された素地は直接にトンネルキルン台車に積まれて乾燥・焼成工程に移るようになっていた。また、このれんがの製造工程とは別に、原料置場の端の粉砕機に近い所に、不定形耐火物用の原料ホッパー秤量装置・袋詰機械も設置されていた。

工場全体の設備は古い。使用している粘土の結合力が少ないか、配合量が少ないかによって、全般的に製品の粒子は多く、焼結もあまり良好でないように思われた。試験室も整備中との事であり、X線回折装置と蛍光X線分析装置が設置されて試験稼働中であったが、品質管理の点から見ても、もう少し厳しく行わないとより高品位なものの製造は難しいように思われた。

ＪＩＣＡの集団研修コースへの参加意欲は強い。

② Refractarios Mexicanos 社

米国の General Refractory 社の 100% 出資で会社が創立されたが、現在はメキシコのペニョレスグループの 100% 出資会社である。

生産品種は塩基性れんが及び不定形耐火物で、マグネシア原料には同じグループ中の他の会社で製造したマグネシアクリンカーや、一部に中国産の原料も使用している。クロム鉱は南アフリカ及びフィリピン産のものを輸入している。製品の一部は米国や南米地区に輸出している。

れんがの製造技術に関しては、日本からの技術も導入されて良好な製品が製造販売されているという点では、日本の新しい製造技術に適応できる Refractarios Mexicanos 社の現在技術が受け入れ可能なレベルであると判断されるものの、高温焼成品等に関しては原料・配合・焼成条件と種々の点で最適の条件を見い出していかなければならない。したがって現状に合わせた方法を技術的に指導する必要がある。

ＪＩＣＡの集団研修コースへの参加については積極性が認められた。

メキシコにおける耐火物の製造技術は一応のレベルに達しているが、より高度なものの製造に関しては種々と指導を行う必要があると考えられた。

(2) 外務省における選考・推薦のしくみ

ＪＩＣＡからメキシコ外務省文化局に送付される集団コースのＧＩは、以下のような機関に配布されて適任者の推薦に努めるとともに全国紙を通じて公募される。

(1) メキシコ外務省の地方事務所
(2) メキシコ国内の各州政府
(3) 民間企業などの関係機関
(4) 全国製造業会議所などの業界団体

応募しめ切り期限までに提出される要請書は、資格要件を満たしていればすべて、メキシコ外務省からＪＩＣＡに提出される。

ＧＩの内容については、よく整備されておりおおむね問題なく、受け入れ回答時期も現行の研修開始約１か月前でよいとのことである。

帰国後、研修についての報告書の提出が義務づけられる。

メキシコ側は、ＪＩＣＡの集団コースを、応募すれば最低限１名は参加できるものとして信頼性の高いものとの印象をもっている。メキシコ外務省が、集団コース参加者を積極的かつ公正に募集していること、多くの工業地帯を抱える同国では耐火物産業の必要性もあると認識していることから、調査団は、当コースのメキシコへの割り当てに際しても候補者の発掘にメキシコ外務省が最大限努力するものと判断する。

日本側としてもこれに協力すべく、メキシコ側での募集期間が十分（最低限１か月）取れるようにＧＩを早期に送付し、コースによっては１か国から２名以上の研修員を受け入れることも考慮する必要があろう。

2. Questionnaire（質問票）

配布・回答依頼先別に3種類のFormを作成した。

(1) 援助窓口に対する質問内容

配布先；ブラジル外務省研修課

メキシコ外務省文化局

(2) 研修員所属先に対する質問内容

配布先；ブラジル ①IBAR社

②IPT（サンパウロ州立技術研究所）

メキシコ ①Refractarios Mexicanos社

②Refractarios Green社

③Barro-Mex社

＊メキシコからの帰国研修員2名は所在がつかめなかったため、訪問機関・セミナー参加関係者に当コースへの研修員を各機関から出すとした場合を想定して回答してもらった。

(3) 研修員本人に対する質問内容

配布先；ブラジルのみ 帰国研修員10名

（1）援助窓口に対する質問内容

Questionnaire to the participants nominating organization
援助窓口に対する質問内容

(Please type or write in block letters)

1. Please tell us the processes of nominating the participants after you receive the General Information (GI) of Group Training Course in Application Technology for High Temparature Refractories (the former name of this course had been Refractory Manufactuaring Technology until fiscal year 1988) sent from the Embassy of Japan/JICA office and also the time requird.
ＧＩ受領後の人選手順
Your office → → → → →your office

1)____ more than 2 months 2) ____ less than 2 months

2. Are the above processes subject to change from year to year or the same over the years?
1)____ yes 2)____ no

If yes, why?

3. Mark one matched with the selection of the applicants for the participation in this group training course in your country. 当該研修分野への需要.
1) _____ difficult to select one due to the large number of the applicants
2) _____ easy to select one due to the small number of the applicants
3) others (list other reasons)

3. Do you finalize the nomination on the basis of GI (1) or on the basis of your organization's criteria (2) ?
窓口機関での最終人選
1)____ 2)____
If you answered (2), please explain the screening policies in your organization..

4. Do you think the GI of this course clearly describes the objectives, the contents and the level of the training program?
ＧＩ内容の適否
1)____ yes 2)____ no
If no, what sort of additional information would you found useful ?

Please tell us also your opinions about the timing that your participant's nomination is accepted .

5. After your organization receives the notice of participant's acceptance, how long does it take till he/she finish all the procedures necessary for departure ?
受入れ回答後、出発までの手続き
1)____ more than 1 month 2)____ more than 2 weeks 3)____ less than 2 weeks

6. Does the participant report to your office after he/she finishes his/her training ?
帰国後、窓口機関での研修成果の確認
1)_____ usually yes 2)_____ usually no
If usually yes, please tell us the methods and content of that reporting.

If usually no, how does your organization confirm the accomplishment of the training ?

7. With reportings mede by participants after finishing the this Group Training and return to your country, how does your organization look at the position of this training opportunity in view of the length of training, contents and level of training? Please give us your suggestions and comments of this Group Training Course in Application Technology for high Temparature refractories.

8. Indicate your evaluation of this course in your country.
   a. excellent
   b. good
   c. not so good
   Discribe the reasons for your above choice.

9. Give your suggestions and comments on the follow-up activities for the ex-participants.

10. If you have any opinion about this course in comparison with other similar courses inside or outside your country, please state below.
    他機関主催の研修との比較

11. Please state your observation about the future demands in your country in the field of refractory industry and their background information so that we can apply them to this training course.
    同分野での将来ニーズ等の関連情報

Thank you very much.

（2）研修員所属先に対する質問内容

Questionnaire to the organization of the ex-participants
研修員所属先に対する質問内容

(Please type or write in block letters)

A. Group Training in Japan

1. Please let us know the necessary processes to nominate candidates, after you receive the General Information (GI) of the Group Training Course in Application Technology for High Temparature Refractories (Refractory Manufacturing Technology) sent from the embassy of Japan and also the time required at each process.
ＧＩ受領後、人選の手順

Could you tell us your opinions concerning the timing that GI is sent to your organization ?

2. Are the above processes subject to change from year to year or the same over the years?
1)____ yes 2)____ no

If yes, why?

3. Mark one matched with the selection of the applicants for the participation in this group training course in your country. 当該研修分野への需要.
1) _____ difficult to select one due to the large number of the applicants
2) _____ easy to select one due to the small number of the applicants
3) others (list other reasons)

4. What is your policy to select candidates? 人選方針

5. Before the selection in your organization, are you well informed of the objectives, target of the training, content and level of the program ? 人選時の充分な情報の有無

1)____ yes 2)____ no

If no, could you point out the information not clear ?

6. Please tell us the procedures until a participant will leave your country for Japan, from the time your organization receives the notice of participant's acceptance, and the time requirement ? Please tell us also your opinions about the timing that your participant's nomination is accepted ?

7. There have been several number of participants sent to this Group Training Course from your country. Before your organization's screening of candidates , are you informed of training, the methods and level of training ? 候補者人選前の事前情報把握の有無

8. Once the candidate participant is accepted, until his/her departure, what kind of discussion/meetings are held between he/she and his/her superiors to give him/her the proper orientation for the training in Japan ? 受入れ回答後、上司とのオリの有無

9. What kind of report will the participant give to your organization, to the immediate superior when he/she returns to your country after finishing the training in Japan ? In what method of reporting and content ? Do what have been reported meet the objective of your organization dispatching the participants ? 帰国後の報告とその方法, 報告に対する評価.

10. Do you take the participation in this Group Training Course as a contributing factor for participant's personnel appraisal and promotion in your organization in future ?
研修参加と人事評価との関係

1)_____ yes (_____ a lot, _____ somewhat) 2)_____ no

If yes, how do you consider it ?

11. Judging from the report submitted by the participant, how do you evaluate this training from the view point of length, content, level etc ? Please give us your suggestions and comments of this course. 研修へのコメント

12. Do you find that what the participant acquired or developped during his/her training in Japan is practically applied in his/her work ? 研修成果の活用度

1)____ yes (____ a lot _____ somewhat) 2)_____ no

If no, please explain the reason why.

13. As after-care services, Japan International Cooperation Agency conducts for ex-participants the followings:
- to dispatch follow up team for the purpose of further improvement of Training Courses (survey of training effects and future technical needs, technical guidance)
- to provide the ex-participants with technical information, literatures(addresses are selected by JICA)
- to send magazine "ＫＥＮ－ＳＨＵ－ＩＮ" (only for 2 years) to ex-participants
- to assist ex-participants to organize alumni associations.

If you have any comments or suggestions concerning these services, please explain them.
アフターケア活動へのコメント

14. Please state your observation about the future demands for applying to this training course and their background information.
同分野での将来ニーズ等の関連情報

B. General Situation of Refractories in your Country or your Factory

1. Indicate any probable problem according to the following items, which you think will be a barrier to the development of the refractories industry, and explain them respectively:

(1) talent (technical expert and apprentice)

(2) standard raw material

(3) machinery and the connected items

(4) analysis and evaluation of raw materials

(5) forming

(6) kiln and firing control

(7) fuel

(8) inspection of final products

(9) research, development and training

(10) quality control

(11) maintenance of productive equipment

(12) training for skill workers

(13) application(kiln designing, etc.)

2. Please show the statistical data of factories & employees in refractory industry in your country. (Please annex the paper, if needed.)

3. Indicate any organization for research and quality testing in refractories according to the following items and explain them respectively:

(1) name of institute (central/local government) with location

(2) organization

(3) services

(4) research theme

(5) instruments and facilities

(6) information resources (please let us know from which developed country this institute get technical information most and how to get them.)
-name of country

-the way to get information

4. Indicate any organization for training in refractories according to the following items and explain them respectively:

(1) name of institute (central/local government) with location

(2) objective, purpose and type of an organization

(3) training programme

(4) instruments, machinery and facilities

5. Describe the situation and the data of export and import of the refractories products:
(Please annex the paper, if needed.)

6. Describe the statistical data of refractories and their amount of production in each kind, in your country and your organization. (Please annex the paper, if needed.)

