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UNIDO-Czechoslovakia Joint Programme
for International Co-operation in the Field of Ceramics,
Building Materials and Non-metallic Minerals Based Industries
Pilsen, Czechoslovakia

ORIGINAL:

44p.

Technical Workshop

on "Complex Utilization
of Non-metallic Minerals
in Developing Countries"

Pilsen, Czechoslovakia
21 - 28 April 1985

Presentation of requests and recommendations expressed by the participants concerning the needs of their home countries

Pilsen, Czechoslovakia
April 1985

1/

Having evaluated the workshop, the participants stressed that it offered them a unique opportunity to share and enhance their experience by joining training and consultations. The participants appreciated the high level of the workshop and recommended additional workshops on specific fields which are of significance to developing countries. These should be of a duration of two weeks.

In the course of the workshop, the participants from particular developing countries expressed great interest in further co-operation with UNIDO and the UNIDO-Czechoslovakia Joint Programme in Pilsen and presented their individual requests and recommendations concerning the need of their home countries in the development of building materials, ceramic and non-metallic industries.

Mr. Shi Daxin, People's Republic of China
expressed a deep interest in the co-operation between the Wuhan Institute of Building Materials and the UNIDO-Czechoslovakia Joint Programme concerning exchange of technical experience, training and mutual consultation visits.

Mr. Adel Kamal Ismail, Egypt
The co-operation in the field of integrated exploitation of bentonites with the UNIDO-Czechoslovakia Joint Programme and other Czechoslovak organizations is of interest. In order to utilize the potential of mutual co-operation among developing countries, a UNIDO Panafrican Seminar on the exploitation of bentonites is intended to be organized in Egypt in co-operation and active participation of the UNIDO-Czechoslovakia Joint Programme. A very actual field for the co-operation with the Joint Programme is also the utilization of bentonites for environmental protection and animal feeding in Egypt.

The co-operation was negotiated to start with semi-industrial tests of Egyptian bentonites (during 1984 study tour under UNIDO project UC/EGY/83/233 - Draft Final Report, January 1984). The samples were sent through UNIDO several months ago but they have not yet arrived. There is an urgent need to conduct the tests as soon as possible.

Ms. Eleonora Haigou Constantinidou, Greece
There is a wide field of co-operation with the UNIDO-Czechoslovakia Joint Programme, namely testing, classification and evaluation of an inventory of selected non-metallic minerals including their technological and industrial evaluation. A project proposal is now being drafted covering the above and also training and high-level consultations. This is now negotiated with relevant authorities. The visit of Dr. Papavassiliou, Director General of the Institute of Geology and Mineral Exploration to UNIDO and the UNIDO-Czechoslovakia Joint Programme is foreseen.

Mr. Roshandeen Habibullah and Mr. Robert J. Lee, Guyana
A wider co-operation with the Joint Programme and the Czechoslovak Ceramic Works is requested. This co-operation is to include testing and evaluation of selected Guyanese ceramic raw materials. The co-operation will also consist of training and technological research conducted on laboratory scale and verified semi-industrially. Particularly, there is an concern about the production of wall

Mr. B. M. Ravindranath Rai, India
Follow-up of previous contacts with the Joint Programme and active mutual participation in different international seminars both in Czechoslovakia and India is recommended. There is also interest in consultations and co-operation with the Joint Programme in the field of special ceramics and a wall tile plant construction and operation.

Mr. Ali Anani, Jordan
The co-operation with the UNIDO-Czechoslovakia Joint Programme in the exploitation of selected non-metallics, especially of bentonites for agriculture and training of technicians is of great interest. Selected activities initiated in Jordan by the Chief Executive of the Joint Programme will be followed up and further exploited.

Mr. Muftah M. Abdelkarim, Libya
The assistance of the Joint Programme in troubleshooting in the brick-making industry in Libya is requested. The Joint Programme is also demanded to train technicians and conduct semi-industrial tests of brick raw materials. To this purpose the Joint Programme technical assistance mission is urged.

Mr. Jean René Ratsimbazafy, Madagascar
The evaluation, classification and elaboration of an inventory of non-metallic minerals as a base of furtner development considerations is requested to be done in co-operation with the Joint Programme. Especially tests, evaluation and possible following exploitation of vast reserves of kaolins and feldspars for local production of tableware as well as possible exports of upgraded raw materials are of prior concern for the co-operation. The application of local bentonites in agriculture will also be followed.

Mr. Jorge González Montesinos, Mr. Rolando Diaz Lopez, Mexico
The co-operation with the Joint Programme is requested for the establishment of a Centre for Testing, Evaluation and Classification of Non-metallics. Technical assistance by the Joint Programme is requested in the field of technologies for refining graphites, washing kaolins and production of refractories.

Mr. Ilídio Godinho, Mozambique
The co-operation with the Joint Programme is requested in the field of testing and of non-metallics, their upgrading and evaluation of possibilities of industrial exploitation and also in the technological research for the manufacture of ceramic wall tiles and red bricks.

Mr. C.T.S. Bandula Perera, Sri Lanka
Three Joint Programme missions are under preparation on research and development of ceramics and energy management including feasibility study to evaluate possibility of energy conservation. The tests of ceramic raw materials carried out by the Joint Programme were appreciated and further co-operation in the development of ceramics, building materials and refractories was requested together with training of technicians in energy management and ceramic research.

Mr. Rumisha H. Kimambo, Tanzania
Co-operation with the Joint Programme in testing raw materials and upgrading tests of selected ceramic raw materials is of interest as well as specialized training of engineers and manpower. The Joint Programme is also requested to co-operate in elaboration of a national publication on non-metallics of Tanzania.

Mr. Parkorn Suwanich, Thailand
There is a need for protection of topsoil against salty underground water. The Joint Programme is requested to assist in bentonite application attempts to this purpose.

Mr. Aboulhassen Charfi, Tunisia
A deep concern in application of bentonite both as natural sorbents for reclamation and as a carrier of fertilizers to protect environment was expressed. The Joint Programme is expected to assist in testing, technological evaluations, upgrading of bentonites and other non-metallics.

Mr. Ibrahim Yavuzel, Turkey
The Joint Programme will be applied for co-operation in washing tests of kaolins and upgrading and refining tests of other non-metallics.

Mr. William Mumbi, Zambia
Co-operation with the Joint Programme in researching of appropriate upgrading and refining methods of local selected non-metallics is requested.

Mr. Eliah Mutowo, Zimbabwe
There is in Zimbabwe high potential for industrial exploitation of non-metallics and the urgent need of the diversification of ceramic industries. The Joint Programme is expected to continue previous co-operation in the field. Especially tests, evaluation of non-metallics and technological research are of prior concern for the above co-operation.

Mr. M. Said Ould Ali, Algeria
A closer co-operation with the Joint Programme in testing of raw materials and their upgrading and utilization is envisaged in the following sectors: bentonite in agriculture, production of wall tiles and refractories. A visit of the Minister of Industry in UNIDO Headquarters and the UNIDO-Czechoslovakia Joint Programme is foreseen.

The participants in the workshop were also deeply concerned with kaolin extraction and upgrading and requested the description of technologies of particular types of washed kaolin manufacture. They also demanded the edition of specialized publications, for example on the production of refractories and application of bentonites in agriculture and environmental protection.

