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TECHNICAL WORKSHOP ON THE INTEGRATED EXPLOITATION
OF LOCAL NON-METALLIC RAW MATERIALS IN DEVELOPING COUNTRIES

Organized by UNIDO and the UNIDO-Czechoslovakia Joint Programme,
Non-metallic Industries from 14 through 29 March 1988 in Pilsen,
Czechoslovakia

UNIDO Project UT/INT/87/041 (Specific Activity Code J 13419)

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,
Non-metallic Industries, Pilsen

Pilsen, Czechoslovakia

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LIST OF ABBREVIATIONS

1. RICRRMP Research Institute for Ceramics,
Refractories and Non-metallic Raw
Materials, Pilsen
2. INTIB Industrial and Technological
Information Bank
3. DSA Daily Subsistence Allowance

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I. INTRODUCTION

The Technical Workshop on the Integrated Exploitation of Local Non-metallic Raw Materials in Developing Countries was organized by the UNIDO Vienna and by the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries in Pilsen[†], Czechoslovakia in co-operation with the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials in Pilsen. This workshop has been 17th one organized during the 10 years of the Joint Programme history.

The objective of the Workshop was to foster the prospect of integrated exploitation of selected non-metallic minerals (limestone and marble, kaolin, bentonite) in developing countries as they play 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, Non-metallic Industries, Pilsen.

The UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries in Pilsen was established at the Research Institute for Ceramics, Refractories and Non-metallic 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, glass and other products based on non-metallic minerals.

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 programmes and in organizing 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 technical assistance missions that regard all technological issues of the development of ceramics, advanced ceramics, building materials and non-metallic minerals based industries. The Joint Programme also renders technical assistance to developing countries within its programme of energy conservation and management and in the application of non-metallic minerals and rocks in agriculture and environmental engineering.

Transfer of technical and scientific information has taken up a very important place in the overall activity of the Joint Programme. The information and publications are distributed through a node of INTIB specialized in non-metallic minerals and energy conservation which is equipped for contacts with external databanks.

[†]Note: hereinafter called Joint Programme, Pilsen

II. PARTICIPANTS

24 high qualified governmental nominees from 17 developing countries took part in the Workshop. Their list is presented in Annex I.

15 of the participants were nominated under the UNIDO project UT/INT/87/041 (Specific Activity Code 13419). The Workshop was of great concern for many developing countries and 80 professionals requested to participate. Therefore, other participants were invited to come under the arrangement of their respective Governments covering the round trip travel expenses and the Joint Programme covering their DSA from the training activities. Due to late arrangements the nominees from Burma who, however, requested to be invited to participate in the following workshop scheduled to be organized in the autumn 1988, could not turn up. Due to the schedule of departure of participants and according to their individual requests those who were in Czechoslovakia after the terminating of the Workshop were provided individual training programmes.

III. LANGUAGE

The programme was conducted in English and the lectures and country reports were typed in English, too.

IV. ORGANIZATION OF THE WORKSHOP

Organization was ensured by the Organizing Committee:

Director of the Technical Workshop	Mr. A. Lošťák, General Director of the Czechoslovak Ceramic Works, Prague
Programme Director	Mr. Z. A. Engelthaler, Chief Executive of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen and Director of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen
UNIDO Vienna Representative	Mr. N. G. Biering, Industrial Development Officer and Liaison Officer of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen
Technical Advisers	Mr. S. Hora, Technical Director, Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen Mr. O. Řehořovský, Director for Economics and Development, Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen
Technical Secretaries	Ms. E. Engelthalerová, Chief of Administration of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen

Mr. J. Müller, Senior Expert
UNIDO-Czechoslovakia Joint Programme,
Non-metallic Industries, Pilsen

General Rapporteurs

Mr. P. Duchek, Expert, UNIDO-Czecho-
slovakia Joint Programme, Non-metal-
lic Industries, Pilsen

Mr. F. Pecháček, Expert, UNIDO-Czecho-
slovakia Joint Programme, Non-metallic
Industries, Pilsen

Administration, Financial
and Passport Arrangements

Ms. Z. Zoubková, Administrative Clerk
Ms. A. Hrušová, Administrative Clerk

Board of Participants

Chairman:

Mr. Mohand Said Ould Ali (Algeria)

Vice-chairman:

Ms. Basilia Blessie A. (Philippines)

Mr. Zhu Gui Fang (China)

Mr. Silva Bendarage Don S.R. (Sri Lanka)

Mr. José Enrique Pérez Gonzales (Cuba)

1. Programme of the Workshop

The Workshop concentrated on three particular industrial minerals - kaolin, bentonite and limestone and this specialization reflected in the lectures and also in in-plant studies. Eleven lectures were presented by scientists, researchers and professionals from industries and technical universities that focused on exploration, excavation, classification, upgrading, production and integrated utilization of non-metallic raw materials for various applications. Aspects of energy management, environmental engineering and economic aspects related to industrial practice were taken into consideration. The lectures were governed by considerations guiding to practical applications.

The programme of the workshop comprehended industrial study visits to production plants on wall tile production, kaolin excavation and dressing, bentonite and expanded perlite refining and production. An agricultural farm applying non-metallic sorbents to rehabilitate soils and feed animals was also visited and time was reserved for studying the application of sorbents to recultivate landscape after coal mining. Visits to laboratories and pilot plants of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials in Pilsen enabled participants to study the research into non-metallic raw materials and related product development. Some participants requested to visit other plants and manufactures related to their main concern and responsibilities in their countries; the in-plant studies were extended by visits to floor tile production, feldspar upgrading, expansion of perlite and clay preparation.

The lectures and industrial study visits were completed by round table discussions giving the participants opportunity to exchange their opinions and experience with lecturers, managers and technical staffs in the production plants and Research Institute visited as well as among themselves. Observers invited for round table discussions who were Czechoslovak and renowned European companies dealing in non-metallic sector had valuable discussions with participants or sent their informative materials.

The workshop was co-chaired by the Board of Participants who elected the representative of Algeria as their chairman. They collaborated with the Joint Programme staff to prepare daily reports and to draft the final report.

2. Documentation and Aids

The following documentation and aids were handed over to each of the Technical Workshop participant and UNIDO representative

- Technical Workshop Schedule
- Complete set of eleven lectures
- Bulletins and booklets and technical leaflets of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen
- Publication on the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen
- Multilingual vocabulary for ceramic industry and non-metallic raw materials
- English-Czech Practical Handbook
- Writing materials and handbag
- Protective helmet for in-plant training
- Cumulative list of Joint Programme publications

Whenever requested participants were presented samples of products.

3. Discussions

The participants enriched their scope of knowledge during the discussions with the representatives who are mentioned in Annex II.

4. Lectures Delivered

1. Mr. A. Losťák: Czechoslovak Industrial Development Based on Non-metallic Minerals and Rocks
2. Mr. Z. A. Engelthaler: Basic Consideration Guiding the Exploitation of Non-metallic Minerals
3. Mr. M. Kuzvart: Evaluation of Local Non-metallic Raw Materials Deposits
4. Mr. M. Bartuska, Technological Classification of Non-metallic Minerals and Rocks
Mr. F. Pecháček:

5. Mr. Z. Štěpánek: Extraction and Beneficiation of Selected Non-metallics
6. Mr. J. Kačín: Compounding Ceramic Bodies
7. Mr. J. Petr: Non-metallic Minerals in Agriculture
8. Mr. P. Duchek: Special Applications of Selected Non-metallic Raw Materials
9. Mr. M. Nový: Principles of Energy Management in Non-metallic Industries
10. Mr. J. Matoušek, Expanding Non-metallic Minerals Use for
Mr. J. Hlaváč: Advanced Ceramics
11. Mr. J. Müller: Economic Aspects of Non-metallic Minerals Exploitation

5. List of Locations of In-plant Trainings

UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen

Technology and energy conservation in the production of ceramics and refractories

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

Wall tile production

Westbohemian Ceramic Works,
Horní Bříza
Wall tile plant at Horní Bříza

Kaolin extracting and washing

Westbohemian Ceramic Works, Horní
Bříza
Kaolin Washing Plant at Kaznějov

Application of Non-metallic in Agriculture

Agricultural State Farm, Křimice

Perlite production

Košice Ceramic Works, Košice
Perlite Plant, Prague

Extraction, up-grading and refining of Bentonite

North-Bohemian Ceramic Works, Most
Bentonite Dressing Plant at Obrnice

Case study tour on the application of bentonite and recultivations

Coal Mining Area, Most

Extraction, up-grading refining and evaluation of non-metallics

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

Other training was organized according to requests (see chapter VIII).