7. Describe your situations of the refractories products and capacity being manufactured in your plant

(1) brick quality

Chamotte	(SK - SK)
High-alumina	(SK - SK)
Sikica	(SiO_2 %- %)
Alumina	(Al_2O_3 %- %)
Magnesia-chrome	(MgO %- %)
	(Forsterite (Silicate) bonded, Direct bonded)
Dolomite	(Tar bonded, tea impregnated)
Zircon	
Silicon carbide	(SiC %- %)
Graphite	(C %- %)

(2) monolithics

Castables	(Max. service temp. ℃- ℃)
Plastics	(Max. service temp. ℃- ℃)
Ramming mixes	(application)
Gunning mixes	(application)

8. Describe your manufacturing procedures and equipment (including its capacity) in your plant

(1) material preparation

a) crushing equipment

b) sieving equipment

c) mixing equipment

(2) forming

a) hand moulding

b) press (load process, maximum load and numbers)

(3) drying

a) drying equipment (dryer type, temperature, capacity and numbers)

(4) firing

a) firing equipment (kiln type, maximum temperature, capacity and numbers)

(5) packing

(6) quality test equipment (describe name and specification)

(7) relative technology
circle any of the following items which your factory manufactures by yourself.

a) make wooden mould for hand moulding.
b) make and repair press mould.
c) design industrial kiln of your customers.
d) repair and assemble manufacturing machinery.
e) make parts for machinery and equipment.
f) design your (tunnel) kiln.
g) repair and build-up of your kiln.
h) make simple repairs on measuring instruments.

9. Describe applications of your refractories products in each industrial field.

e.g. steel industry - Chamotte brick for pouring pit
cement industry - Magresia-Chrome brick for rotary kiln

(1) steel industry

(2) cement and lime industry

(3) non-ferrous metal industry

(4) glass industry

(5) ceramic industry

(6) incineraters and boilers

(7) others

10. Circle any letters of production control technology which your organization apply, according to process.

(1) raw material
   a. test firing
   b. measure chemical composition
   c. check grain size distribution
   d. measure water content of raw material
   e. remove the impurity contamination

(2) raw material preparation
   a. check grain size distribution
   b. check water content of mixed material
   c. measure chemical composition

(3) forming
   a. check external appearance of products
   b. make regular measurement on size of mould
   c. adjust the size of products
   d. make regular measurement on the size of products

(4) drying
   a. check water content in the green body
   b. keep temperature at the normal temperature
   c. check humidity
   d. check cracking
   e. natural drying only

(5) firing
   a. mesure temperature with the Seger cone
   b. measure temperature by thermometer
   c. measure and record the temperature automatically
   d. measute non-temperature element also.
      (e.g. kiln pressure, kiln gas analysis etc.)
   e. measure caloric power, heavy oil vescosity etc.

(6) products
   a) check external appearance (crack, chipping etc.)
   b) measure the size of products
   c) measure physical properties
   d) measure regractoriness
   e) measure strength (cold crishing strength etc.)
   f) measure refractoriness under load
   g) measute permanent linear change
   h) measure thermal expansion
   i) measure thermal conductivity
   j) measure spalling resistance
   k) measure chemical composition
   l) measure mazimum service temperature of monolithics
   m) measure grain size distrivution of castables

11. Cocerning the development of new products, is there any R & D section in your organization ?

(1) yes (2) no

If yes, what kind of products are their main concern in that section?

12. Circle any letters concerning high-tech machineries which is used for the following purpose in your organization,

a) office automation
b) manufacturing process (body preparation, measurement, quality control etc.)
c) date base
d) design by CAD system

13. Please explain the major operation and function of your organization and show us the organization chart. (please use other paper)

14. Please let us know the number of engineers, their educational level and their promotion system together with the training programs for them, in your organization.

-number of engineers _____

-their educational level

-promotion system and the training program for them

15. Please let us know the line workers' training system and their educational level.

-training system

-educational level

16. Please let us know the percentage of staff (working in the office including engineers) and line workers

-staff %
-line workers % (total should be 100%)

C. Give your ideas about present and future damand and supply for the refractory products and their counter measures in terms of production, kinds, man-power etc.

Thank you very much for your cooperation!

（3）研修員本人に対する質問内容

Questionnaire to the ex-participants

研修員本人に対する質問内容

(Please type or write in block letters)

A. Educational Data

1. Education/Training (Degree/Non-degree) before attending training at JICA.

Name of Educational/ Training Institute	Location of Instituion	Years attended from- to-	Certificate/Diploma/Degree & Major in

2. Education/Training (Degree/Non-degree) after attending training at JICA.

Name of Educational/ Training Institute	Location of Instituion	Years attended from- to-	Certificate/Diploma/Degree & Major in

B. Employment/Work Experience

1. Work experiance: Please describe briefly what kind of work/job you have had since you returned home, including the present one.

Work/Job Position	Dates (from-to-)	Responsibilities

2. Nature of your present job: Indicate by an (x) mark in the corresponding box.

Activities	Full aprox. 85%	Major aprox. 75%	Partly aprox. 50%	Slightly aprox. 25%
Research				
Instruction				
Extension				
Administration				
Others, specify				

3. If there is any personal improvement in your job/work after JICA training, please indicate below:

_____(yes) improved (___ a lot) (___ somewhat)
_____(no) improvement

If yes, please check below where applicable:

_____ work conditions
_____ responsibility
_____ for future prospects
_____ salary wise
_____ for other better Jobs
_____content of work
_____professional recognition
_____international contact

4. Indicate the usefulness of the technical training course by circling a number below.

(1) very useful
(2) useful
(3) less useful

4-a. Circle any of the following reasons if (1) is chosen.

a. exposure at the most advanced refractory industry in Japan
b. improvement in the technical knowledge of the refractory manufacturing technology
c. improvement in the refractory manufacturing technology
d. contact with the Japanese culture
e. others (describe any other reasons below)

4-b. Describe your reasons if (2) are chosen.

4-c. Circle any of the following reasons if (3) is chosen.

a. Your job has nothing to do with the study contents in Refractory Manufacturing Training.
b. The study contents in Refractory Manufacturing Training are so much different from your country's situation.
c. The study contents in Refractory Manufacturing Training are so much theoretical.
d. Too high level of the study contents in Refractory Manufacturing Training.
e. Too low level of the study contents in Refractory Manufacturing Training.
f. Others (describe any other reasons below)

5. Have you taken up, used, and referred to the training text materials, after finishing the Japanese training and return to your country?
Please circle a number below.

A. Quite frequently
B. Sometimes
C. Not at all

6. If you have marked in either A or B in question 5, please write which items of the text materials taken up, used and referred to for what occasions.

item of training text materials	for what occasions as examples

7. Have you been able to pass on to anyone any of the skills/knowledge that you acquired?

Full aprox. 85%	Major aprox. 75%	Partly aprox.50%	Slightly aprox. 25%	Non 0%

-Please explain in what sort of ways and what part of your training you have been able to do this?

-If you answered "Slightly" or "No", please explain why.

8. Have you shown the training text materials to others; have you given guidances teachings in reference to the training text materials? If so, which items of the text materials are they, for what occasions?

item of training text materials	for what occasions as examples

9. Indicate the degree of usefulness in executing your assignments by entering either A, B, C, into ( ) and describe the reasons for determining the degree, considering to what extent you can apply the knowkedge/skills acquired though the JICA training to you job.

A--- very useful B--- useful C--- less useful

Subject

a) Basics on refractories

1) General introduction of refractories ( )

2) Testing and evaluation method of raw materials ( )

3) Refractory manufacturing plant observation

3-1) Raw material preparation (Crushing, Sieving and Mixing) technique ( )

3-2) Forming technique ( )

3-3) Drying tecnique ( )

3-4) Firing technique ( )

3-5) Packing technique ( )

3-6) Quality test and inspection technique ( )

4) General introduction of monolithic refractories ( )

5) Monolithic refractories manufacturing plant observation

5-1) Raw material preparation (Crushing, Sieving and Mixing) technique ( )

5-2) Packing technique ( )

5-3) Quality test and inspection technique ( )

b) Test piece making

1) Testing and evaluation method of raw materials for refractories

1-1) Chemical analysis ( )

1-2) Mineralogical analysis ( )

- o Powder X-ray diffractometry
- o Polarizing microscopy

1-3) Grain size analysis ( )

1-4) Refractoriness test ( )

1-5) Thermal property test

- o Differential thermal analysis ( )

1-6) Chemical analysis ( )

2) Test piece making procedure

2-1) Crushing ( )

2-2) Sieving ( )

2-3) Mixing ( )

2-4) Forming ( )

2-5) Drying ( )

2-6) Firing ( )

3) Test piece inspection

3-1) Firing shrinkage measurement ( )

3-2) Physical properties test ( )

3-3) cold crushing strength test ( )

4) Raw material evaluation ( )

c) Trial bricks manufacturing

1) Trial bricks making procedure

1-1) Crushing ( )

1-2) Sieving ( )

1-3) Mixing ( )

1-4) Forming ( )

1-5) Drying ( )

1-6) Firing ( )

2) Quality inspection

2-1) Physical properties ( )

2-2) Mineralogical analysis ( )

2-3) Cold crushing strength test ( )

2-4) Thermal expansion test ( )

2-5) Slag reaction test (crucible method) ( )

2-6) Permanent linear change test ( )

2-7) Refractoriness under load test ( )

2-8) Hot modulus of rupture test ( )

3) Refractory brick evaluation ( )

d) Supplement lectures and refractories applications

1) Basic refractories ( )

2) Binders for refractories ( )

3) New trends of regractories in Japan ( )

4) Thermal change of major minerals ( )

5) Thermal conductivity ( )

6) Tunnel kiln construction ( )

7) Instroduction on ceramic plant engineering ( )

8) Application of refractories ( )

9) Refractories new trends in steelmaking ( )

10) Refractories new trends in cement industry ( )

11) Field trip ( )

10. JICA have been conducting group training course in Refractories Manufacturing Technology every year from fiscal year 1973 until 1988.

It had mainly covered the subjects concerned to Fireclay and High-Alumina refractories as the kiln materials for the production of potteries and porcelains, one of the promoter of light industry.

This course had been conducted to meet the tendency toward heavy industries. such as steel industry.

But in these countries heavy industry had not been advanced enough as the base of industries. Even in the countries with much natural resources, they were exported as raw materials without refining or processing there.

The equipment for refining in steel industry, for firing in cement industry and for melting in nonferrous metals industry, etc, are necessary for the development of heavy industries. They cannot be established without refractories as main materials of kiln or furnace. Application technology of refractories for many kinds of equipments is also indispensable for the utilization of mineral resources into industries and the increase of their added value.

Therefore in 1989, the curriculum were improved a little bit. Participants learn not only the refractories of kiln & furnace materials for firing potteries, such as Fireclay and High-Alumina, but those for heavy industries including Basic refractories or Special refractories. Contents were extended.

The policy of re-started course and actual curriculum is as follows:

(1) Extention to the materials of kiln & furnace for heavy industry, including the basic

refractories and special refractories besides the refractories with former quality.

(2) The level for the manufacturing & inspection of bricks and raw materials remains at the studying the basic knowledge of materials for kiln.

(3) Introduction of application technology of refractories for many kinds of industrial furnace.

(4) Technology to utilize natural resources into refractories.

Indicate your greater emphasis on the contents of the technical training for its further improvement with the full description of the urgent needs for the technical knowledge, technology, and others. (write the subjects and briefly describe the contents you wish to acquire)

	subjects	contents
1.		
2.		
3.		
4.		
5.		
6.		

11. Indicate your hope for the possible participation in the refreshers training course if organized (circle either (1) of (2))

(1) participate in

(2) do not participate in

11-a. Write any subjects below you would pursue if (1) chosen.