TECHNICAL WORKSHOP ON COMPLEX UTILIZATION
OF NON-METALLIC MINERALS IN DEVELOPING COUNTRIES

Organized by the UNIDO-Czechoslovakia Joint Programme
for International Co-operation in the Field of Ceramics,
Building Materials and Non-metallic Minerals Based Industries,
from 21 through 28 April 1985 in Pilsen, Czechoslovakia

D R A F T

F I N A L R E P O R T

This report has been prepared by:

Board of Participants in the Technical Workshop

UNIDO-Czechoslovakia Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries, Pilsen

UNIDO Representative

Pilsen, Czechoslovakia

I. INTRODUCTION

The Technical Workshop on Complex Utilization of Non-metallic Minerals in Developing Countries was organized by the UNIDO-Czechoslovakia Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries in Pilsen, Czechoslovakia, as a follow-up of the First World Congress on Non-metallic Minerals in Belgrade, to complement practically its subject.

The objective of the Workshop was to foster the prospect of integrated exploitation of non-metallic minerals in developing countries as it plays a significant role in the industrialization of these countries and to identify the areas of concern for transfer of technologies, technical co-operation and training through UNIDO and the UNIDO-Czechoslovakia Joint Programme.

The UNIDO-Czechoslovakia Joint Programme was established at the Research Institute for Ceramics, Refractories and Raw Materials, Pilsen and it has been backed by the companies associated under the Czechoslovak Ceramic Works. It commenced its activities in 1978. The Joint Programme has also been maintaining close contacts with companies producing lime, cement, bricks and other building materials and with other organizations, exploiting non-metallic minerals in different sectors.

Technical Assistance Programme

The Joint Programme provides assistance to developing countries in fostering twinning arrangements between the appropriate Czechoslovak organizations and similar ones in the developing countries, in carrying out individual training of technicians and engineers as well as group training programmes and workshops, in testing raw materials together with the related technological research and pilot investigations leading to the selection of appropriate industrial technology. Its staff provides technical assistance to the developing countries during exploratory and advisory missions that regard all technological issues of the development of ceramics, building materials and non-metallic minerals based industries. The Joint Programme also renders technical assistance to developing countries whithin its programme of energy conservation and management and in the application of non-metallic minerals and rocks in agriculture and environmental protection. A special attention is being paid to the Industrial Development Decade for Africa in which the Joint Programme is expected to play a significant role. UNIDO and Czechoslovak authorities authorized the UNIDO-Czechoslovakia Joint Programme to implement this Seminar. Taking into consideration that the topics of the Seminar created high interest in the developing countries, many of them applied to participate.

II. PARTICIPANTS

26 highly qualified governmental nominees and one observer from 20 developing countries took part in the Workshop. Their list is presented in Annex I.

III. LANGUAGE

The programme was conducted in English and the lectures were typed in English, too. On their requests, some participants were provided with translation into French and Spanish.

IV. ORGANIZATION OF THE WORKSHOP

Organization was ensured by the Organizing Committee:

Director of the Workshop	Dr. A. Lošťák, General Director of the Czechoslovak Ceramic Works, Prague
Programming Director	Mr. Z. A. Engelthaler, Chief Executive of the UNIDO-Czechoslovakia Joint Programme and Director of the Research Institute for Ceramics, Refractories and Raw Materials, Pilsen
UNIDO Representative	Ms. S. H. Yalcindag, Industrial Development Officer, Chemical Industries Branch, Division of Industrial Operations, UNIDO Vienna
Secretary	Ms. E. Engelthalerová, Chief of Administration of the UNIDO-Czechoslovakia Joint Programme, Pilsen
Technical Adviser	Mr. J. Müller, Deputy Senior Expert, UNIDO-Czechoslovakia Joint Programme, Pilsen
	Mr. P. Jenčík, Expert, UNIDO-Czechoslovakia Joint Programme, Pilsen
General Rapporteur	Mr. M. Nový, Expert, UNIDO-Czechoslovakia Joint Programme, Pilsen
Administration Arrangements	Ms. A. Fremlová, Administrative Clerk, Ms. V. Vohrnová, Administrative Clerk, UNIDO-Czechoslovakia Joint Programme, Pilsen

Board of Participants +/

Chairman: Mr. Ismail A. /Egypt

Mr. Anani A. /Jordan
Mr. Balcha B. /Ethiopia
Ms. Constantinidou E. /Greece
Mr. Habibullah R. /Guyana
Mr. Montesinos J. /Mexico
Mr. Mutowo E. /Zimbabwe
Mr. Perera B. /Sri Lanka
Mr. Rai R.B. /India

1. Programme of the Workshop

Aside the introduction into the Workshop, five lectures were presented by high-qualified and experienced lecturers, focused on the importance of non-metallics to the ceramic production, non-metallic minerals for energy conservation, application of non-metallics in agriculture, anticipated exploitation of non-metallics and technology assimilation in non-metallic minerals based industries.

The programme of the Workshop comprehended industrial study visits to production plant on porcelain tableware, extraction and beneficiation of kaolin, and to an agricultural farm applying non-metallics in agriculture as well as to two divisions of the Research Institute for Ceramics, Refractories and Raw Materials, Pilsen.

The lectures and industrial study visits were completed by comprehensive discussions, giving the participants opportunity to exchange their opinions and experience with lecturers, managers and technical staff in the production plants and Research Institute visited as well as among themselves.

The participants of the Workshop established a working group which prepared the daily summary reports (see Annexes) and drafted the Workshop Report in co-operation with the Organizing Committee. The participant from Egypt was elected the Chairman of the Workshop.

+/ Names are listed in alphabetical order.

2. Documentation and Aids

The following documentation and aids were handed over to each of the Technical Workshop participants and UNIDO Representative:

- Technical Workshop Time Schedule
- Complete Set of Five Lectures
- Information on Plants and Research Facilities to Be Visited
- Guide to the Technical Workshop
- Technical Leaflets and Bulletins of the UNIDO-Czechoslovakia Joint Programme
- Informative Materials
- Publication on the Research Institute for Ceramics, Refractories and Raw Materials
- Multilingual Vocabulary for Ceramic Industry and Non-metallic Raw Materials
- Writing Materials and Handbag
- Protection Helmet /for industrial study visits/

3. Discussions

The participants enriched their scope of knowledge during the discussions with the following officials:

UNIDO Vienna	- Ms. S. H. Yalcindag, Industrial Development Officer, Chemical Industries Branch, Division of Industrial Operations
CSSR	- Dr. A. Lošťák, General Director of the Czechoslovak Ceramic Works, Prague
	- Mr. Z. A. Engelthaler, Chief Executive of the UNIDO-Czechoslovakia Joint Programme and Director of the Research Institute for Ceramics, Refractories and Raw Materials, Pilsen
	Mr. Z. Štěpánek, Head of the Division, Research Institute for Ceramics, Refractories and Raw Materials, Pilsen, Division at Karlovy Vary
	Mr. M. Bareš, Chief of Laboratories, Research Institute for Ceramics, Refractories and Raw Materials, Pilsen, Division at Karlovy Vary

Mr. V. Hanus, Chief Researcher,
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Pilsen, Division at Karlovy Vary

Mr. S. Hora, Head of the Division,
Research Institute for Ceramics,
Refractories and Raw Materials, Pilsen,
Division at Horní Bříza

Mr. S. Vaněk, Chief Researcher,
Research Institute for Ceramics,
Refractories and Raw Materials, Pilsen,
Division at Horní Bříza

- Mr. M. Bartuška, Associate Professor,
Chemical-technological University,
Prague

- Mr. Z. Nouza, Plant Director,
Carlsbad Porcelain Works, Karlovy Vary,
Production Plant at Nová Role

Mr. J. Vocilka, Production Manager,
Carlsbad Porcelain Works, Karlovy Vary,
Production Plant at Nová Role

- Mr. Jan Dlouhý, Production Manager,
Westbohemian Ceramic Works, Horní Bříza,
Kaolin Washing Plant at Kaznějov

Mr. Petr Havel, Chief Technologist,
Westbohemian Ceramic Works, Horní Bříza,
Kaolin Washing Plant at Kaznějov

- Mr. J. Petr, Director, Agricultural
State Farm, Křimice

V. ADMINISTRATIVE ORGANIZATION OF THE PROGRAMME

1. Administrative Work

Administrative staff was engaged in organizing and arranging lectures, plant visits in factories and in the Research Institute, accommodation arrangements, local transport, social events, providing of visas and air-tickets booking, etc.