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 17 countries to share their experiences in an industry which has not been getting due attention in the effort of industrialization. In the time that was available the participants shared freely the problems faced by their respective countries in the effective utilization 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, standardization, quality control and testing, and integrated exploitation of indigenous raw materials. The participants recognized that the information gained during the visits, lectures and round table discussions will help in their further activities in their home countries.

Following visits to the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen and factories of the Czechoslovak Ceramic Works the participants desired for further co-operation with the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen 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, Non-metallic Industries were of great interest to participants.

The participants considered that the scope and coverage of the workshop was adequate. The workshop contributed 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 non-metallic industries.

The participants expressed their gratitude to UNIDO and the Joint Programme for arranging this workshop in Czechoslovakia where the authorities are very generous in sharing their knowledge and experience. The participants highly appreciated generosity extended by the organizers to arrange for extra visits of plants according to their individual concern and requests.

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 for Ceramics, Refractories and Non-metallic Raw Materials and Chief Executive of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, for well prepared programme and his personal involvement in the various activities. They further appreciated his part in the round-table discussions.

The participants expressed their gratitude to Mrs. E. Engelthalerová, Chief of Administration, and Mr. J. Müller, Senior Expert, Mr. P. Duchek and Mr. F. Pecháček, General Rapporteurs and to the other staff members of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, who were always helpful and contributed to the success of the workshop.

VII. CONCLUSIONS AND RECOMMENDATIONS

The discussions of the Workshop generated conclusions:

1. Upgrading of Knowledge in Developing Countries in Industrial Mineral Sector

Non-metallic minerals and rocks play an important role among the industrialization plans and projects of developing countries. International co-operation and technical assistance to promote the development of industrial minerals sector is needed.

UNIDO and the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, should:

- a) arrange regular workshops and seminars at regional and inter-regional level specialized on one mineral alternating with workshops devoted to broader technological problems annually. The participants recommended that those workshops should be also organized in developing countries (in the co-operation with the UNIDO and the Joint Programme) in which facilities and capabilities for such arrangements are well established, such as Algeria, India, People's Republic of China.

The pattern of financing the participation on the basis of the nominating governments covering the round trip air tickets and the organizer covering the DSA should be considered as one of the means for the extension of Joint Programme Pilsen training activities, however UNIDO is requested to continue to provide round trip air tickets as at present.

Aide memoires of seminars are recommended to describe in detail the programme to facilitate the nomination procedure with reference to the topic of specific activities in geology research, mining extraction, mineral upgrading etc. In future this can be a base for specialized discussions in the seminars. It is considered desirable that these discussions concentrate on specific problems as presented by participating countries pending on time available.

- b) review the status of this industry in developing countries in view of its constraints related to:
- planning
 - technology
 - financing
 - manpower
 - environmental protection
 - role of research and development centres and non-governmental organization in the development of non-metallic minerals based industries.
- c) continue editing technical publications focused on particular minerals, particular plant profiles and other issues as requested by developing countries. These indigenous publications will be distributed through the INTIB node, Pilsen, which can also edit and distribute titles presented by the scientists, researchers and professionals from developing countries who may have concern. Some participants in the workshop presented the works for publishing through the INTIB node. On the other hand they requested Joint Programme publications in the amounts of 30 - 110 titles each.

The participants desire that the Joint Programme, Pilsen technical publications may be made available to the R + D organizations through UNDP offices in the respective developing countries.

- d) continue casting new audiovisual programmes focusing on particular problems related to the industrial minerals so that training process in their national centres could be upgraded. The participants found the presented audiovisual programmes interesting and useful and requested UNIDO and Joint Programme, Pilsen to provide copies for their national centres. They also appreciated the promptness of CAVIS (Centre for Audiovisual Systems, Prague) who cast and presented a short movie recording some events of the workshop the copy of which they requested to be added to the above parcels.

The Joint Programme, Pilsen is ready to provide developing countries with copies of any audiovisual programme of its own on assumption that the country will send free cassette to the Joint Programme, Pilsen.

2. Introducing of Advanced Materials and Technologies to Developing Countries

The prospect and importance of advanced materials, namely ceramics, that are related to the industrial mineral sector, were emphasized by the participants. UNIDO and the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, should arrange for an expert group meeting

to analyze the status of the industry and institutional frameworks for the development of this industry, formulate the need for UNIDO technical assistance and for international co-operation. Special attention should be paid to testing indigenous raw materials from developing countries. It is recommended that experts from developing and developed countries should be invited.

3. Energy Conservation

There is the growing need of energy conservation in developing countries. Non-metallic minerals are recognized to play an important role in this respect both in residential as well as industrial sectors. There exist 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 large scale due to lack of adequate know-how and technology transfer. The following problems are in the centre of the interest:

- a) utilization of fluxing agents
- b) optimization of thermal processes
- c) energy diagnostics
- d) rehabilitation of thermal units
- e) kiln furniture
- f) waste heat recovery
- g) application of mobile diagnostic unit for energy audits in production plants

Participants recommend that the system of energy control should also focus on energy conservation during geological exploration, mineral extraction and dressing because these processes are energy intensive, such as grinding.

The experience of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen in this field was shared with the participants, who asked for basic information on Mobile Diagnostic Units. The list of equipment to audit energy was attached as Annex IV. UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen is ready to extend necessary assistance.

4. Industrial 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 including the measures taken to lower the waste during mineral processing which will contribute considerably to economic results and environmental protection. In this respect it is recommended that inventory studies are conducted and industrial directories are prepared and made available to the users. An important part of the exploration process is the characterization of the raw materials. The participants recognized the work that the Joint Programme carried out in testing non-metallic raw materials for developing countries and welcome any possibilities of extending this activity through a new UNIDO project.

5. Non-metallic raw materials for agriculture and environmental engineering

Non-metallic minerals and rocks functioning as sorbents may successfully be applied in agriculture to enhance the yield of deficient soils and for wastewater disposal. To promote the application of those minerals in developing countries the following is recommended:

- establishment of a group of consultants to assist developing countries in this field
- organization of group training programmes
- publishing activities

6. UNIDO technical assistance and further co-operation with the Joint Programme, Pilsen

Evaluating the capability of the Joint Programme, Pilsen, representatives of participating countries expressed conclusions and requests for further co-operation as mentioned in Chapter IX. They recommended that their requirements should be respected by the Joint Programme, Pilsen and UNIDO Headquarters in further activities and planning.

Some of participants will investigate the opportunity for applying to UNIDO for the formulation of new UNIDO technical assistance projects related to the integrated industrial exploitation of non-metallic raw materials in their respective countries.

Participants appreciated the assistance of UNIDO Vienna that supplied a psychrometer for the determination of humidity.

VIII. OTHER ARRANGEMENTS

- a) Participants from People's Republic of China, Democratic People's Republic of Korea, Greece, Algeria, Cameroon, Ethiopia, Suriname, India raised the request to visit some other plants in addition to the programmed activities.
 - feldspar upgrading plant, Halámky (Calofrig Borovany)
 - perlite expansion plant, Prague (Ceramic Works Košice)
 - laboratories of environmental engineering and ceramic research (Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen)
 - floor tile plant (Chlumčany Ceramic Works, Chlumčany)
 - wall tile plant (Westbohemian Ceramic Works, Horní Bříza)
- b) Participants from China, Vietnam, Yugoslavia, Cameroon, Ethiopia, India, the Philippines, Indonesia presented technical and country papers to be edited and disseminated through the INTIB node of Joint Programme Pilsen. All participants were made acquainted with this arrangement and invited to publish whenever felt relevant.
- c) Renowned European and Czechoslovak engineering firms and organizations were invited to participate in as observers. Some of them took part in the round table discussion on 22 March and other sent informative materials such as LECO, the USA. During the above discussions possibilities and opportunities for co-operation were highlighted as well as some technical and technological issues.

IX. REQUESTS FOR CO-OPERATION

The participants in the workshop presented Country Reports. Their analyses of the status of the non-metallic mineral sector yielded conclusions that formulated the need for technical assistance and co-operations as seen from the participant's professional standpoints. The following are particular country's requests for UNIDO technical assistance and co-operation with the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, including some comments/remarks regarding this seminar.

India

This Technical Workshop on Integrated Exploitation of Local Non-metallic Raw Materials in Developing Countries primarily has given us the opportunity to study the activity of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen.

It has been made clear from various deliberations, visits to different factories that the programme is very relevant to the basic needs of the developing countries including India.