11-b. Describe your reason if (2) chosen.

12. List and describe all the pending problems you are truobled with in promoting and developing the refractory manufacturing industry in your country (Check 4 or less items in each row below:)

Lack of

_____ trained personnel
_____ equipment
_____ funds
_____ foreign experts
_____ research facilities
_____ career perspective
_____ support of supervisor
_____ technical literature
_____ markets
_____ national training institutes
_____ transport facilities
_____ foreign currency

Various constraints:

_____ economic situation
_____ poor management
_____ too much foreign influence
_____ political situation
_____ brain drain
_____ promotion structure
_____ no suitable training
_____ poor maintenance if equipment

12-a. The detailed description of the pending problems

13. Request or suggestion to JICA, if any:

_____ Retraining

_____ JICA publication

_____ Technical informations

Describe your reasons

Thank you very much for your cooperation!

3．高温構築材／耐火物製造技術集団研修コース参加研修員実績

(数字)；割当国からの来日参加研修員　　0；割当国ながら応募なし　　(上付数字)；割当国外参加／個別参加研修員　　♥；92年度割当国

－；割当なし　　＊；フォローアップ調査団派遣　　(下付数字)；来日中止

▒；要望国　　×；割当国で応募あったものの不合格　　(空欄)；資料散逸のため不明

No	地域	国名	耐火物製造技術															高温構築材応用技術				計	
			1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992		
1	アジア	バングラディッシュ					1	1		1	0	1	0	－	×	－	－	－	－	－	－	－	4	
		ビルマ	1								0	1	1	1	×	1	0	▒	0	－	－	－	5	
		中国									－	－	－	－	－	－	－	▒	－	－	▒	▒		
		インド					1				－	－	－	1	－	×	1	1	×	▒	▒	－	6	
		インドネシア	2	2	1	1	1	1	1		0	1	2	＊1	1	1	1	▒	1	▒	0	♥	18	
		パキスタン						1		1	－	1－	－	－	－	－	－	－	－	－	0	－	2[1]	
		フィリピン	1	2	1	2			1	12	1	3	3	1－	－	0	1	▒	1	▒	－	♥	20[2]	
		シンガポール			1						－	－	－	－	－	－	－	－	－	－	－	－	1	
		スリランカ		1	1	1	2	1	2	1	1	1	1	1	－	－	－	－	－	－	－	♥	13	
		タイ	1		1	1			1	1	1	1	2	＊－	1	1	1	▒	1	▒	▒	♥	16	
2	中近東	アフガニスタン		1					1		－	－	－	－	－	－	－	－	－	－	－	－	2	
		エジプト	1	1			1			1	2	0	－	1	2	1	1	▒	×	1	1	♥	14	
		イラン						1			0	0	0	－	－	－	0	1	1	▒	▒	♥	5	
		イラク		1			1				1	－	－	－	－	－	－	－	－	－	－	－	3	
		トルコ	1			1	1	1	1	1	2	－	－	＊1	1	1	1	1	1	2	▒	♥	18	
3	アフリカ	ガーナ								1	1	1	1	－	0	1	1	1	1	1	0	♥	9	
		ナイジェリア	1								－	－	－	－	－	－	－	－	－	－	－	－	1	
		タンザニア						1			－	－	－	－	－	－	－	－	－	－	－	－	1	
		ウガンダ									－	－	－	－	－	－	1	－	－	－	－	－	1	
		ジンバブエ									－	0	0	0	0	－	－	－	－	－	－	－	0	
		アルジェリア									0	－	－	－	－	－	－	－	－	－	－	－	0	
4	中南米	ブラジル		1	3	2					－	－	－	－	1	1	1	0	1	▒	＊1	♥	11	
		コロンビア				1	1	1			－	－	－	－	－	－	－	－	－	－	－	－	3	
		メキシコ	2								0	0	0	0	－	－	－	－	－	－	＊－	♥	2	
		ペルー					1		1	1	1	1	1	－	0	1	0	0	[1]	－	1	－	8[1]	
		ベネズエラ						1			－	－	－	0	－	－	－	－	－	－	－	－	1	
		ジャマイカ									－	0	－	－	－	－	－	－	－	－	－	－	0	
合計			10	9	8	9	10	9	8	[1]10	10	[1]10	11	[1]6	6	8	9	8	[1]7	8	8		[3][1]164	

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① 星徹美団長（総括）担当分

a）「通商産業省の組織」と「窯業建材課の役割」について

日本における「窯業全般の現状と今後の施策」、「日本の海外技術協力」について説明する前に、日本の「通商産業省」とはどういった組織なのか、その中での「窯業建材課」ではどのような分野を担当しているのかを紹介することとする。

「通商産業省」は組織的に大きく分類すると「通商」分野と「産業」分野に分けることができる。通商分野には２つの局があり、約６００人の職員が海外貿易、国際問題、技術援助等を担当している。産業分野には５つの局があり、この分野は更に大きく２つに分類することができる。１つは産業全体をウオッチする分野であって、２つの局がある。その１つは産業全体の政策、例えば、資金、物価、流通等を担当する産業政策局、もう１つは公害・地球環境、立地政策、工業用水、保安等を担当する立地公害局である。この２つの局は合計約４００名の職員により構成されている。もう１つの分野は、直接物資を所管する３つの局であり、１つは鉄等の金属、化学製品、アルコール等を担当する基礎産業局、それと機械、電子・電気製品、自動車、航空機、情報等を担当する機械情報産業局、もう１つは「窯業建材課」が所属している生活産業局である。この生活産業局の担当する物資は主に、繊維、紙、日用品、窯業、住宅等である。直接物資を担当するこれら３つの局は合計約５５０名の職員で構成されている。

その他、約８００名の職員で構成される「大臣官房」を含めた以上の局が、本省と呼ばれる組織であり、その職員数は合計２，２８５名である。

通商産業省の組織はこの他に、エネルギーを担当する「資源エネルギー庁」が約６００名、特許・意匠権等を担当する「特許庁」が約２，４００名、新技術や研究の開発、標準化等を担当する「工業技術院」が試験・研究所を含めて約３，５００名、輸出する物資や新製品等の安全性を確認するための検査所が約５５０名、地方の局や支所が約２，７００名で総合計約１２，３００名が所属している。

セラミックスの分野を担当する窯業建材課は、①課の総合調整のための総括班、②セメント製品・砂利等の骨材を担当するセメント・骨材班、③サッシ・ドア・ボード等を担当する建材班、④そして窯業班で構成されている。窯業の中でもファインセラミックスについては窯業建材課の中のファインセラミックス室で担当している。窯業班はガラス係と工業用窯業製品係で構成されており、ガラス係は板・ブロックの他に、建築用ガラス製品、

光学・石英ガラス、ガラス繊維等を所管している。一方、工業用窯業製品係では電極・ピッチコークス・炭素繊維等の炭素製品、研削材・砥石等の研削・研磨製品、そして耐火物を主に所管している。

前述したとおり、通商産業省の組織は大きく２つに分類することができるが、業務についても同様である。１つは産業の振興であり、もう１つは通商・貿易問題を含めた流通問題である。業界の一層の発展のためには、産業の育成策は欠くことのできない施策であるといえる。日本の業界は殆どの業種が９割以上の中小企業によって支えられており、これらの中小企業は、自社のブランドで独自の製品を生産、販売しているものも一部あるものの、その殆どは大手企業からの発注を受けて、部品の製造、仕上げ加工等の作業を行っているのが現状である。

通商産業省ではこれらの中小企業のために、税制面、投資、雇用、事業転換等に対しての援助を行っている。また、地方公共団体においても、それぞれの自治体の事情に見合った方策により援助を行っている。これらの援助を受けるのには一定の基準が必要であり、担当者はその審査や、援助を決定する相手方（中小企業の施策については中小企業庁）との交渉を行う。また、公害問題への対応のようなことも業務の一つである。例えば、大気汚染等の防止基準を改定するときには、当該業種にとってその基準が妥当かどうかを検討することも大切な業務である。仮に、現在の防止基準を上回っている企業があったときには、それをどの様にして解決するか等様々な業務がある。このような業務の相手方は、前述の「立地公害局」や「総理府・環境庁」であるが、現在の窯業関係の分野では、このような問題は発生していない。

通商産業省が行う企業への援助については、新技術の開発のための税制優遇措置、研究開発費の補助、国と民間企業との共同研究等がある。特に近年においては、地球に優しい技術開発、貴重な環境・資源の有効利用といった内容が注目されている。それは、次の世代のために現在何をすべきかが、真剣に考えられているからである。そのため、現在の理便性だけを求めた生活が過剰にならないよう、資源のリサイクル、まだ使われていない資源の利用の可能性等様々な事項が調査、研究されている。

b）日本における「窯業全般の現状と今後の施策」について

日本の窯業にも様々な業界があるが、その殆どの業界は生産、出荷ともに減少傾向が続いている。

その理由として、全般的には２つの原因が考えられる。１つ目は、今までが鉄鋼産業に頼りすぎていたこと、２つ目は、どの業種でも良質すぎる製品を造ってしまったことである。

耐火物については鉄鋼向けの出荷が全体の約７０％を占めており、人造黒鉛電極に至っては、鉄鋼の電気炉用向けの出荷が９９％以上を占めているのが現状である。この例は、日本の窯業業界が、鉄鋼の好不況の影響を直接受ける業界であることを証明している。

また、鉄鋼もその性格上、自国の経済全体の影響を直接受ける産業であるということができる。それは、「鉄」が「道路」や「橋」といった公共事業、「ビル建設」や「自動車産業」などには欠くことのできない製品であるからである。因みに我が国の粗鋼生産量の推移と耐火物の出荷数量の推移を比較してみると、対前年比の伸び率が非常に似ていることが確認できる。（資料１：鉄鋼生産統計、資料２：耐火物出荷数量）

日本の粗鋼生産量は、毎年多少の増減はあるものの、概ね１億トンのレベルで推移しており、対前年の伸び率を見ても特別に大きな変動は見られない。これを、輸出比率が５％程度で、国内の鉄鋼メーカーへの出荷が７０％を占めている耐火物の出荷数量の伸び率と比較してみると、対前年比の伸び率が非常に似ていることが確認できる。

当然のことながら、耐火物の種類によって毎年の変動には差が見られるが、粗鋼生産の技術力向上に伴い最もノーマルな粘土質耐火煉瓦の減少が最も激しいことが確認できる。

耐火物の歴史は、鉄鋼の生産技術の向上とともに刻まれている、といっても過言ではなく、耐火物の種類により消長がある。過去に大量に生産された「けい石煉瓦」や「ドロマイト煉瓦」は年々需要が減少しており、今日では、「マグネシアカーボン煉瓦」や「アルミナカーボン煉瓦」が脚光を浴びている。また、不定形耐火物の生産量については、２０年程前には全体の生産量の２０％未満であったものの、現在では５０％近くを占めるにまで至っている。不定形耐火物のシェア拡大は、ユーザーの操業状態を考えれば当然のことといえる。施行が楽であり、必ずしも冷修の必要はなく、更に比較的価格的にも安価な不定形に人気が集中しているのが現状である。しかしながら、耐火煉瓦が全て不定形耐火物