2. Secretariat and Audience Room

The Secretariat of the Workshop was established in the premises of the UNIDO-Czechoslovakia Joint Programme, the Audience Room in the URAL Hotel in Pilsen.

VI. EVALUATION BY THE PARTICIPANTS

This workshop offered a unique opportunity for participants of 20 countries to share their experiences in an industry which has not been getting due attention in the effort of industrialization. The participants greatly appreciated the workshop which followed the Belgrade conference on non-metallic minerals. In order to obtain a better understanding of the mutual problems of the industry, it was felt that the workshop could have been extended for a duration of two weeks. However, in the time that was available the participants shared freely the problems faced by their respective countries in the effective utilisation of mineral resources.

The contribution of Czechoslovak industries in this programme was very significant. The participants appreciated the high standard of research and manufacturing technology in mineral industries in Czechoslovakia. The participants were able to discuss with these institutions the problems related to planning, development of manufacturing technology, standardisation, quality control and testing, and integrated exploitation of indigenous raw materials. The participants recognised that the information gained during the visits, lectures and round table discussions will greatly help in their further activities in their home countries.

Following visits to the Research Institute and factories of the Czechoslovak Ceramic Works the participants desired for further co-operation with the UNIDO-Czechoslovakia Joint Programme in the field of training, testing and evaluation of raw materials for industrial application, commercial exploitation, energy conservation and assistance in establishing laboratories, research facilities and production units in their home countries. Publications of the UNIDO-Czechoslovakia Joint Programme were of great interest to the participants.

The participants considered that the scope and coverage of the workshop was adequate taking into consideration the constraint of time for the workshop. The workshop contributed greatly to a mutual understanding of the status of the mineral industries in the respective countries of the participants. The participants recommended additional workshops on specific fields which are of significance to Developing Countries.

The participants in the workshop presented some individual requests and recommendations expressing the need of their home countries in the development of building materials, ceramic and non-metallic industries.

The participants expressed their gratitude to UNIDO and the Joint Programme for arranging this workshop in Czechoslovakia where the authorities were very generous in sharing their knowledge and experience.

They were thankful to Dr. A. Lošťák, General Director of the Czechoslovak Ceramic Works and Director of the Workshop, for his active part in the programme and for his permission to visit the Ceramic Works.

They greatly appreciated the role of Mr. Z. A. Engelthaler, Director of the Research Institute and Chief Executive of the UNIDO-Czechoslovakia Joint Programme, for his well prepared programme and his personal involvement in the various visits. They further appreciated his part in the round table discussions.

The staff members of the UNIDO-Czechoslovakia Joint Programme were always helpful and contributed greatly to the success of the workshop.

VII. CONCLUSIONS AND RECOMMENDATIONS

The discussions of the workshop generated the following conclusions:

1. There is a strong need of further co-operation among developing countries for promotion and establishment of non-metallic minerals processing industries.

   In order to realize this, UNIDO and the UNIDO-Czechoslovakia Joint Programme should:

   a/ arrange workshops and seminars at regional and inter-regional level with the duration of about 2 weeks

   b/ review the status of this industry in developing countries in view of its constraints related to
   - planning
   - technology
   - financing
   - manpower
   - energy
   - role of research and development centres and non-governmental organizations in the development of non-metallic minerals based industries
   - introduction of advanced techniques of energy management to related non-metallic minerals processing industries

   c/ continue in editing technical publications and UNIDO should encourage the UNIDO-Czechoslovakia Joint Programme in this activity. The copies of these publications can be obtained from INTIB, UNIDO Vienna.

2. Application of non-metallic minerals in agriculture is identified as a potential area which is expected to contribute to the overall performance of the agricultural sector in developing countries. The main advantages of application of non-metallic minerals in agriculture read as follows:
   - soil reclamation
   - water retaining
   - lowering of chemical fertilizers
   - yield increase
   - reduction of imports

   To promote the application of non-metallic minerals in developing countries, the following actions are recommended:
   - arrangement of relevant seminars and workshops
   - establishment of the group of consultants to assist developing countries in the field
   - establishment of specific training programmes
   - preparation of a manual by UNIDO for bentonite application in agriculture

   The participants from Egypt, Tunisia, Algeria and Ethiopia agreed to co-operate with the UNIDO-Czechoslovakia Joint Programme with UNIDO assistance in order to promote above specified activities.

3. Industrial commercial exploitation of non-metallic minerals
   In promoting the appropriate exploitation of non-metallic mineral industries the requirements of the user industries, e.g. building materials industry, paper, glass, rubber, cosmetics, ceramics, refractories, foundry, should be carefully examined and governments should take necessary measures to ensure the proper utilization of locally available raw materials. In this respect, it is recommended that inventory studies are conducted and industrial directories are prepared and made available to the users.

   In establishing new industry, the technical-economical assessment of the raw materials situation is vitaly important. Indigenous capability in conducting market feasibility studies for establishing non-metallic minerals industries should be strengthened to specific training programmes and utilization of documents prepared for this purpose. In this respect, UNIDO is recommended to prepare an experts group meeting to review the issue.

4. Energy

There is the growing need of energy conservation in developing countries. Non-metallic minerals are recognized to play a dominant role in this respect both in residential as well as industrial sectors. There exists quite a few non-metallic insulation materials and developing countries do have the resources to develop such materials. They are not producing them on a larger scale due to lack of adequate know-how and technology transfer.

a/ Utilization of fluxing agents

Development and use of non-traditional technologies utilizing blends with different fluxing agents while maintaining high product quality, such as oxides of sodium, potassium, calcium, magnesium. These have the added advantage of producing better glazed product of high quality.

b/ Optimization of thermal processes

In order to achieve ideal conditions of thermal processes, under lowered firing temperatures, improvement of design and operation of kilns is a necessity. In this respect, the improvements achieved and techniques introduced to these plants in the CSSR were outlined. Therefore, the proper selection of kiln type and technique of firing to match the type of blend used to economize on energy were emphasized.

c/ Energy diagnostics

This method is bein successfully utilized in the CSSR to identify the deviation of kiln operations from ideal operating conditions and to bring corrective measures. For this purpose through mobile diagnostic units the plants are supervised and monitored regularly.

d/ Rehabilitation of thermal units

For existing old plants, rehabilitation studies are conducted whenever proven economically viable and corrective changes are made, e.g. change of burners, replacement of flue gas systems, controlling air/fuel ratio, etc.

e/ Kiln furniture

Much emphasis needs to be given to optimum loading of the kiln and control of the kiln furniture/fired products so that energy is not wasted and maximum utilization of heat is achieved.

f/ Waste heat recovery

Improvement of plant energy efficiency through the use of proper insulation materials, introduction of by-pass and heat recovery systems wherever applicable is recommended.

g/ The application of mobile diagnostic unit for energy audits in production plants represents an integral part of energy management system. With no or negligible investment significant energy savings can be achieved through proper adjustment of heat consuming units. The energy audits by means of mobile diagnostic units and realization of recommendations lead to:
- energy savings
- quality improvements
- rejects decrease
- production intensification.