The suggested areas of future collaboration are enumerated:

1. Beneficiation of Low-grade Ceramic Raw Materials

It has been discussed in details that India has vast deposits of low-grade raw materials which need upgrading for meaningful utilization for manufacture of socially beneficial items like sanitarywares and other building material components. A low-cost proven technology for upgrading of low-grade clayey materials is very much necessary in India and any programmes in the above field in future would be beneficial.

2. Technology on Newer Types of Building Components for Low Cost Housing

India has a massive programme for development of non-conventional building components for low-cost housing under the 7th Five year plan. Scientists at Central Glass and Ceramic Research Institute are actively engaged in such activities and they would be happy to share their experiences with those of the other experts from various developing countries.

3. Application of Bentonite in Agriculture and for Environmental Protection

The participants from India are delighted to know that the Research Institute for Ceramics is actively engaged in new research activities concerning with non-traditional application of sorbent properties of some non-metallic raw materials, e.g. bentonite, perlite, zeolite, diatomaceous earth, expanded clays etc.

Specially, the use of bentonite for agricultural purposes enriched the soil and achieved a significant rise in yields in sandy soils. In northern part of India, the soils are sandy and rainfall is not adequate. The use of bentonite may help in lowering down the consumption of irrigation water, to promote more efficient use of nutrients and fertilizers in the soil and to prevent their washing out to subsoil water. India would be happy to join in such programmes organized in future.

4. Energy Audit and Energy Management

There are in India around 5000 down draft kilns, mainly concentrated in the small scale sector, being used for firing of heavy clay wares, refractories, stoneware products and various other ceramic items. The kilns are not energy efficient and also create environmental pollution by belching out thick smokes through the chimney to the atmosphere. Most of the units in the small-scale sector are sick and are not in a position to switch over to sophisticated kilns: like tunnel, shuttle and roller kilns due to resource constraints. The Central Glass and Ceramic Research Institute has therefore identified the areas of Energy Conservation/auditing and pollution abatement as one of the "Thrust area" of its research activities. India looks forward to share its experiences with the rich experiences of the experts in the developing countries and such interactions would be beneficial to both.

Finally, the participants from India would like to record their sincere thanks and gratitude to UNIDO Vienna, UNIDO-Czechoslovakia Joint Programme, Pilsen and Government of India for the opportunity to visit and to study various research programmes carried out at Czechoslovakia. Special thanks are due to Mr. and Mrs. Engelthaler and all their colleagues for the discussions, arranging visits to R+D institutions and factories as well as for the warm and homely hospitality during stay here at Pilsen.

5. Establishing of Technical Library

UNIDO and UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, are asked to consider the possibility of establishing a technical library in the field of non-metallic minerals and rocks which should be made freely available to developing countries.

Sri Lanka

1. Further development of ceramic and glass industries in Sri Lanka will require an adequate exploration of local mineral basis, especially, kaolins, clays, silica sands and blended clays. In this respect there is a need for characterization of raw materials and for relevant training. The existing ceramic research laboratories, established in co-operation with UNIDO need to be extended, from ceramic technology to the integrated exploitation of non-metallics.
2. The previous tests done by the Joint Programme were highly appreciated and further co-operation in this field is expected and desired, as well as Joint Programme publications, training and other assistance of the following scope:
 - a) It is requested that the UNIDO mission of the Joint Programme, Pilsen, should take place in November 1988. The Authorities recommended that this mission should also formulate a non-UNIDO project which they plan to submit to UNIDO.
 - b) The Ceramic Research and Development Centre needs new facilities to cope with the requirements of industry-devices for testing brightness of kaolin, pilot plant equipment for upgrading of non-metallic including experimental hydrocyclones and magnetic separator and experimental air classifier.

- c) Upgrading the knowledge of Sri Lankan technicians is important for further non-metallic mineral exploration. Therefore three-month courses for 3 technicians will be requested to be executed by the Joint Programme, Non-metallic Industries, Pilsen.
3. International experts are to be appointed for the newly required UNIDO technical assistance project to assist in the exploration of kaolins, clays, silica sands and blended clays. 3 experts for two-month missions each considered to be included to the project together with a one-month mission of one expert related to integrated technological exploitation.
4. Sri Lankan representative gave his thanks to all members of the Joint Programme, Pilsen for their kind co-operation and hospitality.

Cuba

1. The following indigenous raw materials are in the focus of concern for further development
 - raw materials for various ceramic products
 - manufacture of refractories
 - limestone and sands for building materials
 - clays
 - kaolins
 - gypsum
 - raw materials for cement industries

Technical assistance of UNIDO through the Joint Programme to cope with the exploration of above materials will be studied to include the following issues:

- a) training in the Joint Programme, Pilsen
- b) geological prospection and testing of selected industrial minerals including the research of relevant technologies
- c) installation of a pilot plant to develop relevant technologies for the above materials

The Ministry of Industrial Building Materials will analyze possibilities, especially financial sources, for further expansion of non-metallic mineral sector and will formulate a request for the above assistance from UNIDO. The Ministry might request Joint Programme experts for the formulation mission to Cuba.

2. The Ministry of Industrial Building Materials is much interested in the co-operation with the Joint Programme, Pilsen. They are especially interested in the following Joint Programme activities:
 - a) tests of selected raw materials which will be despatched to Pilsen soon.
 - b) technical information and Joint Programme publications
 - c) training of technicians and participation in workshops. Two experts will be nominated by Cuba to participate in the next Joint Programme workshop on non-metallics.

Democratic People's Republic of Korea

1. The previous co-operation with Joint Programme, Pilsen consisting of training and, especially, of testing raw materials is highly appreciated by the Korean Authorities that are interested in developing this fruitful co-operation with the Joint Programme, Pilsen also in future.
2. The main concern relates to the development of industrial exploitation of indigenous reserves of industrial minerals. It has been recognized in Korea that UNIDO technical assistance in this respect should bring results and, therefore, an exploratory mission of the Joint Programme, Pilsen to formulate need and to draft a UNIDO project is requested.
3. One of the main concerns to go on developing industrial mineral sector is the upgrading of particular knowledge of technicians and engineers.

The following training as requested to be realized through the Joint Programme, Pilsen:

- perlite expansion
 - non-metallic mineral upgrading including glass technologies
 - manufacture of selected ceramics
 - manufacture of refractories
 - exploration of magnesite raw material
4. The Joint Programme, Pilsen is requested to develop technology of indigenous perlite expansion. Other raw materials are of concern to be tested, too, in Pilsen.
 5. To settle the pressing need of expanded perlite for lightweight concrete Korea intends to import expansion kilns heated by propane-butan.

Cameroon

1. There is a market for clay building materials in Cameroon which is supplied from abroad despite of fact that quality clays are available in the country. Among the most prospective for industrial utilization are smectites and lateritic clays.
2. In this respect of developing local material based industries the lack of adequate characterization tools is felt. Therefore, the Authorities will apply for UNIDO assistance through the UNDP office. As the initial activity a 3-week mission of 2 Joint Programme, Pilsen, experts will be requested to analyze the need, capabilities and to formulate a relevant project.
3. The establishment of own non-metallic material characterization laboratories is considered vital for further development. The relevant assistance from UNIDO and the Joint Programme, Pilsen, will be welcome.
4. The Joint Programme, Pilsen, previous publications as well as new ones, concerning man-made substrates to grow cash and decorative plants are of concern together with information on soil standardization and classification.

The Philippines

1. The prior concern is the development of the manufacture of flat glass by means of float technology. The development largely depends on the availability of feldspar and silica. The assistance of UNIDO and UNIDO-Czechoslovakia Joint Programme, Pilsen is requested to test the samples of feldspar and silica which will be submitted soon. Further co-operation is expected to arise based on the preliminary test results of these materials.
2. The Philippines has been conducting laboratory studies on the utilization of local kaolin for industrial use. A technical co-operation to set up a pilot plant to test and verify the laboratory results for paper coating and filling is highly requested.
3. There is a need to organize an individual training in the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen for a group of engineers to establish their capabilities of quality control techniques in the sheet glass manufacture and manufacture of kiln furnitures.
4. The Philippines has vast deposits of limestone which is not well exploited. There is a need for investigation, characterization and exploitation of this material for industrial use such as for paper coating and filling.
5. Other non-metallic materials which need upgrading for industrial use are gypsum and bauxite. The Philippines import big quantities of this materials from Europe and Japan. We would like to request for technical assistance on the beneficiation of these materials.
6. Czechoslovakia is technically and industrially experienced in the bentonite utilization for agriculture and waste treatment. The Philippines would also like to await of this technical know-how through technical assistance agreements.
7. The Philippines is having a programme on energy conservation. Non-metallic industries in the country would appreciate very much if a co-operation with UNIDO-Czechoslovakia Joint Programme and Philippines will be organized on Energy Audit and Energy Management.

