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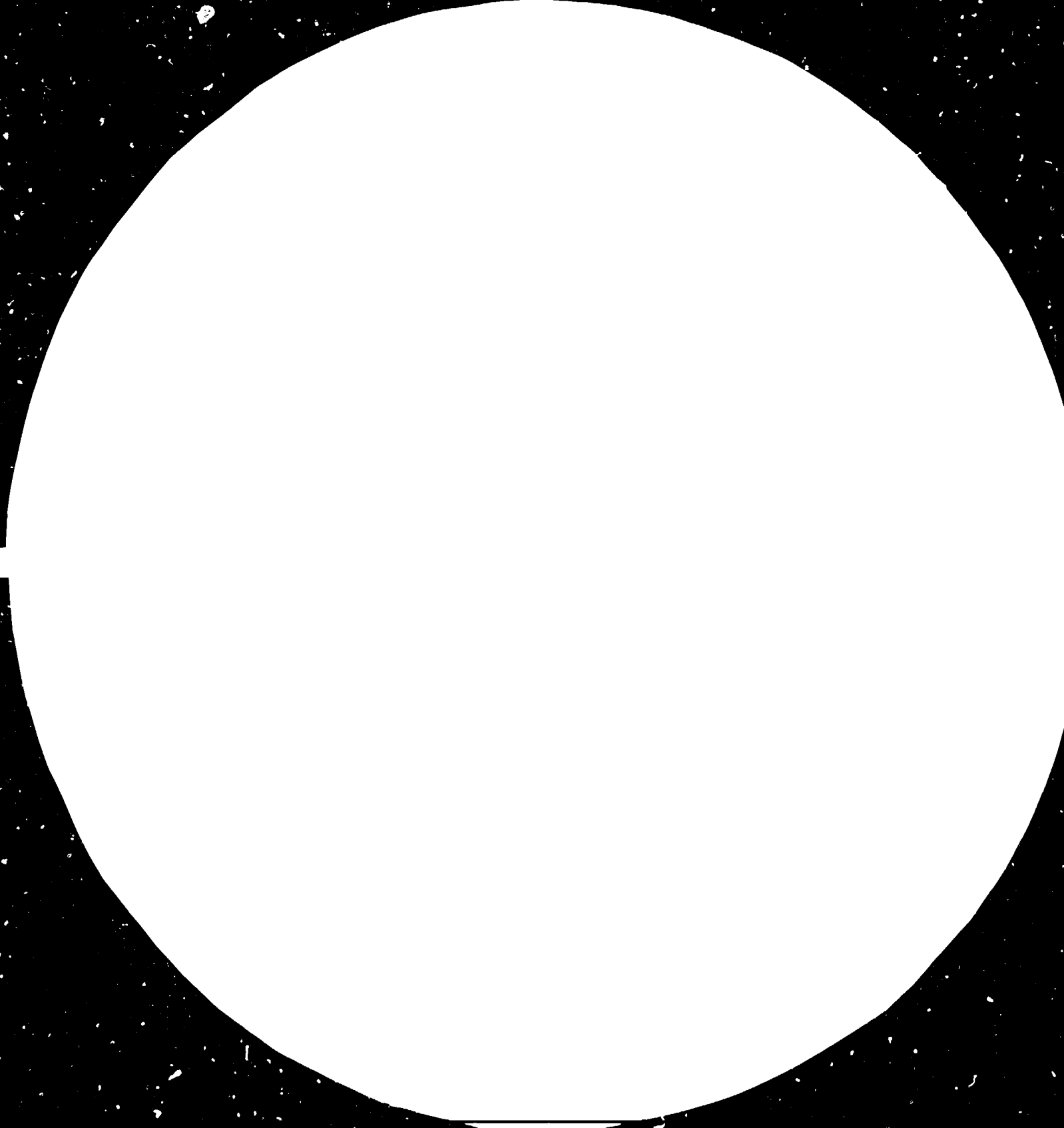