5. Integrated non-metallic industries

In order to prove the profitability of the non-metallic industries and to find uses of by-products it is strongly recommended that non-metallic industries be integrated wherever possible. To give an example, sand as a by-product from the kaolin washing operation can be utilized in several industries including silicate industry, foundries and in the manufacture of light-weight building materials, building ceramics and refractories.

In addition, the TiO_2 from high intensity magnetic separation of kaolin can be used as a paint pigment. Impurities separated by dry magnetic technology are ideal filler for cast floor materials.

Annex I

LIST OF PARTICIPANTS, LECTURES AND STUDY VISITS

UNIDO Vienna Representative: Ms. S. H. Yalcindag
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Observer:

Mr. Robert J. Lee
Technical Expert / UNIDO

c/o
Institute of Applied Science
and Technology
Turkeyen Campus
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List of Lectures and Lecturers

1. Importance of Non-metallics to the Czechoslovak Ceramic Works

Dr. A. Lošťák
General Director,
Czechoslovak Ceramic Works

Trojská 13
182 00 P r a g u e
Czechoslovakia

2. Non-metallic Minerals for Energy Conservation

Mr. Z. A. Engeltmaler
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UNIDO-Czechoslovakia
Joint Programme
and Director,
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Ceramics, Refractories and
Raw Materials

P. O.Box 211
305 11 P i l s e n
Czechoslovakia

3. Non-metallic Sorbents in Agriculture

Mr. J. Petr
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Agricultural State Farm,

330 31 K ř i m i c e
Czechoslovakia

4. Technology Assimilation in Non-metallic Minerals Based Industries

Mr. J. Müller
Deputy Senior Expert,
UNIDO-Czechoslovakia Joint
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5. Anticipated Industrial Exploitation of Non-metallics

Dr. M. Bartuška
Associate Professor

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166 28 P r a g u e
Czechoslovakia

Study Visits

Porcelain dinnerware production

Carlsbad Porcelain Works,
Karlovy Vary
Production Plant at Nová Role

Extraction, upgrading and refining of non-metallics

Research Institute for Ceramics,
Refractories and Raw Materials,
Pilsen
Division at Karlovy Vary

Kaolin mine and a kaolin washing plant

Westbohemian Ceramic Works,
Horní Bříza
Kaolin Washing Plant at Kaznějov

Application of non-metallics in farming and cas.. plant germinating

Agricultural State Farm, Křimice

Technology and energy conservation in the production of ceramics and refractories

Research Institute for Ceramics,
Refractories and Raw Materials,
Pilsen
Division at Horní Bříza

UNIDO-Czechoslovakia Joint Programme

UNIDO-Czechoslovakia Joint
Programme Headquarters
Pilsen

Application of selected non-metallic products in architecture

Prague

Annex II

Date: 22 April 1985

Day: Monday

Session: No. 1

Title: Importance of Non-metallics to the Czechoslovak Ceramic Works

Lecturer: Dr. Alois Lošťák /CSSR/

I. SUMMARY

1. The opening lecture was on "Importance of Non-metallics to the Czechoslovak Ceramic Works" by Dr. A. Lošťák. He outlined the history and the extent of the raw material exploitation and the ceramic industry in the CSSR in general. This included the exploitation of china clays, feldspars, perlites, diatomaceous earths, bentonite, magnesites, calcites, sands, shales, etc. He also pointed out that as the ceramic industry is an extensive user of energy, the CSSR has been concentrating on energy conservation work in this industry. His speech included details of dressing of the above raw materials and their proper use in the industry. It was strongly pointed out in his speech that research and development work forms an integral part of the total work done. A lot of work is being done in trouble shooting for the industry.

2. The Research Institute for Ceramics, Refractories and Raw Materials is currently engaged in
   a/ decreasing the energy demand in the production of ceramics by introducing new technological processes,
   b/ the introduction of automation in production processes due to constraints of manpower in the CSSR,
   c/ reduction in the consumption of imported materials and substitution by cheap local materials.

3. The speaker stressed on both the proper utilization of non-metallics property and energy conservation in the manufacturing processes.

II. CONCLUSIONS AND RECOMMENDATIONS

1. The Czechoslovak ceramic industry is already co-operating with a number of developing countries and providing expertise and training through the UNIDO-Czechoslovakia Joint Programme and bilateral agreements. Assistance provided is also supported by the research and developing centres, working in the field and in this respect raw material investigation and tests are carried out at laboratory and on a semi-industrial scale whenever needed.

2. The coating agents used to hydrophobize perlites and kaolins are produced according to CSSR patents. In preparing the refractory insulating materials different technologies are applied.

3. For the problem of using a good quality kaolin /brightness 85 - 87%/ as a paper coating material containing montmorillonite, separation of this mineral from kaolinite may become possible by allowing montmorillonite to swell in water while the kaolin settled down. However, it is very difficult to separate the montmorillonite suspension.

4. Ball clays can successfully be used in the production of sanitary ware. The new powder pressing /isostatic/ technique will reduce the consumption of energy.

   The isostatic pressing technology for dinnerware and sanitary ware production offers new scope for research aiming to economize the manufacturing costs. However, simple shapes and some tableware products are being manufactured.

5. Replacement of paraffin or diesel by coal is not possible directly. However, it could be converted to produce gas and use it as a fuel.

6. In the ceramic industry, removal of crystobalite from bentonite is not recommended if it is present in minute quantities.

Annex III

Date: 22 April 1985

Day: Monday

Session: No. 1

Title: Energy Conservation in Non-metallic Based Industries

Lecturer: Dr. Zdeněk A. Engelthaler /CSSR/
Dr. Ali Anani /Jordan/

I. SUMMARY

The second paper introduced on the first day on the "non-metallic minerals for energy conservation" stressed the importance of energy conservation in this particular industry with specific emphasis on ceramic industries.

With a brief introduction to the technology and know-how involved in manufacturing ceramic products, the speaker summarized the following seven major approches to the conservation of energy.

1. Utilization of fluxing agents

Development and use of non-traditional technologies utilizing blends with different fluxing agents while maintaining high product quality. Among those fluxing agents used, the speaker gave detailed technical information on the use of oxides of sodium, potassium, calcium and magnesium. These have the added advantage of producing better glazed product of high quality.

2. Optimization of thermal processes
In order to achieve ideal conditions of thermal processes, under lowered firing temperatures, improvement of design and operation of kilns is a necessity. In this respect the speaker outlined the improvements achieved and techniques introduced to these plants operating in the CSSR. Therefore, he specifically emphasized the proper selection of kiln and technique of firing to match the blend used to economize on energy.

3. Energy diagnostics
This method is being successfully utilized in the CSSR to identify the deviation of kiln operations from ideal operating conditions and to bring corrective measures. For this purpose through mobile diagnostic unit the plants are supervised and monitored regularly.

4. Rehabilitation of thermal units
For existing old plants, rehabilitation studies are conducted whenever proven economically viable and corrective changes are made, e.g. change of burners, replacement of flue gas systems, controlling air/fuel ratio, etc.

5. Kiln furniture
Much emphasis needs to be given to optimum loading of the kilns and control of the kiln furniture/fired products so that energy is not wasted and maximum utilization of heat is achieved.

6. Waste heat recovery
Improvement of plants energy efficiency through the use of proper insulation materials, introduction of by-pass and heat recovery systems wherever applicable is recommended.