People's Republic of China

1. Wastewater disposal technology by means of activated bentonite as developed by the Joint Programme, Pilsen is of prior concern considering the availability of sorbents and the type of pollution in the country. Therefore, the Chinese Authorities will analyze the situation and are expected to apply for UNIDO technical assistance in this field. The project should cover the following:
 - transfer of relevant technical information
 - exploration mission to analyze the pollution type and sample appropriate bentonites
 - testing the samples and development of activating technology appropriate to the pollution type
 - training of Chinese technicians

2. A study tour of Chinese specialists is requested to precede the above project. They would study the results of the application of the bentonite for wastewater disposal on industrial scale.
3. The training provided so far by the Joint Programme, Pilsen, is highly appreciated as a contribution to upgrading Chinese experience in the upgrading of non-metallic raw materials. Further similar training programme is requested to cover especially upgrading of bentonite and delamination of kaolin.

Ethiopia

1. In connection with laboratory testing of bentonite samples in the Joint Programme, Pilsen, it is requested to conduct further technological tests aiming at the complex bentonite exploitation.
2. As the reclaiming effect of bentonite on sandy soils was proved in Ethiopia the follow-up in agricultural use of bentonite is expected pending on further government's decisions.
3. The development of the sheet glass manufacture has a priority in Ethiopia. Locally available materials (silica sands, dolomite, limestone and feldspar) are considered to be based on the results of tests. Technical assistance of UNIDO and co-operation of the Joint Programme in this field is requested.

Algeria

1. The traditional co-operation with the Joint Programme in the field of testing non-metallic raw materials, training and technology transfer is appreciated by Algerian authorities. It is requested to continue the successful future co-operation with the Joint Programme, Pilsen on a wider basis.
2. With respect to previous activities of the Joint Programme, Pilsen, in the field of non-metallics, Algeria is interested mainly in following problems:
 - a) Application of local bentonite in agriculture for plant growing/animal breeding purposes, for treatment of different wastewater types, as a filler and for bleaching purposes.
 - b) Improving of halloysite brightness and proposal of its exploitation in refractories together with proposal of body composition, as a filler, etc.
 - c) Exploitation of sand and feldspar separated during kaolin washing and verifying of kaolin use as a paper filler.
 - d) Lowering of iron content in feldspars, namely fine fractions
 - e) Beneficiation of the lower-grade diatomite before the calcination process
 - f) Proposal of up-grading technology for glass sands aiming at its use for quality glass production.

3. It is requested to carry out pilot-plant up-grading tests with raw materials sub para 2 a-f) to verify the beneficiation methods proposed by laboratory tests. The amount of each raw material should be 150-300 kg.
4. It is requested to establish a laboratory for testing and up-grading of non-metallic raw materials at E.N.O.F. through the UNIDO project which will be requested by Algerian Authorities.

Viet Nam

1. Viet Nam is interested in the future close co-operation with the Joint Programme, Pilsen, concerning technical assistance in industrial mineral testing, up-grading, training of Vietnamese specialists in the field of ceramics and non-metallic raw materials evaluation etc.
2. It is requested to arrange for laboratory testing of representative samples of Vietnamese bentonites, diatomites, glass sands, kaolins, sillimanite and disthen in the Joint Programme, Pilsen. The amount of samples should be 5 kg per each mineral and 20 kg for glass sand.
3. Viet Nam is interested in bentonite applications in agriculture (sandy soil reclaiming) and environmental engineering. In this connection representative samples of soil types which bentonite should be applied in are requested to be also tested. The amount of soil samples should be 2-5 kg.
4. It is requested to arrange for laboratory testing of kaolin samples from Viet Nam with a special attention paid to grinding and filtration processes.
5. The activities outlined above will be applied for through UNDP office Hanoi to UNIDO Headquarters, Vienna. A formulating mission of three experts (specialists in agricultural and environmental applications of non-metallic sorbents and in up-grading of industrial minerals) will be appreciated for bentonite applications in agriculture and wastewater treatment.

Mozambique

1. Originally the Mozambique ceramic industries were based on the import of ready-formulated bodies for Portugal. However, according to geological survey done after independence, the country is very rich in all non-metallic materials. There is a pressing need for a mission of a prominent expert to formulate what is to be done to further the development of the sector. The formulating mission should analyze the situation and recommend:
 - studies to be done
 - geological survey to be done
 - testing and exploration to be done
 - specialists to be appointed
2. Preliminary tests of selected raw materials that will yield recommendations for decision making process are requested.
3. The capacity of the Joint Programme, Pilsen has been recognized during the workshop as relevant for the above scope of assistance and in addition for the training of Mozambique engineers in integrated utilization of industrial minerals.

4. The above requests will be discussed with Governmental Authorities and an official application for the assistance of the above scope can be formulated and presented through UNDP.

Indonesia

After returning home the need for co-operation with the Joint Programme, Pilsen will be discussed within the National Committee for the Processing and Development of Industrial Raw Materials.

Because the capability of the Joint Programme in the line of the responsibilities of the National Committee has been recognized the future fruitful co-operation is welcome and expected. The request will be submitted through official channels.

Participants from other countries did not present any concerning UNIDO technical assistance and/or co-operation with the Joint Programme, Pilsen.

The participants agreed upon that co-operation among developing countries is beneficial. They, therefore, will recommend their governments to request that UNIDO could consider a possibility of establishing a formal network of co-operating R + D institutions in developing countries. This establishment is believed to help overcome obstacles which are frequently beyond the capacity of institutions desiring for co-operation.

The participants recommended that UNIDO should consider involving the conclusions and issues of the workshop into a background UNIDO paper presented at the IInd World Congress on Non-metallics in Beijing next year.

Annex I

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- UNIDO Vienna
- Mr. N. G. Biering, Industrial Development Officer, and Liaison Officer of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen
- ČSSR
- Mr. A. Lošák, General Director of the Czechoslovak Ceramic Works, Prague
 - Mr. Z. A. Engelthaler, Chief Executive of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen and Director of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen
 - Mr. J. Procházka, Head of the Division Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen (hereinafter called RICRRMP) Division at Horní Bříza
 - Mr. Z. Štěpánek, Head of the Division, RICRRMP, Division at Karlovy Vary
 - Mr. Kačín, Chief of Research and Development Department, RICRRM, Pilsen
 - Mr. M. Hajský, Senior Researcher, RICRRMP Division at Horní Bříza
 - Mr. M. Fiala, Senior Researcher, RICRRMP Division at Horní Bříza
 - Mr. P. Růžička, Chief of Laboratories, RICRRMP Division at Horní Bříza
 - Mr. J. Dlouhý, Technologist, Westbohemian Ceramic Works, Horní Bříza Wall Tile Plant at Horní Bříza
 - Mr. J. Kleisner, Technologist, Westbohemian Ceramic Works, Horní Bříza Wall Tile Plant at Horní Bříza
 - Mr. M. Kužvart, Professor, Department of Mineral Deposits, Faculty of Science, Charles University, Prague
 - Mr. P. Havel, Chief Technologist, Westbohemian Ceramic Works, Horní Bříza Kaolin Washing Plant at Kaznějov
 - Mr. M. Engelthaler, Assistant of the General Director, Czechoslovak Ceramic Works, Prague

- Mr. J. Mašek, Chief Technologist of Mining
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- Mr. M. Bartuška, Associate Professor,
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- Mr. F. Janák, Director of Stoneware Plant,
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- Mr. F. Pecháček, Expert, UNIDO-Czechoslovakia
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DAILY REPORTS

DAILY REPORT

14 th March, 1988

1. Registration of participants

Together 23 participants from contacted countries were registered. Mr. Kedar Nath Maiti from India and Mr. Bogalle Biazen from Ethiopia are still expected to arrive to Pilsen later.

2. Opening the Technical Workshop by the Programme Director Mr. Z.A. Engelthaler, Chief Executive of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen and Director of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen.

Mr. Z.A. Engelthaler introduced then the members of Organization Committee, participants, guests and the staff of the Joint Programme, Pilsen.

3. Mr. A. Lošťák, Director of the Technical Workshop, General Director of Czechoslovak Ceramic Works, Prague welcomed all participants, organizers of the workshop and guests and firstly made them acquainted with historical conditions of establishing UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen which accomplishes 10 years of activity in 1988. He stressed the important role of the trust of Czechoslovak Ceramic Works and of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials as the scientific and research centre of the trust.