に転換できるものではない。炉内部での耐火物の使用位置、炉内部の温度の分散等を考えれば、煉瓦は必ず必要とされる製品である。

次に生産量が減少している２つ目の理由について述べる。

昨年までの数年間の国内景気は、鉄鋼産業をはじめとして好調であったため、耐火物産業も順調な歩みを続けてきたが、そのような好調な中にあってもその生産量は１０年前と比較すると当時の７０％、最盛時（１９７０年）の４８％にまで落ち込んでいるのが現状である。

これは、耐火物の品質が年々向上したこと、新製品の開発等により製品寿命が長くなったこと、製鉄技術の革新・操炉方法の改善により耐火物の使用量が少なくてすむようになったためである。従って、当然のことながら鉄鋼向けの耐火物の需要は減少し、１０年前と比較すると、粗鋼生産１トン当たりに要する耐火煉瓦の必要量は、４０％も減少しているのが現状である。

通常であれば、製品の高品質化や新製品の開発といった努力は、買換え需要に繋がり、収益状況は改善するのが一般的であるが、日本の耐火物業界と鉄鋼業界の現状では、お互いの力関係、耐火物業界内部での過当競争等により、製品の値上げや新製品に対する高価格の設定は困難な状況にある。

このような状況下、通商産業省としては、更に高品質なものを開発するための援助、新規用途（ユーザー）開発のための調査等を行っている。

耐火物の分野とは異なるが、炭素製品における通商産業省と民間企業との共同研究について一例を挙げることとする。共同研究全体のテーマは１０個程度あるが、その中の１つとして９１年３月までの３年間に実施した研究である。

耐火物の場合には一般的には１，５００℃以上での耐熱性が要求されているが、炭素製品の本研究では、３，０００℃を目標値に設定した。炭素材料は、２，０００℃以上３，０００℃の超高温領域でも使用されているものの、２，０００℃以上での物性、挙動といった既存のデータ・研究がないため、本研究で高温物性を調査することを目標とした。

超高温領域における電気的、力学的そして熱的特性の測定のための装置は、本研究により開発されたものである。物性に関する評価方法の研究は現在もなお継続中であるが、この評価方法が確立された時には、ロケット、航空機、原子炉そして核融合炉等への信頼性の評価が可能になると考えられている。

c）日本としての海外技術協力について

日本においては技術協力の一環として、海外諸国の経済・社会開発の担い手となる人材の養成のための研修生などの受入れや専門家の派遣等を実施している。また、経済・社会開発計画の策定や開発プロジェクトの実施に関する調査の実施等の多様な協力を積極的に推進し、海外諸国の経済発展に寄与している。

日本の技術協力の形態を分類すると、①技術協力、②研究協力、③教育協力に大別することができる。２国間の技術協力については、従来から政府ベースと民間ベースの２本立てで実施されている。政府ベースにおいては、ＪＩＣＡを中心として海外諸国からの公的な要請に基づく協力事業を実施している。一方、民間団体の活動による技術協力事業については、政府としても補助金の交付などにより、その活動の振興を図っているところである。また、拠出金等による国際機関を通じる技術協力についても、積極的に実施しているところである。

１．政府ベースの技術協力のひとつには、

(1) 開発調査協力事業がある。これは大綱的な国家や地域全体の開発計画を策定するための、①総合開発計画調査事業と②開発調査事業に分類される。

開発調査事業とは、公共的な開発計画に関して、その開発計画の推進に寄与する報告書や実施設計書を作成する事業である。２つ目にあげられるのが、

(2) 単独技術協力事業である。これは、①研修生の受入事業、②専門化の派遣事業、③機材の供与事業が対象となっている。３つ目にあげられるのが、

(3) 複合技術協力事業である。この事業の１つには、技術協力センター、産業開発、農林水産業、保健医療・人口家族計画等の分野において、「専門家の派遣」「研修生の受入」「機材の供与」の３つの方式を有機的に組み合わせ、４～５年計画で実施される①プロジェクト方式技術協力事業がある。また、開発に必要な資金を、日本輸出入銀行と海外経済協力基金から融資するとともに、併せて技術を提供することを目的としている②開発協力事業もこの事業の１つである。

２．民間ベースの技術協力は、(1)調査協力事業と(2)単独協力事業、(3)センター協力事業から構成されている。

(1) 調査協力事業については、①海外中小企業技術協力事業と②海外コンサルティング

活動振興事業に分類することができる。

①海外中小企業技術協力事業とは、中小規模の工場の建設と既存の中小規模の工場のリハビリテーションに関してのフィージビリティー調査から、工場の実施計画、工場建設、そして運営に関する技術指導に至るまでの一貫した技術協力を行うものであり、②海外コンサルティング活動振興事業とは、経済開発に有効なプロジェクトの発掘、形成等の促進を図ることを目的とするものである。

(2) 単独協力事業は、政府ベースの「単独技術協力事業」と同様に、①研修生の受入、②専門家の派遣を行うものである。

(3) センター協力事業は、セミナーの開催、技術訓練・指導、文献資料等の翻訳・頒布、図書の貸出等を行うための海外協力センターを設立し、運営するものである。

3．以上の技術協力のほかに、我が国の協力事業としては、研究協力事業、教育協力事業がある。

(1) 研究協力事業においては、共同研究の実施、研究者の交流、国際シンポジウムの開催、研究開発の実態やニーズの調査、情報の提供等が行われている。

研究協力事業の種類は様々であり、研究テーマに関してだけ見てもその数は色々な分野において、１９８９年ベースのプロジェクト数で３６の研究が実施されている。

(2) 教育協力事業では、①留学生の受入れ、②外国人に対する日本語教育、③教育指導者の招へいなどが行われている。

以上のとおり、日本からの海外諸国への技術協力には様々な方策があるものの、その実績がどの程度になっているかを以下に列記する。

日本における技術協力を形態別の構成で見ると、留学生の受入れが１億３５百万ドルで、これは、技術協力の総額に対し９．６％を占めている。研修生の受入れに関しては、２億３百万ドル・同１４．４％、専門家の派遣が２億２２百万ドル・同１５．８％、青年海外協力隊員の派遣が５８百万ドル・同４．１％になっている。具体的数字は、資料の「我が国技術協力の現状」を参照されたい。

また、その他に資料として、日本の「主な受入機関別・年度別研修生受入実績」と「派遣機関別・年度別専門家派遣実績」を添付したので、参考にされたい。

皆さんのご協力に感謝申し上げます。　ありがとうございました。

Annex 1

Steel Production Statistic

(unit : ton)

	crude steel						brick shipment	monolithic refractory shipment
Term	total	comparison with the previous year	open hearth furnace steel	converter steel	electric arc furnace steel	proportion of electric arc furnace steel	comparison with previous year	comparison with previous year
1975	101,613,094	89.1%	885,264	83,481,440	17,246,390	17.0	77.9	93.8
76	108,326,392	106.6%	504,024	87,550,196	20,272,172	18.7	97.2	103.6
77	100,646,112	92.9%	249,084	80,580,900	19,816,128	19.7	87.6	93.0
78	105,059,335	104.4%	0	81,606,038	23,453,297	22.3	100.9	98.7
79	113,010,326	107.6%	0	85,691,176	27,319,150	24.2	102.2	103.9
80	107,385,644	95.0%	0	81,223,024	26,162,620	24.4	100.2	103.7
81	103,028,857	95.9%	0	77,395,416	25,633,441	24.9	93.0	99.1
82	96,298,758	93.5%	0	69,774,082	26,524,676	27.5	83.7	96.3
83	100,200,452	104.1%	0	71,896,678	28,303,774	28.2	93.5	103.0
84	106,470,137	106.3%	0	76,873,135	29,597,002	27.8	99.9	102.3
85	103,757,664	97.5%	0	73,367,696	30,389,968	29.3	98.3	100.6
86	96,378,912	92.9%	0	67,511,116	28,867,796	30.0	90.6	91.4
87	101,877,188	105.7%	0	71,890,718	29,986,470	29.4	91.6	96.1
88	105,656,003	103.7%	0	73,970,479	31,685,524	30.0	106.0	107.0
89	108,138,923	102.4%	0	74,810,422	33,328,501	30.8	102.2	103.5
90	111,709,678	103.3%	0	76,374,080	35,335,598	31.6	100.5	102.3
90.4	9,126,320	100.5%	0	6,152,191	2,974,129	32.6		
5	9,335,267	101.6%	0	6,369,799	2,965,468	31.8		
6	8,980,196	100.1%	0	5,980,041	3,000,155	33.4		
7	9,188,898	100.0%	0	6,426,401	2,762,497	30.1		
8	9,156,606	104.4%	0	6,582,507	2,574,099	28.1		
9	9,076,902	104.2%	0	6,186,936	2,889,966	31.8		
10	9,822,160	104.1%	0	6,718,731	3,103,429	31.6		
11	9,393,729	105.2%	0	6,365,219	3,028,510	32.2		
12	9,642,916	104.3%	0	6,567,001	3,075,915	31.9		
91.1	9,532,797	103.9%	0	6,669,515	2,863,282	30.0		
2	8,839,448	106.8%	0	5,926,399	2,913,049	33.0		
3	9,614,439	104.9%	0	6,429,340	3,185,099	33.1		
91.4	9,499,613	104.1%	0	6,358,802	3,140,811	33.1		
5	9,635,092	103.2%	0	6,504,354	3,130,738	32.5		
6	9,345,373	104.1%	0	6,211,830	3,133,543	33.5		
7	9,237,474	100.5%	0	6,454,664	2,782,810	30.1		
8	9,015,999	98.5%	0	6,442,743	2,573,256	28.5		
9	8,894,268	98.0%	0	6,125,961	2,768,307	31.1		
10	9,244,064	94.1%	0	6,419,963	2,824,101	30.6		
11	8,469,749	90.2%	0	5,825,836	2,643,913	31.2		

statistic by the industry ⇧

⇩ statistic by MITI

Refractory·Shipping Amount

Annex 2

(unit : ton)

	grand total	total of brick	share of brick	clay	high almina	basic	carbon graphite	silicon carbide	refractory insulator	zircon	others
1983	2,103,941	1,223,462	58.2	508,900	150,401	256,570	43,317	52,087	35,092	96,108	80,987
84	2,101,143	1,200,327	57.1	477,136	164,589	267,193	49,830	49,213	37,486	106,403	48,477
85	2,066,076	1,160,296	56.2	449,708	161,019	253,747	55,241	44,857	36,817	109,960	48,947
86	1,872,265	1,044,079	55.8	391,084	149,670	232,320	46,800	36,577	32,923	96,033	58,672
87	1,715,606	919,896	53.6	337,066	139,535	218,580	47,694	31,580	25,291	83,624	36,526
88	1,817,842	966,606	53.2	350,536	155,197	220,917	54,186	32,792	35,167	79,114	38,697
89	1,857,422	976,760	52.6	337,524	167,904	270,917	26,600	29,448	34,236	66,163	44,688
90	1,866,738	965,953	51.7	341,503	160,008	275,619	25,230	29,411	34,192	55,885	44,105
91	?	?	?	?	?	?	?	?	?	?	?
91.1	143,479	73,998	51.6	26,815	12,208	21,938	1,670	2,143	2,262	3,810	3,152
2	146,123	75,736	51.8	28,055	12,060	22,058	1,782	1,991	2,141	4,036	3,613
3	156,836	82,891	52.9	28,024	13,458	25,708	2,008	1,944	2,533	4,837	4,379
4	160,997	82,849	51.5	28,908	14,850	23,727	2,907	2,199	2,835	4,136	3,287
5	152,075	78,763	51.8	26,869	13,313	24,133	2,047	2,198	2,318	4,816	3,069
6	148,602	76,419	51.4	27,715	13,868	21,196	1,972	2,132	2,502	3,639	3,395
7	152,874	76,991	50.4	26,073	12,908	24,767	2,225	2,852	1,926	3,663	2,577
8	156,262	78,538	50.3	25,561	13,500	25,849	1,993	2,719	1,947	3,952	3,017
9	152,116	80,527	52.9	27,477	13,782	24,921	2,263	2,490	1,724	3,628	4,242
10	146,740	72,323	49.3	27,274	13,133	19,425	1,711	2,524	1,648	3,727	2,881
11	153,729	76,397	49.7	25,223	14,512	23,261	1,744	2,547	1,294	4,745	3,071
12	?	?	?								