7. Effect of climatic conditions
The speaker emphasized the effect of climatic conditions on the overheat costs of the plant as well as on manufacturing cost. The use of sun-drying to reduce energy consumption was given as an example.

II. CONCLUSIONS AND RECOMMENDATIONS

The discussion of the participants on the energy conservation generated following conclusions:

1. Energy auditing and training of management on this subject is of utmost necessity. In order to establish energy auditing systems at factory level, intensive training programme introducing advanced energy saving techniques and methods should be regularly conducted at industry level.

2. In establishing new plants, during the pre-investment and technology selection stages, energy related constraints and possible savings through utilization of local energy resources should be carefully examined.

3. The research and development centres in developing countries providing services to the plants should enhance their capability and awareness in energy conservation to upgrade the performance of plants as well as in finding cheaper alternative energy resources compatible with existing technologies.

4. There is growing awareness of the need for the processing and application of non-metallic minerals as thermal insulants. However, in planning such industries necessary attention must be paid to the energy requirements of technologies available today, as well as to the proper selection, manufacturing and application of such products. The participants urged the meeting and the Joint Programme to organize a special workshop which will examine the appropriate technologies and application of various non-metallic insulating materials, namely perlite, vermiculite, refractory insulating materials.

5. The construction industry being a major user of non-metallic insulating materials should also be aware of the economic

advantages of such materials and should be able to select construction technology which is technically, economically and environmentally viable.

6. Plastic foams being the major competitors of non-metallic insulating materials, the performance of this industry should be regularly monitored and should receive necessary attention. In this respect further research should be carried out in developing less energy-intensive methods, such as foaming of vermiculite and cement at low temperatures, compounding of large volumes of minerals in polymer foams, production of non-conventional stabilized mineral foams wherein mineral particles are entrapped in air bubbles, and the use of mineral wastes for the preparation of mineral foams.

Annex IV

Date: 23 April 1985

Day: Tuesday

Session: No. 2

Title: Non-metallic Sorbents in Agriculture

Lecturer: Mr. J. Petr /CSSR/

I. SUMMARY

Mr. Petr began his lecture by reviewing performance of agricultural sector in Czechoslovakia before 1960. He reported that crop yield was low, the soil of sandy type with low humus content and the demand for agricultural products was increasing. The need to increase crop yield necessitated experimentation with different soil improving /reclaiming/ materials. He identified the following stages which gradually lead to the increased use of non-metallic sorbents as soil conditioners:

1. Experimentation with chemical fertilizers
   Between 1960 and 1965, 120 kg/ha/year of chemical fertilizers were applied to the land. After 1965, this was increased to 200 - 300 kg/ha/year. However, although the initial addition of chemical fertilizers gave higher yields, further application of greater quantities of the same did not result in the expected greater yields. Some of it was lost as solution during the downward percolation of excess water and, therefore, unavailable to the plants.

2. Experimentation with humus
   Humus was considered as an alternative to chemical fertilizers. To do this, the amount of humus content of the soil has to be increased. But to increase it by 0.5% required the unrealistic quantity of natural fertilizers of 20 - 30 tons/ha to be applied over 20 - 30 years.

3. Experimentation with non-metallic sorbents
   As the result of the problems associated with chemical and humus fertilizers, attention was directed towards non-metallics that could affect increased retention of applied chemicals.

   Pioneering experimentation was carried out in Czechoslovakia at Křimice State Farm near Pilsen. Reporting on the experimentation he mentioned that initially bentonite was applied only to few hectares of land. This gave higher yield for all categories of crops. After this, bentonite was

applied to all the sandy soils of the farm. The optimum amount was to be 20 tons per hectare per seven years for bentonite and 200 to 250 kg/ha per year of chemical fertilizers. The lower demand of chemical fertilizers was the result of the fertilizer retaining capacity of the bentonites which confirmed their importance as soil conditioners and lower costs of production. It requires no processing and the only consideration is the cost of transport.

4. The use of perlite in agriculture
It is applied to heavy soils in the production of cash crops and also to nursery beds. Crushing, screening, expansion and sorting is necessary before its application.

5. The use of bentonite in animal feeding
Bentonite slows down the movement of food through the digestive system resulting in better digestion and absorption and greater use of the feed. The health condition of the animal improves, the amount of feed and costs of production hence lower. However, the optimum amount has to be determined through experiments for each type of feed, animal and type of bentonite. The lecture was followed by a lively round-table discussion.

II. CONCLUSIONS AND RECOMMENDATIONS

1. To demonstrate the applicability of bentonite in arid or semi-arid regions, determination of soil quality, identification of rain fall and irrigation situation, availability of data on climatic conditions, selection of crops are found to be necessary. Tests are recommended to be carried out in green houses /ideally 0.5 - 1 hectare/ or better on a larger scale.

2. The bentonites which cannot be used for industrial applications might be used in agriculture.

3. The use of other sorbents /such as zeolites, tuffs, pumice/ are recommended apart from bentonite and perlite.

4. The possibility of application of bentonite in saline areas was discussed. In this connection the participant from Thailand presented the attached country case /Annex V/. The possibility of providing a protective layer of bentonite was suggested.

Annex V

The Problem of Salty Soil in Northeastern Thailand

Introduction

Northeastern Thailand is divided into two basins which may represent a potential region for agriculture in Thailand. The southern basin /Khorat Basin/ extends to about 33,000 sq.km and the northern one /Sakon Nakhon Basin/ has an area of about 17,000 sq.km. (Figure 1) These two basins are underlied by thick beds of rock salt. These salty beds gradually supply salt to the top soil rendering it not suitable for growing the crops.

Geology and Hydrogeology

However, this problem is related to the structural geology of rock salt and hydrogeology. All evaporates of rock salt and potash are originally about 600 - 900 meters thick, the reserves amount to more than one billion tonnes. There is a lateral variation in thickness due to progressive salt tectonics. The structural geology of rock salt formation shows a great deal of salt domes, anticlines, ridges and diapires. (Figure 2) Because the rock salt is a plastic-like mineral, it can move up and down occasionally laterally if there is a lot of loading or presses due to tectonic forces.

In addition, the soil covering these salt strata consists of 70% of sand which is a good aquifer that admits fresh water from the surface to pass downwards and dissolve a part of the salt dome forming brine groundwater. The brine is stagnant or slightly moving except if it is pumped out. The numerous drillings made around the front of a trial mine at Bamnet Narong Area for groundwater exploration proved the presence of a plenty of brine groundwater.

Problem

The problem of salty soil does not arise in the rainy season because the rains will fill the paddy fields. Surface water prevents the brine from moving upwards since the latter is of higher specific gravity. This fresh water will wash out any salts deposited in the soil.

The problem occurs in dry seasons (4 - 6 months) when there is no rain, the brine groundwater evaporates through the characteristic capillary fringes and leaves salt behind in the soil. (Figure 3) These salty areas cannot grow any crop.

However, at the higher areas, such as small hills, the problem does not appear because of the presence of thick layers of claystone, siltstone and sandstone over the salt bed which prevent brine evaporation.