4. Mr. A. Lošťák presented his lecture "Czechoslovak Industrial Development Based on Non-metallic Minerals and Rocks" in which he described history, presence, and future of ceramic and building materials industry in Czechoslovakia. He explained also assortment and organization of Czechoslovak Ceramic Works.

5. Mr. Z.A. Engelthaler informed of all materials which all participants had been provided with.

6. Election of Board of Participants

Mr. Mohand Said Ould-Ali (Algeria) - chairman
Ms. Basilia Blessie A. (Philippines) - vice-chairman
Mr. Zhu Guifang (China)
Mr. Silva Bendarage Don S.R. (Sri Lanka)
Mr. José Enrique Perez Gonzales (Cuba)

have been elected.

7. Organization matters

Mr. Z. A. Engelthaler informed of the most important activities during the workshop.

Mrs. E. Engelthalerová, Chief of Administration of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, informed of administration and financial matters and advised participants upon the possibility of supplementing the workshop programme according to individual wishes of participants.

8. Mr. J. Müller, Senior Expert of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen, presented some remarks concerning changes in the programme.

9. Official opening lunch

Mr. A. Lošťák, Mr. Z.A. Engelthaler and Mr. P. Hostinský, Lord Mayor of the City of Pilsen greeted the guests and participants.

10. Lecture: Basic Consideration Guiding the Exploitation of Non-metallic Minerals (by Mr. Z.A. Engelthaler)

In the first part of the lecture, Mr. Engelthaler thoroughly explained the ten-years activity of UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen. He stressed the increasing importance of this organization and presented the official standpoint of UNIDO-Headquarters, Vienna classifying it as the extended scientific and technical hand of UNIDO. Mr. Domingo Siazon, jr., Director General of UNIDO expressed his deep satisfaction with results of the Joint Programme during his official visit to this organization.

The scope of activities of the Joint Programme involves fostering of twinning arrangements, individual and group training (study tours, fellowships, seminars, meetings, workshops), testing of non-metallic raw materials, transfer of know-how and technologies to developing countries, industrial inquiry service provided by INTIB node established in Pilsen in 1987, energy management, environmental engineering, advanced ceramics and conservation of historical buildings. The second part of the lecture was devoted to the exploitation of non-metallic raw materials itself. It was claimed that the role of non-metallics is still increasing and these material play also important role within industrialization of developing countries. Kaolin, bentonite and limestone were dealt with in detail from the standpoint of their exploration, up-grading and final utilization.

11. Discussion on the paper presented by Mr. Z. A. Engelthaler dealt with problems of international standards and the relevant role of UNIDO (Mr. Mohand Said Ould-Ali, Algeria and Ms. Fotini-Halkiopoulou, Greece). Mr. Njianjek Azefor (Cameroon) raised the question of mutual feasible co-operation of UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen with Cameroon private and/or governmental enterprises. All questions were answered by Mr. Z.A. Engelthaler.
12. Mr. Zhu Guifang presented to the Organizing Committee a paper concerning a new method of the application of investment risk. The paper has been accepted to be formally edited as UNIDO-Czechoslovakia Joint Programme official publication to be disseminated through the UNIDO INTIB node Pilsen. Other participants were also invited to present their papers which they might find relevant to be published through this INTIB node service.
13. All participants agreed to the suggestion that their country reports would be presented under their authorship as the official publication of the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen.

DAILY REPORT

15th March, 1988

1. Lecture: Extraction and Beneficiation of Selected Non-metallics (by Mr. Z. Štěpánek)

Mr. Štěpánek presented his lecture dealing with kaolin and bentonite with respect to geological origin, mining and upgrading technologies. A special attention was paid to kaolin processing and upgrading using both classical and new modern methods of mechanical and magnetic separation. Concrete types of magnets used in Czechoslovakia were described as well as the efficiency of the beneficiation method. Bentonite properties applicable in various spheres of industry and agriculture were also mentioned.

2. Discussion on the paper of Mr. Z. Štěpánek involved mostly questions dealing with types and cleaning of matrix in the magnetic separator, applicability of this method for other types of non-metallics, treatment of raw materials before magnetic separation, determination of delamination degree and chemical methods of kaolin beneficiation. The questions were answered by Mr. Z. Štěpánek.

3. Lecture: Technological Classification of Non-metallic Minerals and Rocks (by Mr. M. Bartuška). Mr. Bartuška made all participants familiar with variety of methods for determination of chemical and mineralogical composition and microstructure of non-metallic raw materials.

For the selection of limestone for lime production the high content of CaO and the proper texture are very important. On the other hand, production of Portland cement requires lower content of CaO but not less than 35% of hydraulic components such as SiO_2 , Al_2O_3 and Fe_2O_3 .

Concerning kaolin properties, differences of grain size distribution and technological composition influence properties used in ceramic, refractory and filling applications.

4. The participants raised several questions on chemical analyses (determination of both FeO and Fe₂O₃), preparation of limestone samples for testing and suitability of atomic absorption method for silica and Fe₂O₃ determination. Concerning separate FeO analysis, it is of top importance for applications of non-metallics in rubber industry. It was also explained by Mr. Bartuška that for quick lime production chemical analysis and texture studying are of importance.

5. Lecture: Evaluation of Local Non-metallic Raw Materials Deposits (by M. Kužvart)

Mr. Kužvart presented principal non-metallic raw materials under consideration of this workshop (limestone and marble, kaolin and bentonite) from the geological point of view. For all of them, he explained separately geology, mineralogy, genetic types of deposits and prospecting exploration and dressing. The lecture was illustrated with many interesting examples of these raw material deposits and uses.

6. The questions related to the lecture of Mr. M. Kužvart were devoted to mechanisms of non-metallics testing with respect to geological drilling samples (Greece), properties of Algerian attapulgite, low cost and effective method of activation of low grade bentonites (India) etc. Some participants pointed out reserves in mutual co-operation between geologists and technologists. Mr. Z. A. Engelthaler explained different levels of non-metallics testing (orientation, laboratory and pilot tests) and approximative amounts of raw materials required. He also stressed the necessity of exact identification of samples subjected for testing.

7. Lecture: Compounding Ceramic Bodies (by Mr. J. Kačín)

Mr. J. Kačín explained several systems of division of ceramics according to the chemical composition, application, porosity and structure. He also presented different factors influencing thermo-mechanical properties and structure of ceramic bodies together with basic rules for compounding

ceramic bodies according to different chemical, structural and thermo-mechanical requirements. These rules were applied in case study dealing with high-alumina bricks, electrically conductive floor tiles and firing auxiliaries for microelectrical circuits substrates firing.

8. Discussion on the paper of Mr. J. Kačín involved following questions:

- influence of grain size on final properties of refractory products
- replacement of spray-drying by new methods of drying
- differences between single- and double-firing technologies in production of tiles and the relevant situation in Czechoslovakia
- moisture content in ceramic bodies before firing, firing temperatures and porosity of final tile products
- problems dealing with replacement of original raw materials in the ceramic body.

9. Mr. Kedar Nath Maiti from India was registered as the 24th participant of the workshop and handed over a leaflet "Technical Information on the Central Glass and Ceramic Research Institute, Calcutta, India" to the participants.

DAILY REPORT

16th March 1988

1. Practical in-plant training in the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen, Division Horní Bříza.

The participants were welcomed by Mr. J. Procházka, Head of the research division at Horní Bříza. He presented the organization scheme of the division and main research and development tasks which were in the centre of interest. The division consists of the following main departments:

- department of structural ceramics
- department of refractory materials
- department of construction mechanization and automation development
- department of laboratory testing
- pilot plant

2. Mr. M. Hajský, Head of structural ceramics department informed about research in technologies of floor tiles, wall tiles and stoneware production.

3. The discussion of participants was aimed at:

- composition of bodies (wall tiles, floor tiles)
- using only clays without application of grog in body compositions
- critical values of raw materials used in wall tiles production
- determination of plasticity
- body composition for unglazed floor tiles with white and coloured bodies
- properties of final products with respect to relevant standards
- homogenization of clays before grinding process
- common chemical composition of raw materials used in Czechoslovakia for structural ceramics production
- principle of achieving mat surfaces of glazes.

The questions and remarks were answered by Mr. M. Hajský.

4. Mr. M. Fiala, Head of refractory materials department made participants familiar with the research programme consisting of all types of refractory materials research ranging from silica bricks (dinas) through fireclay products to high-alumina refractories. Special attention was paid to newly developed unfired refractories with chemical bond prepared on the colloidal SiO_2 basis as well as to layered materials with dense working and lightweight insulating layer. Casting under vibration and pressing technologies were presented.