	total of monolithic refractory	share of monolithic refractory	refractory mortar	castable	plastic	sprayed material	others
1983	880,479	41.8	113,141	322,075	70,571	0	374,692
84	900,816	42.9	121,725	324,828	93,625	0	360,638
85	905,780	43.8	115,961	339,640	92,700	0	357,479
86	828,186	44.2	95,805	332,294	55,745	0	344,342
87	795,710	46.4	81,434	324,112	51,758	0	338,400
88	851,236	46.8	85,465	338,829	52,226	0	374,716
89	880,662	47.4	88,015	357,493	54,664	194,638	185,852
90	900,785	48.3	83,125	373,171	56,035	199,401	189,053
91	?	?	?	?	?	?	?
91.1	69,481	48.4	6,471	27,398	3,909	16,389	15,314
2	70,387	48.2	6,315	28,329	4,026	16,450	15,267
3	73,945	47.1	6,692	29,319	4,601	17,258	16,077
4	78,148	48.5	7,299	32,237	4,308	16,989	17,315
5	73,312	48.2	6,438	29,212	4,591	17,540	15,531
6	72,183	48.6	6,530	29,261	4,957	15,434	16,001
7	75,883	49.6	6,666	30,936	4,768	16,538	16,975
8	77,724	49.7	6,483	30,025	4,751	16,784	19,681
9	71,589	47.1	6,288	30,858	4,205	14,822	15,416
10	74,417	50.7	6,439	31,100	4,678	15,754	16,446
11	77,332	50.3	6,029	32,448	4,597	17,485	16,773
12	?	?					

Situation of Technical Cooperation in Japan

(unit : million $)

	1985	1986	1987	1988	1989
1. Reception of students from abroad & trainees	118.34	193.63	246.52	339.32	337.99
Students from abroad	35.69	59.78	79.67	137.69	135.25
Trainees	82.64	133.85	166.86	201.62	202.74
2. Dispatch of experts & JOCV members	215.70	313.16	381.38	483.33	279.53
Experts	96.16	132.24	334.10	431.99	221.91
JOCV members	23.02	35.40	47.28	51.45	57.62
3. Others	214.62	341.91	439.14	535.74	787.77
Total of Technical Cooperation (A)	548.66	848.70	1,067.04	1,358.50	1,405.29
Official Development Assistance (B)	3,796.8	5,634.42	7,454.44	9,133.68	8,964.89
Percentage of technical cooperation (A)/(B)	14.5%	15.1%	14.3%	14.9%	15.7%

(NOTE 1) Experts here don't include survey teams.

(NOTE 2) Total of technical cooperation include administrative expenditure.

Trainees Receiving Record by Main Organizations & by year

(unit : person)

1954	JICA (OTCA)	APO	UNIDO	total of the government	AOTS	OISCA	ILO	others	grand total
～78	31,940	2,936	179	35,055	15,796	1,133	798	335	53,117
79	3,124	292	18	3,434	1,730	130	163	69	5,526
80	3,393	340	22	3,755	1,660	164	139	76	5,794
81	3,772	354	36	4,162	1,751	143	134	81	6,271
82	3,858	376	26	4,260	1,932	147	182	86	6,607
83	4,363	423	45	4,831	2,222	152	146	83	7,434
84	5,165	413	23	5,601	2,284	169	179	84	8,317
85	5,549	432	21	6,002	2,420	191	188	114	8,915
86	6,015	437	24	6,475	2,499	156	248	137	9,515
87	6,515	374	15	6,904	2,674	134	232	130	10,074
88	6,833	509	21	7,345	2,740	202	192	137	10,616
89	7,632	456	22	8,110	2,907	210	246	129	11,602
total	88,159	7,342	452	95,953	40,615	3,192	2,846	1,146	143,788

(NOTES)
1. The column JICA (OTCA) means receiving by "Japan International Cooperation Agency" (former "Overseas Technical Cooperation Agency")
2. The column APO means an entrusted receiving which Japanese Government asked"Japan Productivity Center" and "The Association for Overseas Technical Scholarship" as a part of Productivity Improvement Activity of "Asian Productivity Organization".
3. The column UNIDO means receiving asked by the government and accepted by "the Association for Overseas Technical Scholarship" and "International Development Center of Japan" based on the government's expenditure.
4. AOTS stands for "the Association for Overseas Technical Scholarship"
5. OISCA is "OISCA International Development Body".
6. ILO means "Japan International Labor Organization", "Tokyo Branch of ILO".
7. The column others means receiving by OFCF (Overseas Fishery Cooperation Foundation), ACCU (UNESCO･Asia Cultural Center) and IA (International Association).

Annex 5

Expert Dispatch Record by Main Organizations & by year

(unit : person)

	JICA			APO	total of governmental dispatch	JODC. The Chamber of Commerce & Industry. World Management Conference	OISCA	total
	dispatch of experts	dispatch of survey team	Japan Overseas Cooperation Volunteers					
1952 ~77	7,134 (4,651)	10,604	2,459	395	20,592	307	508	21,407
78	949 (421)	2,562	303	20	3,834	26	61	3,921
79	994 (437)	2,762	348	23	4,127	92	52	4,271
80	1,543 (701)	3,349	410	18	5,320	90	55	5,465
81	1,681 (797)	4,168	442	19	6,310	128	21	6,459
82	1,470 (584)	4,454	441	21	6,386	96	19	6,501
83	1,578 (645)	4,914	521	13	7,026	111	25	7,162
84	1,774 (790)	5,189	677	19	7,659	89	19	7,767
85	1,732 (708)	5,179	825	22	7,758	91	30	7,879
86	1,979 (775)	5,796	822	19	8,616	83	16	8,715
87	2,274 (960)	6,269	841	19	9,403	113	37	9,553
88	2,444 (1,063)	6,604	889	28	9,863	192	75	10,130
89	2,512 (1,070)	6,811	873	26	10,222	178	92	10,492
total	28,064(13,602)	68,661	9,851	642	107,218	1,596	1,453	110,267

(NOTES) 1. The column JICA (OTCA) means the number of dispatched experts by "Japan International Cooperation Agency" (former "Overseas Technical Cooperation Agency"). Dispatch of experts include project experts for project-type technical cooperation, and the number of individual experts dispatched by JICA'S Expert Assignment Department is shown in the parentheses. (The numbers in the parenthese are individual experts, which are included in the numbers of dispatched experts.)

2. The colunm APO means the entrusted dispatch by the government to "the Japan Productivity Centre" as a part of Asia Procductivity Improvement Activity.

3. The column JODC, "Japan Overseas Development Cooperation", means dispatched experts by JODC, "the Chamber of Commerce and Industry in Japan" and "World Managemant Conference".

4. The column OISCA means expert dispatch by "OISCA International Development Body".

② 鍋田恒之団員（技術指導）担当分

Present and Future of Refractory Industry in Japan

Mino Yogyo Co., Ltd.

Tsuneyuki Nabeta

1. Preface

In Japan, many industries have steadily increased their output in accordance with economical and technical progress of the society. However, in the refractory industry, the output has been decreasing year by year since the peak of 3,596,000t (refractory brick 2,687,000t, monolithic refractories 909,000t) in 1973 (herein under shown as fiscal year). In 1990, it is reduced to 1,767,000t (refractory brick 932,000t, monolithic refractories 836,000t), about 49% of 1973's output. But strikingly enough,' the output of refractory brick reduced to 26%, about a quarter while monolithic refractories reduced to about 92%. The proportion of output decrease of monolithic refractories is small, and decrease is concentrated on refractory bricks.

With the transition of output of crude steel by steel industry which is a main consumer of refractories, the peak was 120,017,000t in 1973, and their outputs have been relatively constant at about 100,000,000t with a little rise and fall. Unit consumption of refractories per crude steel ton which were used for steel making is 21.6 kg/crude steel ton (refractory brick 16.2kg, monolithic refractories 5.4 kg) in 1973 while 11.5kg/crude steel ton (refractory brick 5.5 kg, ,monolithic refractories 6.0 kg) in 1990. These figures show the change of total production of refractories as it is. Therefore, it can be said that the reduction of the output of refractories is greatly influenced by decrease of unit consumption of refractories in steel making industry.

There are many changes in the production process in steel industry : increase of continuous casting ratio and compound secondary smelting ratio, change of blowing method in steel converter, etc. Such technical innovation was made possible by refractory makers' effort to develop good quality refracatories which were suitable for various operation conditions. Development of refractory bricks including carbon (magnesia-carbon & alumina-carbon bricks) is an example in the field of refracatory bricks. While in the field of monolithic refractories, the share of castables is 45 %. This would be because unit consumption of refractories in steel industry was reduced by the development of so-called low cement castable and practical use of monolithic refractories for repairing.

Sale's shares of refractory by industries in Japan are as follows. Refractory bricks in 1990 : about 65 % (67.7 % in 1973) by steel making industry which is the biggest user, about 7 % (5.1 % in 1973) by cement & limestone industry, 5.7 % (6.8 %) for export, 4.9 % (1.9 %) by glass industry and 4.0 % (4.2 %) by ceramic industry. Monolithic refractories in 1990 : 76 % (72.9 % in 1973) by steel making industry, 4.4 % (6.2 %) by machinery industry, 4.4 % (1.3 %) by incenerator, 3.1 % (2.6 %) by ceramic industry. The percentage of monolithic refractories for steel industry is bigger than that of refractory bricks.

2. Situation of the Use of Refractories

2.1. Steel making

As mentioned before, about 70 % of demand for refractories in Japan is from steel making industry. Large scale steel making companies usually have affiliated refractory companies , and keep good communication each other so that they could develop the optimum refractory for their production. The results of their research were reported in "TAIKABUTSU OVERSEAS" and at the international conferences on refractories. Here I'd like to make a report about situation of the use of refractories for main production facilities.

1) Refractory materials for blast furnace

i) Refractories for furnace bottom

Fireclay brick, high alumina brick and carbon brick are used for this. These have good durability. Carbon block is now under consideration, and addition of alumina and Si into a matrix part is drawing attention, as reported.

ii) Refractories for furnace walls

Chamotte bricks are used at upper parts and castable gunning is applied for reqairing. The middle, lower parts and bosh parts are non-oxide SiC, and SiC-C bricks of cooling plate type.

iii) Refractories for tuyer ,

At first it was chamotte, and changed into sillimanite, and into SiC. Beta-SiC binding, silicon nitride bond, sialon bond and so on are used at present.

iv) Refractories for iron notch

Chamotte, sillimanite were used before, and Al_2O_3-SiC-C bricks are used now.

2) Refractories for coke oven

Silica bricks are used, but the production of silica bricks is rather difficult in Japan due to labour shortage. Therefore hot repairing by flame gunning is carried out.