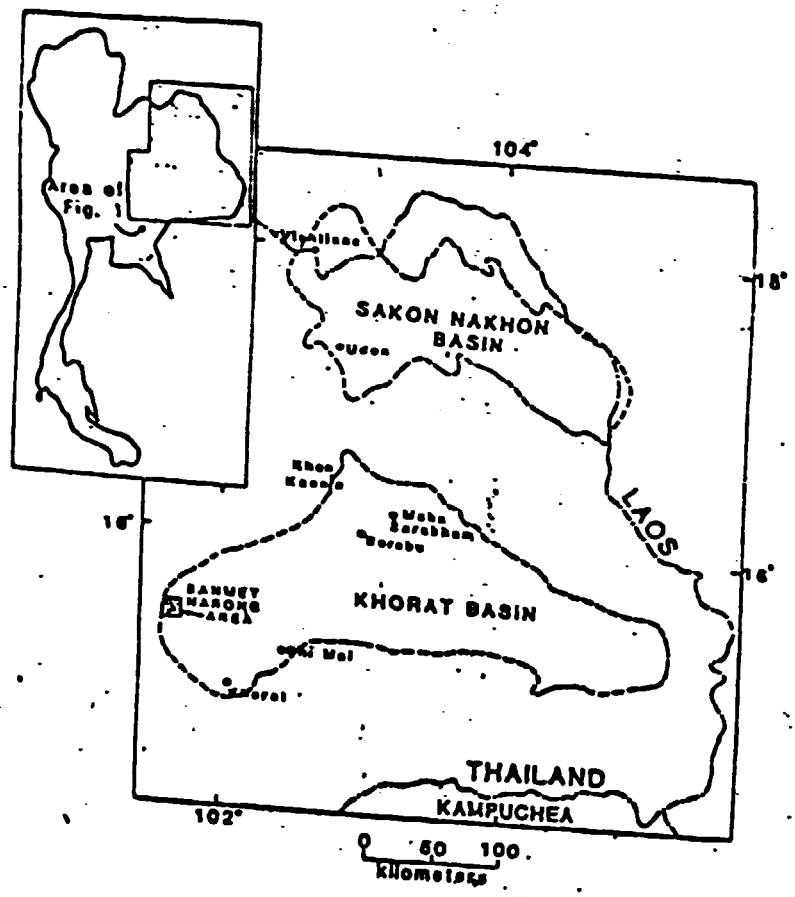


Figure 1 Index map of Khorat Plateau

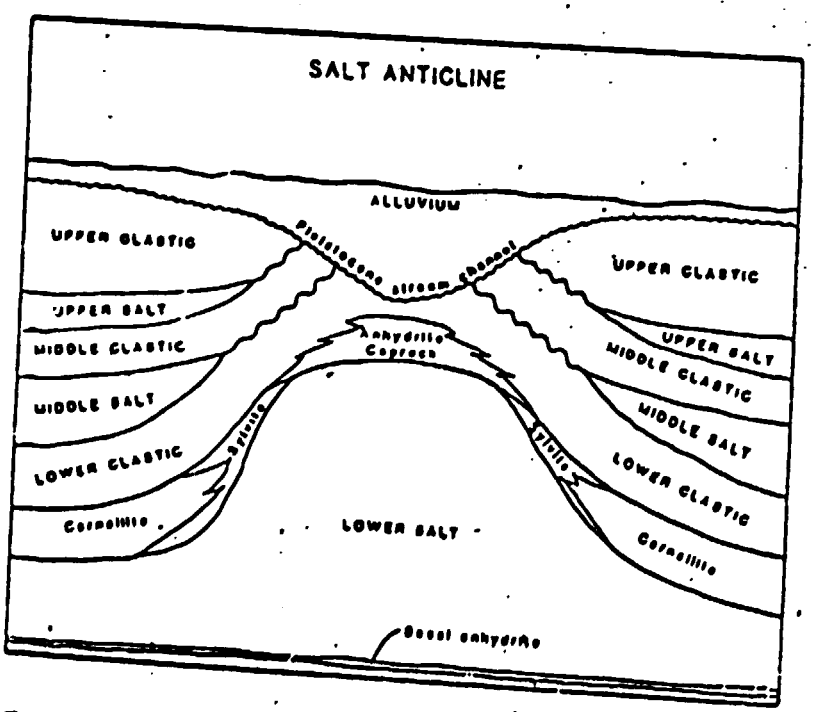
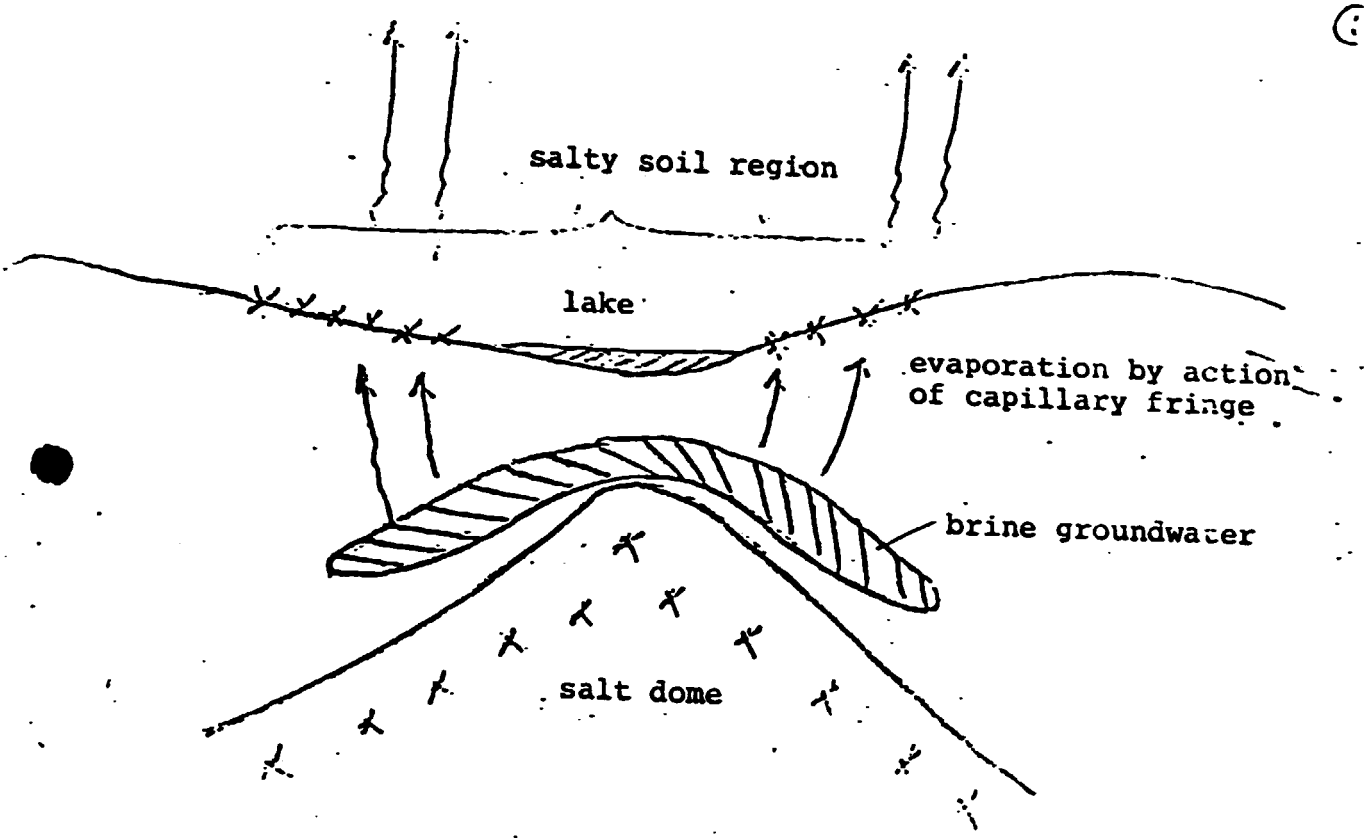


Figure 2 Idealized Salt Anticline Model for the Khorat Plateau

Figure 3


salty soil region
lake
evaporation by action of capillary fringe
brine groundwater
salt dome

Annex VI

Date: 23 April 1985

Day: Tuesday

Session: No. 3

Title: Anticipated Industrial Exploitation of Non-metallics

Lecturer: Dr. M. Bartuška /CSSR/

I. SUMMARY

The paper briefly discussed in general terms six important industrial minerals in terms of : a/ mineralogical structure, b/ production technologies and c/ upgrading methods.