5. The participants were interested in following subject during discussion:

- operating temperature for chemical-bonded refractories
- types of binders
- purity of raw materials used for high-alumina refractories
- up-grading of raw materials for High-alumina refractories
- body composition for production of synthetic mullite
- utilization of silica refractories (dinas) in glass furnaces.

The questions were discussed and answered by Mr. M. Fiala.

6. Participants visited the laboratory department and were informed by Mr. P. Růžička, Head of the department of methods of determination of chemical, physical, thermal and mechanical properties of raw materials and products under testing. In the pilot plant they could see equipment used for verifying new technologies proposed on the basis of laboratory results. The participants got acquainted with the Mobile Diagnostic Unit (MDU) of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen and its equipment, including the evaluation centre with the computer IBM PC/XT. The demonstration computer programme was presented explaining the design of the MDU by Mr. V. Rašpl, research officer of the Institute.

Questions were directed to possibilities of introduction of energy auditing activities in the home countries. They were explained by Mr. M. Nový.

7. The afternoon programme continued by the training in the plant for wall tile production (West Bohemian Ceramic Works, Horní Bříza). Mr. Dlouhý and Mr. Kleisner, production technologists informed experts about technology of wall tile production. During the excursion all important technological processes were described. All individual questions were answered by: Mr. Z.A. Engelthaler, Mr. F. Pecháček and the responsible staff.
8. The consequent round-table discussion in the Research Institute was very extensive and dealt with following questions and topics:
 - refractory layered materials advantages and sectors of their utilization,
 - differences between vibration and pressing technologies
 - types of chemical bonds (unfired refractories) and prices
 - types of binders used in technologies of refractory materials
 - using of wollastonite in Czechoslovak conditions
 - content of CaO and organic matter in clays and their influence on the quality of final products
 - possibilities of halloysite utilization
 - aging of clays
 - role of fluxes in ceramic bodies
 - content of colouring oxides in coloured tile bodies
 - compatibility of glazes and ceramic bodies and its determination; resistance against crazing
 - replacement of lead-containing glazed by other types
 - economic aspects of wall tile production

All the questions, remarks were thoroughly explained and answered mainly by Mr. Z.A. Engelthaler, with contributions of Mr. J. Procházka, Mr. F. Pecháček, Mr. M. Fiala and Mr. Hajský

9. Mr. Girish R. Amladi handed over the sample of a clayey material for determination of chemical and mineralogical properties.

DAILY REPORT

17 th March 1983

1. Practical training in kaolin washing plant in Kaznějov

The participants visited the kaolin deposit in Kaznějov which was the biggest kaolin mine in the Continental Europe. The geology and origin as well as parameters of mining were exploited by Mr.M.Engelthaler, Assistant to the General Director of the Czechoslovak Ceramic Works and Mr.J.Mašek, Chief technologist of mining. The deposit originated in the Pre-cambrian age by kaolinization of granites which were further classified by water transport to the ancient basin at the Tertiary age. The reserves of kaolin are estimated to reach several hundreds million tons.

Open pit selective mining is utilized with the average overburden thickness of 5 m. Clay is extracted by shovel and electric excavators selectively. Blending of different kaolin grades proceeds in the dressing plant which is located in the close neighbourhood to the mine.

2. The technology of kaolin up-grading was presented in practice by Mr.M.Engelthaler, Mr.J.Masek, Mr.P.Havel, Head of laboratory department of the plant and Mr.J.Horák, technologist of the plant. The technology consists in crushing in hammer mills, blunging with water and screening in trommel washers by which the lumps of raw materials are disintegrated and gravels and coarse sand removed. After this operation, the slurry is pumped to a battery of hydrocyclones for separation of clay particles from fine sand. Passing through inclined screens, impurities such as mica and organic substances are removed. The slurry enters then again hydrocyclones (50 mm diameter). After this procedure it is pumped into sedimentation tanks where it is thickened. According to kaolin grades produced the thickened slurry is subjected either to filter-pressing followed by drying or dewatering and classifying in centrifuges. A certain amount of kaolin is subjected to magnetic separation to increase brightness of the product. Super-conductive magnetic separation and delamination will be soon put into full operation.

Kaolin from this washing plant is applied in paper coat-

ing and filling, ceramics, filling of rubber, cosmetics, medicine etc.

3. Discussion on kaolin mining and dressing involved following questions and remarks :
 - types of excavators used
 - problems of environmental protection, dumping grounds and underground water
 - recultivation projects of mining area
 - utilization of underflow from various types of hydro-cyclones
 - utilization of sand and pebble gravel
 - types of flocculants used
 - maximum intensity of magnetic separation and its efficiency
 - laboratory testing during production and the decisive properties of the final product
 - total output of products
 - problem of dust inhalation in the packaging area
 - physical properties of kaolin before and after drying
 - temperature applied in the drying process.All the questions were answered by Mr.M.Engelthaler, Mr. J.Mašek, Mr.P.Havel and Mr.J.Horák.

4. Mr.Mahadew Dewanand (Suriname) expressed his interest in Czechoslovak trucks TATRA which are very reliable and suitable for transportation of raw materials. Messrs.Motokov, Foreign Trade Corporation, Prague will be contacted for providing the expert demanded information and information material.
5. Visit to the Municipality - reception by the Lord Mayor of Pilsen

Participants of the Technical workshop were welcomed by Mr. P. Hostinský, the Lord Mayor of the City of Pilsen. He informed about history and present-day life of the city of Pilsen and the future outlook. During a short visit of the City Hall the experts visited historical rooms of this renaissance building.

6. State farm at Křimice - non-metallics in agriculture

The Křimice State farm was one of the first agricultural plants which introduced bentonites for the soil conditioning in Czechoslovakia. Mr. Josef PETR, Director of the State Farm welcomed participants and made them familiar with the basic information about the farm activities. State farm owns 5.500 cows, 15.000 pigs and it has 10.200 hectares of land two-thirds of which are exploited for farming.

The farm applies bentonite and also other soil conditioners to all its sandy soils and it uses them for different purposes, including greenhouses, cash - plants and field - crops.

Then participants visited greenhouses in Křimice, which are equipped to provide optimum temperature conditions during the winter climate and which are used for planting and multiplication of flowers and decorative trees. The greenhouse soils are mixed with bentonite and other soil conditioners (perlite, bloating clay) to stimulate germination, rooting and growth.

The programme continued by training in greenhouses for vegetable growing in Račice. Mr. J. Petr informed experts of productivity, possibilities and conditions of such type production.

7. The discussion of participants during the in-plant training was aimed at:

- environment protection in the state farm
- kinds of growing flowers, decorative trees and vegetables
- application of various types of soil conditioners in different types of production
- exploited fertilizers
- yield increasing after the application of bentonite
- suitable amount of soil conditioner for different plants
- profitability of greenhouse planting

8. Mr. Biazen Bogalle from Ethiopia was registered on Wednesday, 16th March, by the Organization Committee of the Technical Workshop.

DAILY REPORT

18th March, 1988

1. Mr. Z. A. Engelthaler informed trainees about possibilities to participate in future activities of UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen (technical workshops, seminars) and ways of travel costs payment. He also pointed out the possibility of individual visit to kaolin washing plant in Božíčany near Karlovy Vary, bloating clay production plant and feldspar up-grading plant in Southern Bohemia.
2. Lecture: Non-metallic Minerals in Agriculture (by Mr. J. Petr)
Mr. J. Petr's lecture was centred mainly upon utilization of bentonite in agriculture both for plant growing and animal breeding. Non-metallic sorbents such as bentonites, perlites, tuffs, marls, zeolites etc. play several roles in agricultural applications. In general they reduce wash-out fertilizers and trace elements, enhance water retention and condition the soil due to ion-exchange properties. They deliver nutrients directly to plants resulting in increasing yield by 10 as far as 100%. Mr. J. Petr also discussed bentonite properties in connection with application area and behaviour of this sorbent in pure sandy soils with respect to results achieved in China, Ethiopia, Egypt and Czechoslovakia. Soil reclaiming by bentonite together with practical remarks to the application in animal breeding and/or plant growing were presented. Economy of bentonite use in agriculture was also discussed.
3. The discussion of experts dealt with following problems:
 - definition and description of sandy soils
 - influence of climate conditions on results of bentonite application in soils
 - application of natural zeolites and limestone in agriculture
 - prices of agricultural-grade bentonites and natural zeolites
 - laboratory methods of testing bentonite properties in soils
 - economic aspects of bentonite quality related to applications in agriculture

- possible other natural materials with similar properties in the soil
- ways of enriching the soil by trace elements

The questions were discussed and answered by Mr. J. Petr.