3) Refractories for hot metal pretreatment

Al_2O_3-SiC-C bricks are mainly used, and monolithic refractories are used for repair works at slag lines, impact parts, and periphery area of oxygen lance to compensate temperature.

4) Bricks for converter

Burned magnesia dolomite bricks impregnated with tar, and then magnesia carbon brick was used. Quality of raw materials of this, adding technique of metal powder were improved, and adjustability of refining technique was enlarged very much.

5) Refractories for electric arc furnace

New techniques like direct current electric arc furnace, eccentric bottom tapping, furnace bottom bubbling, etc. are applied and consumption amount of refractories is decreasing. Refractory materials magnesia carbon brick, bubbling brick for furnace bottom, precast block for center ceiling etc. are used.

6) Refractories for ladle and secondary refining

Secondary refining is applied for ordinary ladles in many cases. And application of monolithic refractories instead of ladle bricks is often proceeded to reduce practical problem. Zircon or alumina-spinel material which is strong against severe operating conditions are widely used because of their durable length of time.

The typical brick linings for ladle of LF(Ladle Furnace) are magnesia carbon for slag line, alumina, silicon carbide, and carbon for ordinary walls, and zircon or high alumina for bottom.

Direct bonded magnesia chrom bricks are used for vacuum treatment in RH furnace, and magnesia carbon bricks are used for severly damaged part of lower wall and bottom positions.

2.2. Refractory for cement industry

The author describes the following reports in separate sheets.

1) Refractory trends for cement industry in Japan (Annex A.)

2) Plugging reduction by the use of silicon carbide refracatories in cement kiln preheater (Annex B.)

3. Monolithic Refractory Trend

The share of monolithic refractories is getting bigger in refractory demand, and I describe the outline of castable refractory which is main in its kind. Production of refractory brick has been decreasing since the peak in 1973. However production of monolithic refractories is constant, especially production of castables is distinctive. The percentage increased to 45.4 % (1990) from 35 % (1980), which was 118.8 %, about 20 % more in quantity. Looking back the history, Japan became one of the biggest producing countries in 30 years since it had regularly started industrial production in 1953. This was achieved because steel production expanded during high economic growth and castables was fit for the tendency of rationalization of production process after the oil crises. The quality was improved by newly born technologies such as gel bonding by using sodium silicate and clay bonded castables, low cement castables, etc., and by high grade combination techniques practically accumulated.

4. Vision to the Future

While the total output of refractory brick is decreasing, production of complex refractories such as magnesia carbon and alumina carbon bricks increased with the help of quality improvement of organic binder like resin. From now on also main components will be the same oxide and non-oxide as before, however the research will be proceeded focused on complex types though that production quantity can't be expected to increase. Importance will be attached on the unit consumption of refractories, and the products will be two kinds : high qaulity with high cost, and ordinary quality with low cost. Therefore the high quality refractory which satisfactorily performs by unit consumption would need to be developed even if it is high price. On the other hand, it is presumed that monolithic refractories will be used more because of good energy and labour saving ability in production process and the technique of mechanized hot repairing at lining. Meanwhile precast block of castables was studied more about enlargement and ququk & easy installation, and it is replaced for refractory bricks as one of the countermeasures for labour shortage and senility problem. As a whole, demand for monolithic refractories will be bigger, and the more severe research and development about the production technique will be required to meet the demand for the products which are produced under the highest and the most accurate production control and suitable for the service conditions.

Refractory Trends for Cement Industry in Japan

1. Introduction

The first cement production in Japan was launched in 1875. Since then the amount of production has increased to cope with the demand of the industries. At present there are 21 companies with 42 factories operating and improvement of the technology and capacity of the cement production facilities has been remarkably achieved.

To keep abreast of the development of the cement industry, refractory manufacturing technology has been improved to contribute to the cement production in satisfactory performances.

In this report, refractory trends and recent topics on the refractories for the cement industry are described.

2. Trends of Refractories

Refractories are used for preheater, rotary kiln, hood and cooler, however, in this report discussion is focussed on refractories for the rotary kiln due to severe service condition and large consumption of the refractories.

Magnesia-chrome bricks, magnesia-spinel bricks, high alumina bricks, insulating and fireclay bricks, etc. have been used.

Among them, the basic bricks, first introduced to the cement kiln in 1952, has developed rapidly. Direct bonded magnesia chrome brick appeared in around 1963 and the super direct bonded in 1973.

Later, the start of magnesia spinel brick was done at the transition zone of two rotary kilns in 1975 with very good performance of 1.5 to 2.0 times durable than conventional magnesia chrome brick quality.[1) 2)] Since then, the demand of magnesia spinel brick has rapidly increased. Besides the basic refractories, hot face insulating bricks, developed in 1963, has been extended and tumbling bricks have recovered due to energy conservation. Fig.1 shows refractories trends with the change of cement manufacturing facilities. With the introduction of SP kiln in 1963 and invention of NSP kiln in 1971, nearly all cement clinker have been recently produced by NSP and SP kilns. The change in production facility caused the improvement of refractory quality.

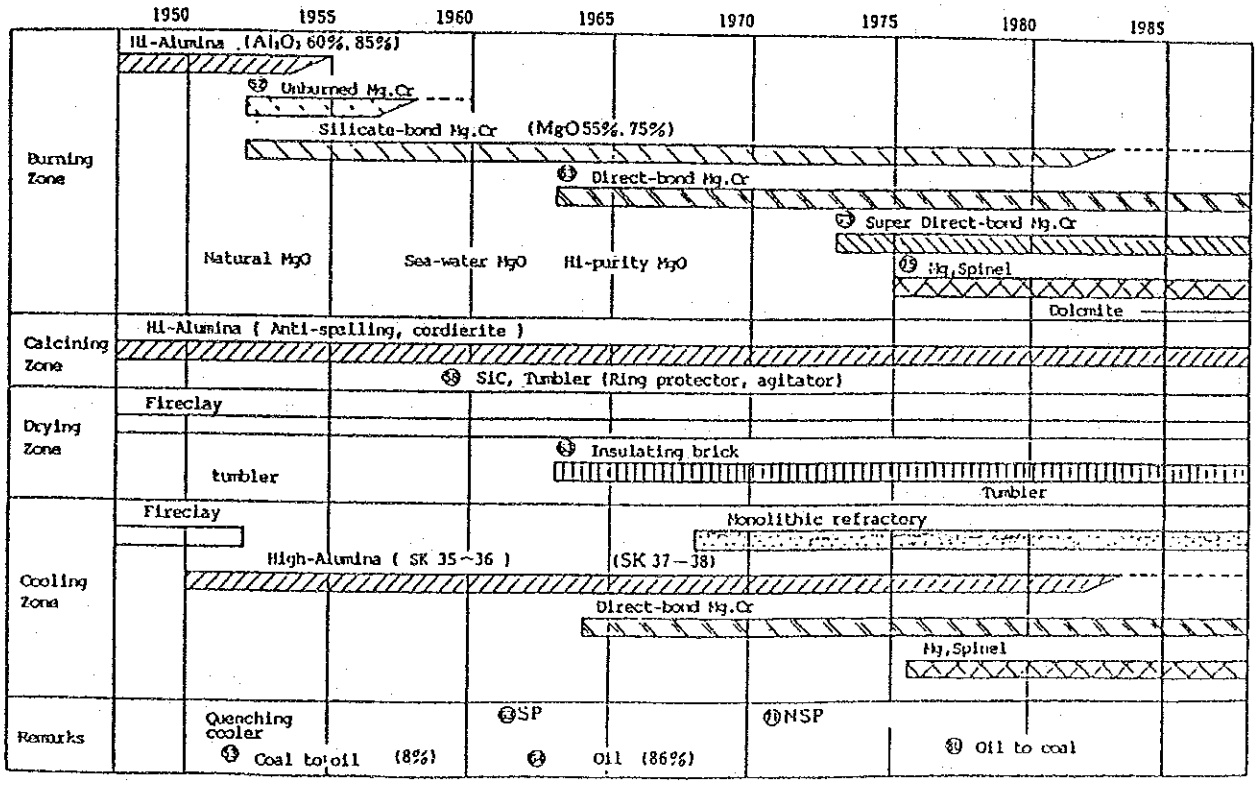

Fig.1 Refractory trends in Cement Kilns

3. Recent use condition of refractories

Investigation results of the refractory usage for SP and NSP kilns(NSP 60kilns; SP 17 kilns) by the cement manufacturing committee of the cement association are shown in Fig.2.[3)]

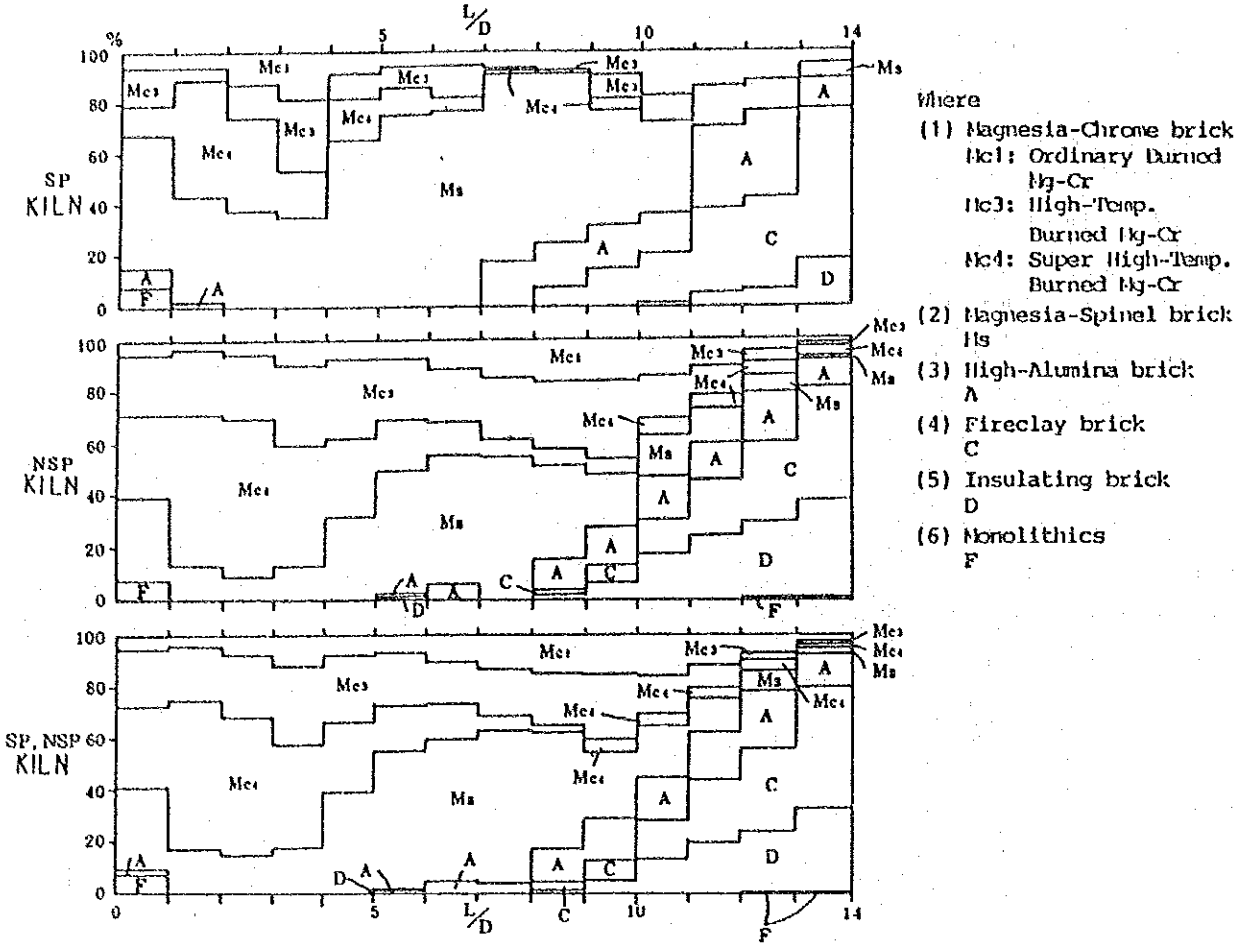

Fig.2 Refractory usage ratio by kiln section

From Fig.2,

(1) Cooling zone

Magnesia spinel bricks are used more than magnesia chrome bricks in SP kilns.