1. Clays
Kaolins were presented as the most important of the clays and they were categorized in terms of their geology/mineralogy as well as their end-uses. The speaker expressed the opinion that large reserves of good quality kaolin would mean wealth for any country.

2. Quartz
The speaker explained that quartz was the second most wide-spread mineral in the earth's crust after feldspar. Quartz mineralization was sub-divided as: vain quartz, crystal quartz, quartz sands and quartzites and the specific end-uses for each type of material were discussed.

3. Diatomite
The basic composition of diatomites was explained and the end-uses of diatomaceous earth were related to the composition. A cut-off grade of 2 microns was suggested with separation in centrifuges. It was explained that magnetic separation could also be applied to separate diatomite from contaminating clay minerals. It was observed that the United States was the largest producer of diatomaceous earth.

4. Feldspar
It was explained that feldspars are used primarily as fluxes and to a lesser extent as binders and that the iron content is a limiting factor in their application in ceramic and glass productions.
Feldspar deposits were categorized as follows:
a/ pegmatites - characterized by large crystals, a high concentration of feldspar and low iron content,
b/ magmatic rocks - typically aplites and granites - with a feldspar content of about 55%. Such deposits are easily mined, being bigger than the pegmatites and flotation is used to upgrade rocks with greater than 0.6% Fe_2O_3 content.

c/ Kaolin residues and feldspar gravel sands - these are usually very large deposits and natural size classification greatly assists in the exploitation of the deposit. Magnetic separation of iron containing minerals, such as biotite, can reduce Fe_2O_3 concentrations from over 0.4% to 0.2%.

Again the United States was highlighted as the main producer of feldspars but it was pointed out that there are still many un-developed pegmatite deposits in developing countries with good prospects for exploitation.

5. Carbonate raw materials
The speaker referred to the written paper but he omitted this topic in his presentation.

6. Perlites
The nature of perlites was explained, both in terms of their geology and commercial application and their importance in the construction industry of the industrialized countries was emphasized. Many other diverse uses of perlites, such as a carrier, an extender and a filter aid, an oil adsorbent and a cryogenic insulator were mentioned.

Annex VII

Date: 23 April 1985

Day: Tuesday

Session: No. 3

Title: Technology Assimilation in Non-metallic Minerals Based Industries

Lecturer: Mr. J. Müller /CSSR/
(Presentation of complex paper was not done because of time constraint)

SUMMARY

1. A care for industrialization in developing countries was presented and the development of ceramic industries in Turkey, Brazil, India and Czechoslovakia were briefly described.

2. The possibilities of economies of scale were outlined but pointing out that most industrialization was through small firms.

3. This complex issue was discussed in length.

Annex VIII

Date: 24 April 1985

Day: Wednesday

Place: Carlsbad Porcelain Works, Karlovy Vary
Production Plant at Nová Role

SUMMARY

One of the five porcelain dinnerware factories of the plant at Nová Role employs about 1,200 people out of which about 70% are women. This factory was built in 1963 and produces a wide range of dinnerware both for local and export markets. The machinery is mostly from West Germany and the kilns are from West Germany, too. The body mix used is basically of 50% washed kaolins, 25% feldspar and 25% quartz sand. No ball clays are used in the body. Due to substantial automation, the % damages up to the end of white drying is around 5 - 6%. Shaping is done both by flat and hollow ware roller machines and casting. Bisque firing was done at around 900°C and the glost firing was at 1380 - 1420°C. Whiteware was then decorated using transfers and finally fired at 700 - 900°C.

The Fe_2O_3 content of the clays should be below 0.8% and the TiO_2 content should be below 0.4%. However, the Fe_2O_3 content of sand is below 0.25% and they use granulated sand of 1.0 - 0.8 mm size.

The suitability of each type of kaolin for a particular product is usually determined in the laboratory by several tests including the Pfefferkorn test for plasticity. The plasticity index permits to find out the suitability of the clay.

Contamination of the body by free iron should be avoided by incorporating stainless-steel piping, etc. as far as possible in the production process and sieving of the slip as well as the glaze should be done through 300## mesh to avoid detectable specks to the naked eye.

For porcelain and electroporcelain industries there is no hard and fast rule on the use of a specific body composition. However, the body composition has to be determined after examining the chemical and mineralogical analysis of the raw materials and calculating the Sagger formula composition of body and glaze.

The glaze and body should be matched for thermal expansion and case must be taken to have the correct glaze thickness. In electroporcelain industry, a high green strength is required to retain the complex shapes during drying.

The porcelain ware should be of zero porosity. To achieve this raw materials should be free of combustible materials so that proper vitrification could be achieved at the right temperature. It must also be ensured that translucency will be achieved along with vitrification at the optimum maturing temperature.

In firing a porcelain product, optimum firing temperature and firing conditions (whether reducing, oxidizing or neutral) should be determined. In some ceramic products, such as silica bricks, there have been efforts to lower the final temperature and firing for a longer time.

Cobalt oxide of various forms is used in the production of stains for porcelain industry.

Greenware waste is reduced and in some plants a certain percentage of the biscuit rejects are incorporated in the body. In the CSSR the rejected glazed porcelain pieces are used by other tile manufacturers.

The waste water is treated to remove the solids and soluble chemicals and allow it to flow into the river.

There are various forms of incentive in forms of bonuses etc. to increase the productivity of porcelain industry in the CSSR.

The quality controlling of the product is being done by the laboratories at the plants.

Annex IX

Date: 24 April 1985

Day: Wednesday

Place: Research Institute for Ceramics, Refractories and Raw Materials, Pilsen
Division at Karlovy Vary

I. SUMMARY

1. The Research Institute for Ceramics, Refractories and Raw Materials in Pilsen, and its Division at Karlovy Vary was established to provide the necessary research services to the ceramic and refractories industries in Czechoslovakia and other interested parties worldwide. The Institute provides services essential to the proper evaluation of non-metallic mineral deposits.

2. The Institute is engaged in the research of:
   a/ methods of extraction of non-metallic raw materials,
   b/ methods of dressing and refining of non-metallic raw materials for the ceramic and glass industries,
   c/ technology and corresponding equipment development.

   Raw materials investigated include: plastic materials, such as kaolins, clays, bentonites, and non-plastic materials, such as feldspars, quartz and diatomaceous earth.

3. The Institute is self-financed and has the following sections: Chemical, Mineralogical and Technological Laboratories in addition to various Research Laboratories and Pilot Plant sections.

   Chemical laboratory
   The laboratory is capable of carrying out complete silicate analyses. About 2000 complete silicate analyses are carried out per year of which 80 per cent are conducted for the Institute's research teams and 20 per cent quality control. Some determinations are also done for other organizations mainly through UNIDO.