4. Lecture: Special Applications of Selected Non-metallic Raw Materials (by Mr. P. Duchek).

Mr. P. Duchek focused his lecture on special applications of bentonites, perlite and zeolites and surface-modified minerals which possess unique properties exploitable in non-traditional areas. Bentonite application in environmental sphere was discussed in detail due to high importance in developed and developing countries. Methods of modification of bentonite structure together with theoretical aspects of processes were explained. Mr. P. Duchek mentioned also application of modified bentonites for wastewater treatment with respect to different types of pollution. It was shown that modified bentonites (Al-, Fe- form) were very effective flocculants for removal of oily matters, polyacrylates and other types of pollution of wastewater. Perlites and natural zeolites are also used for removal of contaminants from waters and air. Surface-modified minerals such as kaolin, mica, silica and mineral "specialties" are used mainly for filling and reinforcement of rubber and plastics.

5. The discussion of participants on the topic of special applications of selected non-metallic raw materials raised following problems:

- coated foundry sands
- chemical agents for activation of bentonites
- technological parameters of the process of wastewater treatment by means of modified bentonites
- replacement of polyphosphates in detergents by natural zeolites with respect to ecological impact
- use of organobentonites
- efficiency of cleaning process
- suitability of bentonite application for treatment of different wastewater types

- design of disposal unit
- sludge utilization

The questions were discussed with participants and answered by Mr. P. Duchek.

6. Some of participants expressed their wish to visit the industrial application of bentonites for wastewater treatment and laboratory research in this field. Visit to the municipal disposal plant in Karlovy Vary and research laboratory of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen will be arranged during the second week of the Technical Workshop.
7. Lecture: Principles of Energy Management in Non-metallic Industries (by Mr. M. Nový)

Mr. M. Nový introduced to participants principles and steps of energy management in non-metallic industries. He presented activities aimed at optimum utilization of energy such as modified and non-traditional technologies, optimized thermal treatment of materials and products, energy audits in production plants, waste heat utilization, complex modernization and maintenance of equipment used, climate conditions etc. Energy auditing was described in detail together with practical experience and benefit. Mr. Nový also highlighted the important role of non-metallics for energy conservation as they were readily used as fluxes, insulating materials, fillers and extenders.

8. During the following discussion, Mr. Nový answered questions which had dealt with:
 - influence of local conditions (fuel import e.g.) on lowering energy consumption
 - possibilities of energy management in third-world countries
 - price of the Mobile Diagnostic Unit and Energy Kit
 - possibility of Energy Kit application in developing countries
 - personnel requirements for Mobile Diagnostic Unit application and possibility of utilization.

in other industrial sectors aside non-metallic industries

- influence of different kiln types, burners, waste heat utilization on the energetical consumption.

9. Mr. B. Žert, Chief Geologist of Messrs. Geindustria Prague informed participants about the activity of Czechoslovak Geological Service and handed over two information booklets of Messrs. Geindustria Praha and Strojexport Praha, Foreign Trade Corporation, Czechoslovakia.
10. Mr. Shr K.N. Maiti from India handed over the paper "Major non-metallic Raw Materials for Traditional Ceramic Industry - Present Status and Future Prospects" to be formally edited by the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen under his authorship.

DAILY REPORT

19th March 1988

Participants visited a plant manufacturing expanded and hydrophobic perlite in Prague which is a division of Ceramic Works Kosice. Due to weekend time the plant was in standstill. Mr. František Odvárka, the plant director briefly informed of the production programme and technology.

- annual output - 90 000 cu. m. of three basic grades
(Agroperlite, Experlite 150 and 100)
- 18 000 cu. m. is hydrophobized for oil spillage treatment

Discussion concentrated on the expansion process and used equipment and provided further detailed information on perlite utilization, energy consumptions, European markets, pre-expansion processes and so.

Mr. Odvárka then showed the participants round the factory and provided other information, invited those interested to visit the factory again during a working time to demonstrate the process in run.

The afternoon programme was devoted to the sightseeing to Prague.

20th March 1988

Sightseeing to Pilsen and a visit to the Brewery Museum in Pilsen.

DAILY REPORT

21st March 1988

1. Lecture: Non-metallic Minerals Use for Advanced Ceramics
(by J. Matoušek and J. Hlaváč)

The lecture outlining development and future outlook in the field of advanced ceramics was presented by Mr. J. Hlaváč, Professor of the Chemical-technological University, Prague, Department of Silicates. Classification of high-tech ceramic by function was described together with production and market development in this sphere. Ceramic raw materials utilizable for advanced ceramics production were classified. The synthetic materials were highlighted from the point of view of their properties and possible preparation methods such as sol-gel processing, vapour processing and solid-state reactions. Special fabrication processes (hot isostatic pressing, high-pressure injection moulding etc.) were discussed. The last part of the paper was devoted to main types of advanced ceramic materials and description of their fabrication, properties and applications.

2. After presentation of the lecture, participants discussed following problems:
 - present situation in advanced ceramics research in Czechoslovakia
 - natural sources of zirconia
 - industrial development in superconductors fabrication
 - research and development organizations involved in advanced ceramic research
 - equipment needed for conducting research in this field

The problems were discussed and answered also individually by Mr. J. Hlaváč.

3. Lecture: Economic Aspects of Non-metallic Minerals Exploitation (by Mr. J. Müller)

The lecture of Mr. J. Müller was devoted to the increasing importance of non-metallic minerals being not only a traditional material basis for building industry and housing but

also a subject of scientific and technological development. This situation is also mirrored by increasing international trade of these materials. Specifics of marketing industrial minerals was explained by a detailed analysis of specific marketing aspects. The integrated interdisciplinary approach to non-metallic minerals was stressed as well. Processings of bentonite and kaolin were selected to illustrate economic aspects in detail.

4. The discussion on the topic of Mr. Müller's lecture reflected the following problems:

- marketing of non-metallic raw materials
- stages for market development
- relationship between raw material, quality, beneficiation and transport costs
- different factors influencing financing industrial ventures

All questions were answered by Mr. J. Müller.

5. Videoprogrammes on Research into Ceramics

Mr. D. Zeman, Head of Scientific and Technical Information Department of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen, introduced following four videoprogrammes:

- Application research in non-metallic industries
- 24 hours with bentonites
- Live water (application of bentonites in wastewater treatment)
- Bentonites in agriculture

6. The discussion following to videoprogrammes was aimed at utilization of bentonites in the environmental engineering, above all:

- bentonite packaging and storing
- optimal doses of modified bentonites with respect to different types of pollution
- efficiency of the cleaning process
- suitability of the bentonite method for various wastewater capacities

- possibilities of sludge disposal

The questions were explained by Mr. J. Kačín, Head of Research and Development Department, Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen.

7. Mr. Tran Xuan Toan from Viet Nam handed over the paper "The Use of Non-metallic Raw Materials in the Industry of Viet Nam. A Brief Survey " to be formally edited by the UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen under his authorship.

DAILY REPORT

22nd March 1988

1. Presentation of country reports by participants

Following participants presented their country reports outlining the complex situation and outlook in the field of non-metallic raw materials

- Ms. Basilia Blessie A. (Philippines)
- Mr. Zhu Gui Fang (China)
- Ms. Fotini-Chalkiopolou (Greece)
- Mr. Mahadew Dewanand (Suriname)
- Mr. Kedar Naith Maiti (India)

Findings and recommendations of country reports will be included as Annex in the Final Report.

2. Round-table discussion with contributions of observers

During the afternoon session observers from four Czechoslovak companies were introduced to participants of the Workshop and made them acquainted with activities and possible ways of co-operation with developing countries.

The observers represented following companies:

- Messrs PRAGOINVEST, Foreign Trade Corporation, Prague, represented by Mr. P. Musil
- Messrs. PŘEROVSKÉ STROJÍRNY, Přerov, represented by Mr. P. Vrba, Ms. Z. Pavlová and P. Navrátil
- Messrs. POLYTECHNA, Foreign Trade Corporation, Technical Cooperation Agency, Prague, represented by Mr. A. Dušek and Ms. B. Kósová
- Messrs. GEOINDUSTRIA, Prague, represented by Mr. L. Vohanka, Mr. M. Laňar and Mr. F. Woller

Information material on activity of these corporations was handed over by observers who also explained and answered questions raised by trainees during discussion.

Messrs. LECO Corporation, USA, and Messrs. STROJEXPORT, Foreign Trade Corporation, Prague, Czechoslovakia, sent their information booklets which were distributed among participants.