On the contrary magnesia chrome bricks are used more than magnesia spinel bricks in NSP kilns.

(2) Burning zone

Magnesia chrome bricks are more popular than magnesia spinel bricks.

(3) Coationg on-off zone

Magnesia spinel bricks are commonly used in this zone.

(4) High alumina bricks are used in the range of 1D between basic brick and fireclay brick.

(5) Calcining zone

Ratio of insulaling brick and fireclay brick is one to one.

4. Refractories in each zone

4.1 Cooling zone

Lining is exposed to the secondary air for cooling cement clinker, to abrasion by cement clinker and to mechanical stress by torsion of the kiln shell.

Lining is selected with the kiln operation condition.

Magnesia spinel brick is popular in NSP kiln and magnesia chrome brick in SP kiln.

4.2 Burning zone

Burning zone is the most severest to the lining in the rotary cement kiln. Magnesia chrome brick is commonly used in this zone and manesia spinel brick is used in some kilns.

In this zone, liquid phase occurs in the cement meal and it penetrates into the brick, reacting with brick and produces monticellite and forsterite. Magnesia chrome brick has been improved with high purity magnesia clinker and firing technology at high temperature.

This is observed in the process of improving direct bonding of magnesia chrome brick. Super direct-bonded brick in Fig.3 shows well developed spinel bonding between periclases.

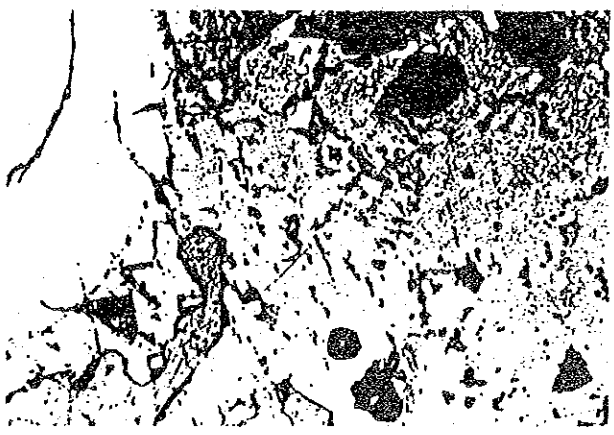

Fig.3 Super direct-bonded Magnesia-chrome brick

4.3 Coating on-off zone

In the transition zone, on and off development of cement material coating on the lining is observed very often. At the temperature of this zone, magnesia-spinel brick very commonly is used. Conversion of Fe oxide from divalent to trivalent state, with great volume changes, causes decomposition of the brick texture. For this reason, since 1977, magnesia-chrome brick has been replaced by magnesia spinel brick which contains very less iron oxide.

The disadvantage of magnesia spinel brick is its high thermal conductivity. Due to this shortcoming, kiln temperature in this area easily goes up permitting alkali penetration through the brick into the kiln shell and corroding it.

To keep the shell safe from corrosion, one of the remedies is to attach an insulating board on the cold face of the brick as shown in Fig.4, however, insulating effect is not satisfactory enough.

On the other hand, the effort to reduce thermal conductivity of the brick itself has been achieved by adding higher percentage of spinel to the brick compornent.

As the result of alkali migration to the magnesia spinel brick in the transition zone, the texture of the brick is often destroyed by the accompanying increase in expansion coefficient. For this reason, lower permeability and higher strength at high temperature of the brick are highly recommended.

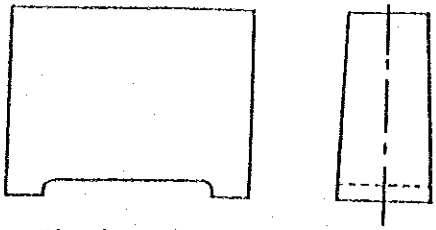

Fig.4 Basic brick with slit for insulating

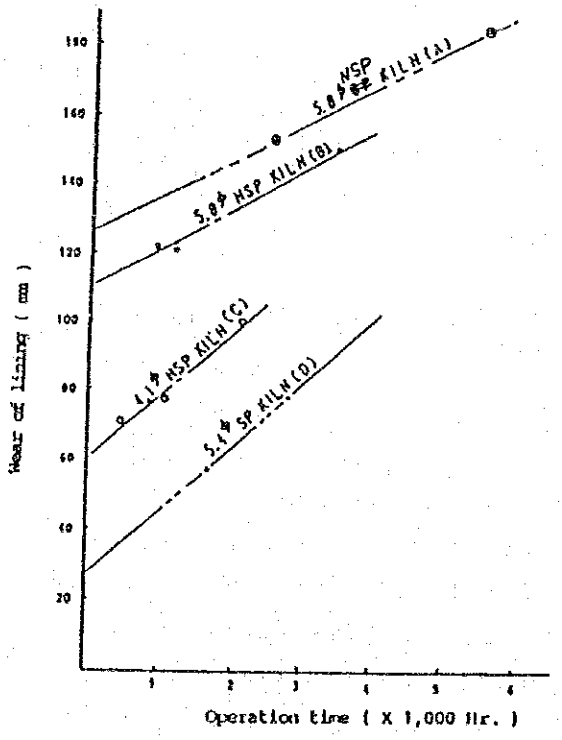

Fig.5 Relation between operation time and wear of lining in burning zone

4.4 Calcining zone

Kaliophillite and leucite produced by reaction between alkali and bricks such as high alumina, fireclay, and insulating bricks are commonly observed in the calcining zone. Cracks in the brick caused by alkali reaction are likewise observed. Recently, in addition to alkali penetration, reaction with lime has been recognized. By the circulation of sulphur in SP and NSP kiln, $CaSO_4$ deposit has been found in the brick lined in the calcining zone and it is considered that $CaSO_4$ together with alkali salts lower the melting point and react with the brick texture.

To solve the problems, the following two ways are taken.

1) Usage of alkali-resistant brick
2) Avoid alkali prenetration to the brick by making thin glassy layer by the reaction of alkali and brick

The latter way becomes recently ahead of the former in price and life of the bricks. To develop glass phase in the brick during service, SiO_2 rich bricks with low refractoriness like fireclay or insulating fireclay brick are suitable. Even the high alumina bricks with refractoriness of SK34 to 36 in the neighboring area of the basic lining zone are considered to have a characteristic resistance to alkali.

In this area, high alumina bricks are used for the following two reasons.

1) High refractoriness is required for high temperature condition
2) Large expansion of the shell due to heat conducted from the basic brick area which normally has high thermal conductivity. High alumina bricks are better fitted to the shell than fireclay bricks because high alumina bricks have larger thermal expansion. The well adaptation of high alumina bricks reduces strain of the brick.

5. Recent trials

5.1 Prevention against spalling at the time of heating up

The range from 1D to 3D of the burning zone in the rotary kiln with grate cooler is normally considered to be covered with stable coating, despite the slight difference in coating thickness due to operational condition.

Stabilized coating is one of the most important conditions to get better performance of the linings. In zones 1D to 2D, the life of lining is comparatively short, while at zones 2D to 3D lining life is longer.

Even both areas, 1D to 2D and 2D to 3D, belong to the stable coating zone, the reason why there is some difference in coating thickness lies on their difference in exposure to direct flame during heat up process. Fig.5 shows the relation between wear amount and operation hour in one campaign of the lining without shutdown. When two points which mean two differnt campaigns in the same kiln are connected by a straight line, the line does not meet zero in wear amount at the beginning of operation.

At the three kilns in Fig.5, 30 to 50mm in wear amount at zero hour are observed.

5.2 Wear of the steel plate for joint of the basic brick in the rotary cement kiln[4)]

In the most of the rotary kilns, steel plates have been used as joint between basic bricks.

Recently, the space between magnesia-spinel bricks caused by worn out steel plate brought cracking of the bricks in the transition zone of SP and NSP kilns.

Used brick taken from the transition zone of an SP kiln with diameter of 5.4m is shown in Fig.6.

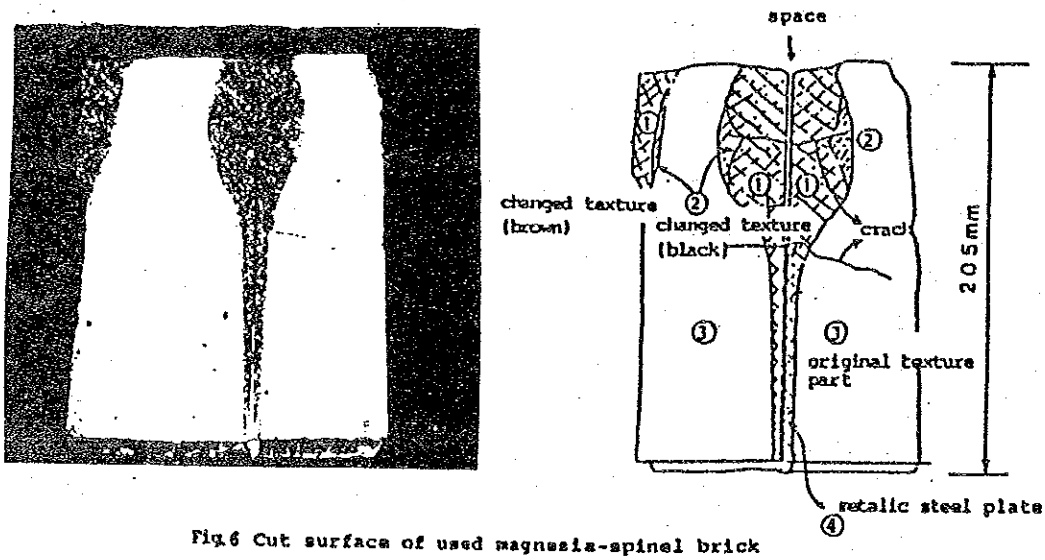

Fig.6 Cut surface of used magnesia-spinel brick

It is obviously observed that disappearance of steel plate betwen bricks results in cracks coming out in the bricks. Even if the pattern of steel plate wearing has been found to differ from one kiln to another, still the same cracking behavior brought about by said wearing phenomenon is observed.

In Fig.6, the steel plate between bricks was worn out and disappeared in the hot face side, on the contrary, in the shell side it stil remained.

It was observed that crack started at the edge of remaining steel plate (indicated 4) and propagated into the brick.

FeS and Fe_3O_4 were recognized in the brick where the steel plate was melted.