   Mineralogical laboratory
   The laboratory is equipped with the following equipment:

   a/ Combined D.T.A. and T.G.A. and the dilatometer apparata for the evaluation of the thermal behaviour of various materials
   b/ High temperature microscope
   c/ Grain size distribution apparatus
   d/ Apparatus for preparation of samples with less than 1 µm grain size
   e/ Infra red analysis
   d/ X.R.A. apparatus for quantitative/qualitative determination of mineralogical compositions

Technological laboratory
Technological apparata for the tests, such as
- whiteness
- bending strength
- shrinkage
- plasticity
- water content
- settling
- rheological properties

Research laboratories
The laboratories have equipment for the separation and upgrading of non-metallic minerals, such as electrostatic separators, magnetic separators, flotation cells, attritioning tanks, etc.

Pilot plant
The pilot plant is capable of scaling up separation and upgrading process for ceramic raw materials. Equipment, such as ball mills, crushers, magnetic separators, filter-presses, stirred tanks and a workshop for maintenance and manufacture of pilot plant equipment suitable for their own use.

II. CONCLUSIONS AND RECOMMENDATIONS

1. The Division at Karlovy Vary of the Research Institute for Ceramics, Refractories and Raw Materials, Pilsen with its highly qualified personnel and its specialized equipment offers a wide range of services for the development of non-metallic raw materials with special reference to the glass, ceramic and other allied industries. In addition, the Research Institute is involved in the development of other uses of non-metallic raw materials, such as agricultural applications, water purification, etc.

2. The Research Institute with its divisions is the most important scientific and research partner for the UNIDO-Czechoslovakia Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries.

   This facility offers assistance to any interested developing country in this field. Such assistance includes for example training of personnel, the provision of expert services, the provision of research services, assistance in establishing similar institutions, energy management, etc. To date, more than 60 mainly developing countries have taken advantage of these services.

3. Establishment of such institutions in developing countries is a necessary first step in the efficient development of the local non-metallic raw materials. These institutions should be adequately equipped and manned by properly trained personnel. In order to ensure maximum benefits from the utilization of non-metallic minerals all possible uses must be investigated. To this end co-operation by way of exchange of information and visits is encouraged among institutions in different countries.

Annex X

Date: 25 April 1985

Day: Thursday

Place: Kaolin Washing Plant at Kaznějov

I. SUMMARY

1. The deposit visited is the biggest kaolin deposit in Continental Europe. Its quality is of the first class and there is an increasing demand for it in the world market, it is exported to over 20 countries. The company is one of the four largest world producers of kaolin.

2. Regarding the origin of the deposit, it results from the kaolinization processes of the Precambrian granites which suffered also secondary classification process due to the transportation by water and that fills the ancient basin at the Tertiary age. The transported sediment field reserves are estimated in the amount of several hundred million tons.

3. Mining method - The mining system is selective from an open pit, with an average overburden of 5 meters. The magnitude of the actual walls allows the selection of several distinct qualities that are blended at the plant in order to satisfy specifications of consumers in a diversity of final industrial uses. They use two methods of clay extraction, one by shovel and the other by electric excavators, both provide the charge to the trucks that transport the ore to the beneficiation plant installed very near the pit.

4. Process - The homogenous high quality of the kaolin clay eliminates the most of difficulties of other processes and allows a logical and very practical design of the layout utilized in order to fulfill a large production of about 350,000 ton/year of products.

   The ore is crushed in hammer mills to max. 80-mm pieces and then mixed with water in special blungers and screened in trommel washers that desintegrate the lumps and eliminate the gravels and coarse sands. The slurry without sands is transported by pumps on to a battery of hydrocyclones that separate two fractions. The underflow is recycled and the overflow is screened on inclined screens to remove impurities, such as roots and light organic substances.

   From here the slurry, which has a low solids content, is again hydrocycloned. The overflow is pumped to the sedimentation tanks where it is thickened and pumped to high gradient magnetic separators /H.G.M.S./ to eliminate iron minerals.

From the H.G.M.S. the slurry goes to centrifuges for dewatering and then to the storage and blending tanks. The slurry conditioned is filtered in a battery of hydraulic filter presses. The filter cake is extruded and dried in 3 band driers and pulverized in an attritor (flash drier and delumper) that drops the water content to 0.5 per cent.

5. Grades - The various grades of kaolin must satisfy the specifications of the different industrial end-uses. It is applied in paper coating, paper filling, ceramics, rubber filler, cosmetics, medicine and other end uses. The main use is in paper production due to the fact that the crude kaolinite ore has around 60% of particles with a size of about 2 µm.

6. Discussions

Silica sand removed from kaolin is used for manufacturing bricks by a neighbouring plant.

Titanium dioxide is used by several industries, such as the paint industry.

The maximum intensity of the magnetic separation was 20 000 gauss.

Output of products is: 20% kaolin, 60% sand and 20% rejects.

Economy of the plant depends only on kaolin.

Balance on materials is under control by weighing all input - output products.

Demand of kaolin is determined by international demand.

Forecast production is up as the paper industry is growing.

About the problem of dust inhalation in the packaging area of the plant, it will be adjusted to more adequate conditions.

Annex XI

Date: 25 April 1985

Day: Thursday

Place: State Farm at Křimice

The Křimice State Farm which pioneered the use of bentonite as soil conditioner in Czechoslovakia is located near the town of Pilsen. It has 10,000 hectares of land two-thirds of which are cultivated and the rest is grazing land. It owns 8,500 cows and 15,000 pigs. The total annual turn-over is 200 million crowns out of which 20 million is profit.

The farm applies bentonite and varying proportions of other soil conditioners to all its sandy soil lands which are cultivated for different purposes, including green house, cash-plant and field-crops.

The green house which is equipped to provide optimum temperature conditions during the severe winter climate is used for planting and preparation of flowers and low green plants. These are transplanted to the nurseries for growth before sales. The green-house and nursery field soils are supplied with mixed bentonite and other soil conditioners to stimulate germination, rooting and growth.

All the sandy soil land cultivated for field crops are also supplied with bentonite which significantly increases the yield. However, the activity of the bentonite decreases with time necessitating additional application after seven years. This is demonstrated by the healthy and high growth rate of plants to which bentonite has recently been applied compared to the rates in fields of earlier application.

Annex XII

Date: 26 April 1985

Day: Friday

Place: Research Institute for Ceramics, Refractories and Raw Materials, Pilsen
Division at Horní Bříza

SUMMARY

The Division for Ceramics and Refractories at Horní Bříza of the Research Institute for Ceramics, Refractories and Raw Materials in Pilsen is engaged in the research of technology of the manufacture of floor and wall tiles, stoneware, refractory and insulating materials of all types and of sanitary and tableware. The Division is also involved in energy conservation in the production of ceramics, refractories and non-metallics.

The Division is divided into a number of sections, such as: planning of research, structural ceramics and glazes, refractories, pilot plant, analytical laboratory, technological laboratories and workshop for prototypes.

The Division has a number of projects in progress, these include projects on fired and non-fired ceramics, special graphite and high alumina refractories, ramming mixtures, plastics materials, non-decorated floor tiles, dense ceramic roofing tiles, chemical bonded refractories and others.

The Division is equipped with highly specialized equipment for the determination of all the technological properties of raw and manufactured products. In addition, the Division has a well equipped laboratory for energy conservation work and a mobile unit for monitoring energy usage in factories. All research duties are verified in the Pilot Plant on a semi-industrial scale before transferring to the industry.

Discussions were centered on the following issues:
a/ graphite refractories including high alumina graphite refractories
b/ chemical bonded refractories including the theory of chemical bonding
c/ various methods of energy conservation in the production plants
d/ organizational chart of the Division in the relationship to other divisions of the Research Institute.