3. Four Chinese participants and Ms. Basilia Blessie A. from Philippines visited the laboratory for special applications of non-metallic raw materials of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen. Mr. J. Kačín informed them about research programme in this field. Applications of bentonite for wastewater treatment was discussed in detail.

DAILY REPORT

23rd March 1988

1. Presentation of country reports by participants

Following participants presented their country reports containing the complex situation and outlook in the field of non-metallic raw materials:

- Mr. Dušan Dragović (Yugoslavia)
- Mr. Sarath R. Silva (Sri Lanka)
- Mr. Njianjek Azefor Wan Njianjek (Cameroon)
- Mr. Milutin Dumić (Yugoslavia)
- Mr. Girish R. Amladi (India)
- Mr. Vladimir Vladkov (Bulgaria)

The presentation of country reports were completed by wide discussions dealing with specific conditions and problems of the individual countries. Findings and recommendations of country reports will be included as Annex IV. in the Final Report.

2. Visit to the Municipality - reception by the Mayor of Most

Participants of the Technical Workshop were entertained by Mr. R. Mooz, the Mayor of the City of Most. He made acquainted experts with history, present day life and future outlook of the city. The visit continued by non-formal discussion dealing with specific problems of the City of Most. Dinner given by Mr. R. Mooz enabled participants to go ahead in talks with representatives of the city.

DAILY REPORT

24th March 1988

1. Practical training in the Northbohemian Ceramic Works, Most

The participants were welcomed by Mr. A. Funda, Production Director of the Northbohemian Ceramic Works. He presented the organization scheme and informed experts about types of production of the company.

Up-grading of bentonites was described in detail by Mr. J. Slabý, Technologist of Bentonite Plant on the light table with the scheme of the plant.

The participants were interested in following subjects during discussion:

- type of equipment for activation of bentonite
- specific density of final product
- contents of S, Fe, Na, Ca and silica sand in the raw bentonite
- selective extraction in the deposit
- system of transport of final product, transport costs and exporting possibilities
- utilization of bentonite in agriculture
- price of bentonite before and after activation, production costs
- system of bentonite classification
- packing of final product

2. Practical in-plant training in the Bentonite Plant at Obrnice

Participants visited a plant manufacturing activated bentonite at Obrnice, which is a division of Northbohemian Ceramic Works, Most. Mr. H. Fröhlich, the plant director briefly informed of the production programme and technology. The discussion during the excursion was aimed at:

- homogeneity of the deposit
- moisture content during the activation of bentonite

- quantity of sodium carbonate for activation
- temperatures in the rotary drier
- plant laboratory equipment
- laboratory tests of raw and activated bentonites
- properties of bentonites for various types of utilization

3. Visit in Horse Breeding Farm at Svinčice

Participants visited specialized Horse Breeding Farm at Svinčice near Most. Mr. J. Podolán, director of the division welcomed the whole group of participants and made them familiar with the basic problems of horse breeding, types of horses bred in the farm and utilization of recultivated areas for a wine cultivating. Participants then visited the stables of racing horses and the training hall.

4. Sight-seeing of recultivated areas and mines at Most

The programme continued by a sight-seeing of recultivated areas at Most - recreational area with a lake at the place of a former coal-mining area, orchards, gardens and vineyards at the places of former mines and dumps.

DAILY REPORT

25th March 1988

1. Practical in-plant training in the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen, Division at Karlovy Vary

The participants were welcomed by Mr. Z. Štěpánek, Head of the Research Division at Karlovy Vary. He presented the organization scheme of the division and the most important research and development tasks. The division consists of the following departments:

- department of laboratories and research of new laboratory methods
- department of beneficiation of plastic and non-plastic raw materials
- department of industrial applications of non-metallic raw materials
- department of automation and regulation
- department of planning and economy

2. Participants visited the laboratory department and were informed by Mr. M. Hladeček, Chief of Laboratory Department of chemical, mineralogical, physical, thermal and mechanical properties of raw materials and products under testing. Using of bentonite for treatment of wastewater from textile industry was shown by Mr. V. Šebek in the specialized laboratory for bentonites. In the pilot plant group of experts could see equipment used for classification of sands, for wet magnetic separation etc.

3. The discussion during the training was very extensive and dealt with following questions and topics:

- production of activated bentonites
- capacity of belt press in municipal wastewater disposal plant
- efficiency of wastewater treatment and hygienic parameters of water after treatment

- accuracy of measuring in the chemical laboratory
 - technical data of various apparatuses
 - expanding temperature of bloating clays
 - utilization of slurries from wastewater treatment in agriculture
4. The practical in-plant training continued by visit to experimental workshop for high-intensity continuous magnetic separation at Otovice.

The magnetic separator VMKS-1, which is installed in this workshop, is a high-gradient two-product separator of a rotor type with continuous working regime and bottom feeding of slurry. The set-up enables a stepless control of velocity of suspension flow, a stepless control of magnetic field induction and pace variation of circumferential velocity of rotor.

The operation of the separator is manually controlled from a control panel with built-up rectifier and distributor. The separator is also provided with an automated system controlling by means of sensors the parameters of operation.

DAILY REPORT

26th March 1988

Sightseeing to Karlovy Vary
Sightseeing to Mariánské Lázně

The participants visited two well-known spa cities in West Bohemia with many springs of mineral water with medicinal properties.

DAILY REPORT

27th March 1988

Preparation for draft final report
Preparation for daily reports
Preparation and discussion for country requirements, for UNIDO technical assistance and co-operation with UNIDO-Czechoslovakia Joint Programme, Non-metallic Industries, Pilsen

DAILY REPORT

28th March 1988

1. Discussions of Draft Final Report

The Draft Final Report has been thoroughly discussed by the participants. All remarks, changes and additions to the presented version of the report were taken into consideration.

2. Excursion to brewery

Mr. J. Krofta, chief technologist of Westbohemian Breweries, Pilsen informed participants of history and presence of beer production and introduced an information movie on production technology. Participants then visited the brewing house of the PILSNER URQUELL brewery.

3. Presentation of audio-visual programme Messrs. CAVIS (Centre for Audiovisual Systems, Prague) presented a short movie recording some important events of the workshop.

DAILY REPORT

29th March 1988

1. Adoption of the Final Report
2. Official closing of the Workshop
3. Cocktail and official dinner

LIST OF EQUIPMENT FOR MOBILE DIAGNOSTIC UNIT

a. TEMPERATURE MEASUREMENTS

Digital Thermometer TECHNOTHERM 7300 (Pt 100)
with accessories

Digital Thermometer TECHNOTHERM 9300 (Ni-Cr-Ni)
with accessories

Infrared Thermometer Therm RAYNGER - II LT
with accessories

Resistance Thermometers Pt - 100 FW 3

-50° + +600°C

Ø 3 mm, 1 = 300 mm - 10 pcs

1 = 500 mm - 10 pcs

Ø 6 mm, 1 = 300 mm - 10 pcs

1 = 500 mm - 10 pcs

Ø 15 mm, 1 = 1000 mm - 10 pcs

Thermocouples NiCrNi

FT 3, 1100°C, Ø 6 mm, 1 = 500 mm - 15 pcs

AM, 1200°C, Ø 26 mm, 1 = 1000 mm - 10 pcs

1 = 1400 mm - 10 pcs

b. HEAT FLUX MEASUREMENT

Digital Heat Flux Density Meter THERM 2273-2

c. HUMIDITY MEASUREMENTS

Digital Hydrometer HYDROTEST 6400

5 - 98% moisture content
with accessories

Digital Psychrometer THERM 2246-2

10 - 100% moisture content
with accessories

d. ELECTRIC VALUES MEASUREMENTS

Multimeter MA 5 D

with accessories

e. FLUE GAS ANALYSES

Flue Gas Analyser IMR 1200 P

for O₂ and CO analyses, with accessories

f. CALORIFIC VALUE OF SOLID FUELS

Calorimeter KL-5

g. PRESSURE MEASUREMENTS

Electronic Micromanometer EDM 2500 M

with accessories

h. FLOW VELOCITY AND VOLUME FLOW MEASUREMENTS

Pitot Tubes

1 = 1000 mm, Ø 8 mm

1 = 1500 mm, Ø 9.5 mm

Digital Anemometer TESTOVENT 4000

0.4 - 40 M/sec

with accessories

i. REVOLUTIONS MEASUREMENT

Revolutions Meter TESTO 4800

10 - 160 000 rev/min

with accessories

j. RECORDING OF MEASURED VALUES

Compensating Recorder TRANSOKOMP 250

k. COMPUTING MEANS

Personal Computer IBM/XT (or compatible)

with: Colour Monitor

EPSON Printer

Microlink Interface