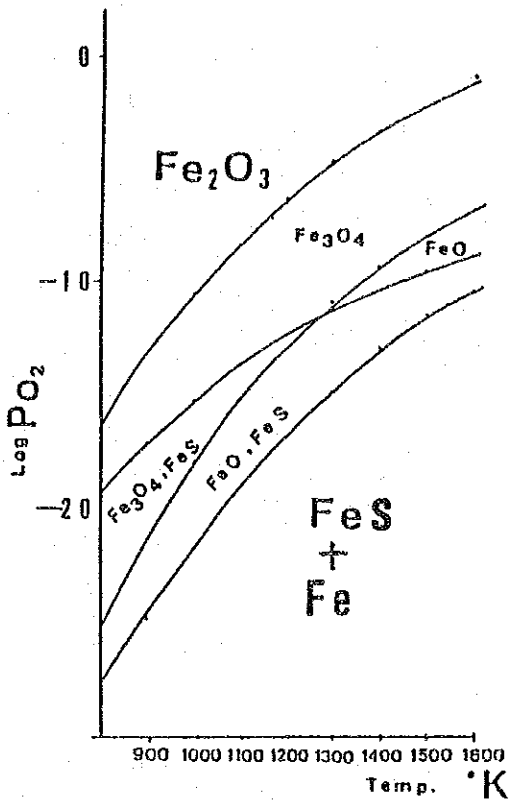

Fig.7 Stability relation of FeO-O-S series in $P_{SO_2}=10^{-2}$atm

Fig.7 features the stability of Fe-O-S series under the condition that P_{SO_2} is fixed to 10^{-2} atm.

According to Fig.7, FeS is decomposed with increased P_{O_2} and becomes Fe_3O_4 and then Fe_2O_3 with further increase of P_{O_2}.

Above 1300K, FeS is decomposed and converted into its oxides in the same manner described in Fig.7. However, over 1213K, FeS and FeO are considered to have a eutictic point and develops a liquid phase.

As a result, activity is not clear, so in case of FeO(liq.), co-existence of Fe_3O_4 -FeO is located at the lower position of P_{O_2}, and there is a possibility that FeS is decomposed and converted into Fe_3O_4 without making FeO.

Analysis was made on disappearance of the steel plates between magnesia spinel bricks used in the "coating on-off" zone of the rotary cement kilns by mainly thermochemical method. As the results, a considerably lower value of P_{O_2} than that of normal kiln atmosphere occurs around the steel plate, and also sulpher in the atmosphere reacts and makes possible the formation of FeS. This causes the steel plates to melt over a certain temperature.

With the lapse of time, P_{O_2} is again increased and decomposition of FeS is introduced.

So far, it has been considered that the steel plate produces Fe_2O_3 and then forms $MgO.Fe_2O_3$ by reaction with MgO in the brick which makes joint tight and prevents the bricks from cracking.

In the condition taken in this case it is explained clearly that at certain conditions steel plates could be a cause of brick damage.

For one of the remedies for this case, installing system without the steel plate has been tried.

5.3 Tumbling brick[5)]

Projected tumbling bricks have been installed in many rotary cement kilns so as to improve heat exchange by agitating raw mix. Many kinds of refractories, such as magnesia spinel bricks, cement-less castable blocks, or silican carbide bricks were applied for the projected tumbling bricks.

We have so many experiences of solving ring problem since 1958 by the special shape of the projected bricks shown in Fig.8 and Fig.9.

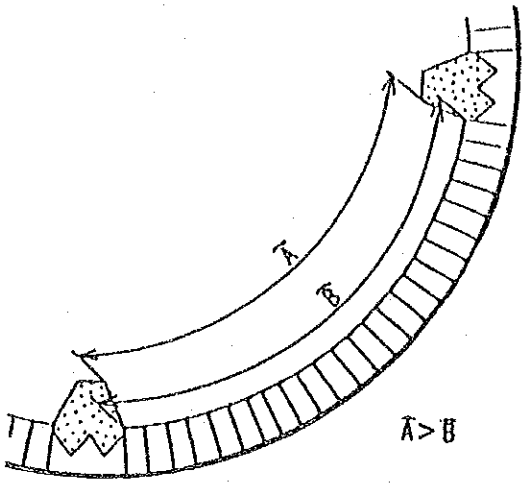

Fig.8 Relation of the space between the projected bricks

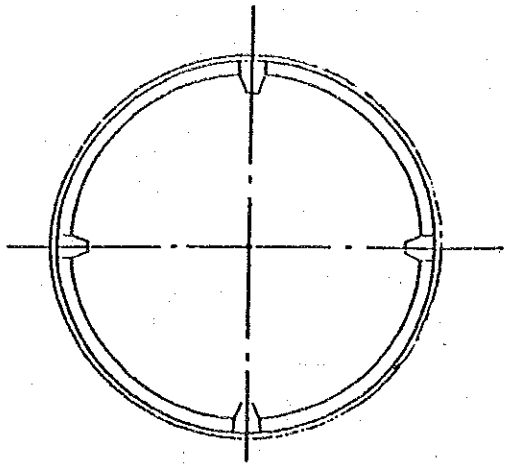

Fig.9 Installation of projected bricks

Lately the application of these bricks for prevention of ring formation has been quite decreased in Japan because ring formation trouble itself was reduced after introducing SP and NSP process. We started to use these silicon carbide projected bricks not only for preventing ring formation but also for the agitation purposes and successful results have been obtained.

By installing tumbling bricks with the length of 5-10m near kiln inlet, temperature around inlet can be reduced 70°C-100°C. It also reduces coating formation at the preheater chute.

5.4 Reduction of preheater plugging by use of silicon carbide[6)]

Problems with cement kiln operation caused by material build-up in the lower parts of the preheater and resulting preheater plugging have often been reported.[7) 8) 9)]

This trouble has recently been frequent because of the wider use of low-grade fuels (such as low-volatility fuels and high-calorific value waste materials). To cope with this problem, the reduction of preheater plugging by using a new lining material was studied.

Since it has been reported that in temperature ranges below 1300°C alkali in exhaust gas has a great effect on the generation of material build-up, a silicon carbide refractory was conventionally used to prevent alkali build-up due to its superior stability to alkali attack. Low cement castables containing 30% to 80% of silicon carbide have been well achieved. Precast block of above castables are most recomended due to lower porosity.

Typical properties of preheater plugging reduction castable NC-De Coat series are shown in Table 1.

Table 1 Typical properties of NC-DC series

	Castables	
	NC-DC30	NC-DC60
Hot face temperature (C°)	1500	1500
Cold crushing strength (kgf/cm²)		
after dry	600	800
1,000 C°	650	950
1,300 C°	980	1070
Chemical composition (%)		
SiO_2	33	18
Al_2O_3	27	18
SiC	30	60

6. Conclusion

As the refractory trends for the cement industry, new products and new systems are described. To improve refractory quality, study should be continued under the tight cooperation with cement manufactures.

References

1) F.Tanemura, T.Honda, Taikabutsu Overseas, Vol.1 No.1, 89(1981)
2) F.Tanemura, T.Honda, Taikabutsu Vol.32, 480(1980)
3) Cement Manufacturing Tech. Committee, Japan, Report T-16, May(1985)
4) T.Honda, A.Yamaguchi, Taikabutsu 40-326(1988)
5) F.Tanemura, T.Honda, H.Kozuka, Proceedings of 2nd International Conference on REFRACTORIES '87 TOKYO 640-648 (1987)
6) F.Tanemura, K.Yajima, F.Haneda, H.Kozuka, Y.Mizuno, Taikabutsu Overseas, 25 Vol.8, No.1 (1988)
7) Von H.J.Schmidt et al : ZKG 39[7], 405-407(1986)
8) G.J.Unland, Rock Product 88[2], S 32A-32E(1985)
9) A.Tsumagari et al : 24th General Meeting Technical Session, Cem, Ass.Japan 68-73(1970)

Plugging Reduction by the Use of Silicon Carbide Refractories in Cement Kiln Preheater

Mino Yogyo Co., Ltd.

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1 Preface

Plugging of cement raw material in cement kiln preheater causes a big trouble in operation : especially in an inlet chamber, a rising duct, a flash furnace, a lowest cyclone and a raw material chute. This trouble is more serious when more inpurities are included in low quality fuel and low quality raw materials. Reduction measures against raw material plugging are required more for the purpose of stable operation at present and in the future.

A variety of researches on the causes and their counter measures of raw marterial plugging have already been reported. The characteristics and the effect of silicon carbide refractories (DECOAT series) which have been used for plugging reduction of raw material, and many satisfactory results are reported in this paper.

2 Mechanism of Raw Material Adhesion

Plugging of cement material is categorized into two types. One is relatively soft coating mainly adhesion on the ceiling, side walls and cone part of the lowest cyclone as well as material chute, and the other is relatively hard coating on inlet chamber, rising duct and flash furnace. However adhesion greatly varies on operation condition, raw material and fuel. A common example is introduced.

Plugging Condition of Raw Material

	Adhesive position	Atmosphere temperature	Main chemical composition of coating
Soft coating	Lowest cyclone (roof, side walls, cone) Raw material chute	800°C ～ 1000°C	$K_2SO_4 \cdot 2CaSO_4$ KCl, $CaSO_4$ $\left\{ \begin{matrix} 2Ca_2SiO_4 \cdot CaSO_4 \\ 2Ca_2SiO_4 \cdot CaSO_3 \end{matrix} \right\}$
Hard coating	Inlet chamber Rising duct Flash furnace	1000°C ～ 1200°C	$CaSO_4$ CaO ($K_2SO_4 \cdot 2CaSO_4$)

2-1 Mechanism of Adhesion of Soft Coating

(1) Soft coating is composed of minerals : mainly $K_2SO_4 \cdot 2CaSO_4$, $CaSO_4$, KCl,etc. Besides them $2Ca_2SiO_4 \cdot CaSO_4 \cdot 2Ca_2SiO_4 \cdot CaCO_3$ and $CaCO_3$ are observed from portion to portion.

(2) Formation temperature of soft coating is 800℃～1000℃.

(3) According to analysis, deteriorated layer of refractory material after service life, 10～15 % of K_2O is included and low melting liquid phase composed of $K_2O \cdot Al_2O_3 \cdot 4SiO_2$ mainly is produced in that layer.

(4) Judging from (1), (2) & (3), formation and adhesion of soft coating is greatly relating to alkaline components, mainly to K_2O component. The mechanism of adhesion is assumed as below.

① Alkaline components and raw material dusts in the atmosphere adhere on the chamber walls.

② In adhesion layer of alkali and raw material dusts, low melting point compound mainly composed of $K_2SO_4 \cdot 2CaSO_4$ (liquid phase is formed above 936℃) is formed.

③ Liquid phase component formed in adhesion layer penetrates also into refractory material, and increases adhesive strength between adhesion layer and refractory material.

④ On viscid adhesive layer, further adhesion of alkaline component and material dusts arises.

⑤ Coating develops by the repetition of the processes ①～④.

Adhesive Mechanism of Soft Coating

Adhesion of alkali components and raw material dusts in the atmosphere

Low melting point materials which contain mainly $K_2SO_4 \cdot 2CaSO_4$ (liquid phase appears above 936 ℃) arise at the alkali and raw material dust adhesived layer

Liquid phases which arised at the adhesive layer penetrate to refractories lining and consequently the increase adhesive property

Alkali components and raw material dust will adhere on the adhesived layer which has much plasticity, coating becomes thick as the result of repeated adhesive process