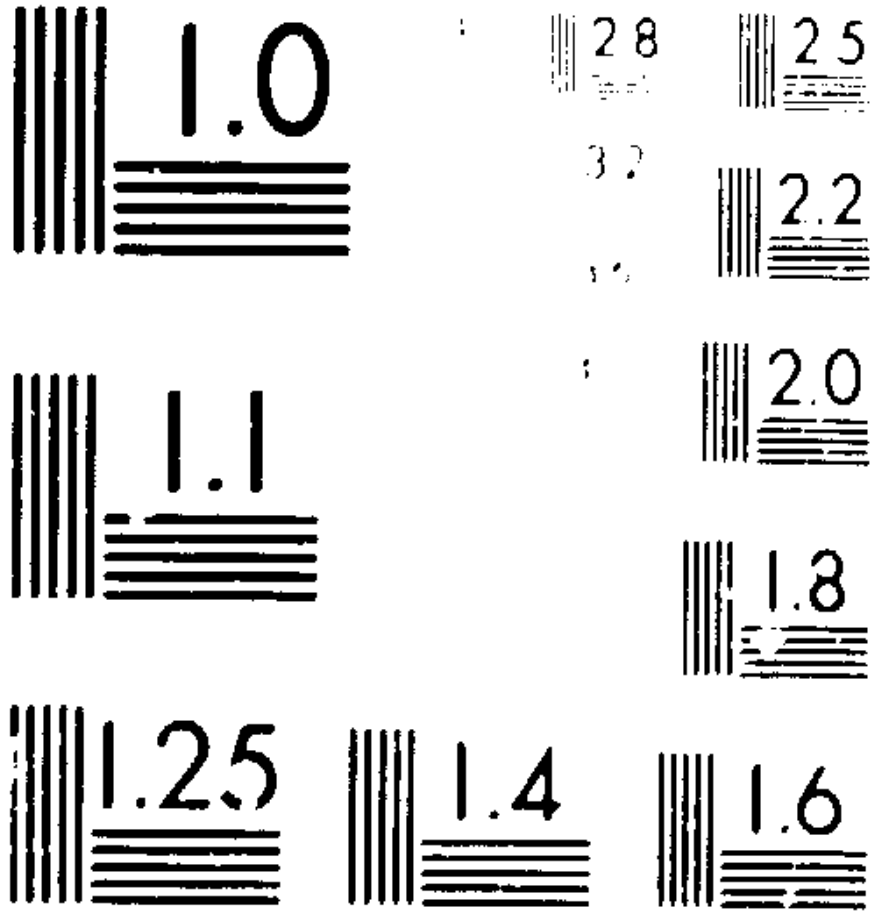
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CZECHOSLOVAK CERAMICS - DEVELOPMENT AND ENERGY CONSERVATION

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1. INTRODUCTION

The ceramic production has a long tradition in Czechoslovakia. The most ancient ceramic products found in Czechoslovakia date back to the later stone age. It was pottery mainly, being used for storage and preparing food.

The first bricks were manufactured on the territory of Czechoslovak state by Roman legions in the first century A.D. The manufacture of bricks was forgotten afterwards for a long time and introduced in 10th century again. The bricks were used for building new towns.

Stove tile making was reported in 12th century, manufacture of ceramic tubes for water distribution in 16th century. The most ancient refractory products are represented by metallurgical crucibles produced from refractory clays for melters in ancient Czech mining towns Kutná Hora and Příbram. These towns were famous in medieval Europe for silver ore extraction and silver production.

The first porcelain workshop was established in Czechoslovakia in the year 1792 at Slavkov in West Bohemia and already 27 kilns with the production volume of 1100 cubic meters were in operation at the Karlovy Vary region in the year 1848.

Fifty three Bohemian porcelain plants with 257 kilns exported 21997 t of China in the year 1913.

Thanks to high quality of local raw materials and to outstanding professional abilities of Czech ceramic specialists, the Czech ceramic products have gained an excellent reputation. Czech structural ceramics have been applied for the construction of many public buildings all over the world. The best known are wall tiles, trade marks RAKO and HOB, further floor tiles and fireclay products.

The long tradition in the industrial production of ceramics was reassumed by the Czechoslovak Ceramic Works after the World War II. Their products - dressed raw materials as well as final products - are indispensable for many industrial branches. Raw materials mined and beneficiated by the Czechoslovak Ceramic Works are delivered not only to enterprises within the trust engaged in the manufacture of structural ceramics, refractories and sanitary ware, but to electroceramics, glass and porcelain industry as well.

The Czechoslovak Ceramic Works with about 20,000 employees and with yearly production volume of about 4 billion Czechoslovak Crowns contribute directly by their production to a smooth function of Czechoslovak national economy and take a significant part in Czechoslovak exports.

2. CZECHOSLOVAK CERAMIC WORKS

Development and Organizational Structure

The inception and further development of the Czechoslovak ceramic industry has been fostered not only by a large abundance of ceramic raw materials, namely kaolins, clays, bentonite, quartz, quartzites, perlites, diatomites, etc., but also by a high professionality and skill of all its employees. Its expansion has been provoked at the same time by steadily increasing needs to cover the demands of Czechoslovak building industry and of other industrial branches by domestic products to avoid imports. Ceramic works grew up namely in the areas of prime raw material deposits, i. e. in West Bohemia (Carlsbad and Pilsen Basins), white kaolins and clays deposits in Northern Bohemia (Most area), in Southern Bohemia, in Central and Southern Moravia.

During the World War II the Czechoslovak national economy and the ceramic industry, too, were heavily destroyed. After 1945, it was necessary to repair all damages in the shortiest time possible.

By the October Decree of the Czechoslovak Government on the nationalization of Czechoslovak industry all large industrial enterprises were nationalized. To manage the nationalized substances in the branch of ceramic and glass raw material extraction of the production of ceramics, mortars, bricks, porcelain, fine ceramics and abrasives and of building enterprises, a central authority - the Czechoslovak Ceramic Works, Prague - was established on 1st January 1946.

During the second stage of nationalization in 1948, further factories were incorporated. Thus the Czechoslovak Ceramic Works were entrusted with a historical role of the nationalization period to realize and to safeguard a successful development of the whole building materials production together with all branches

of the ceramic production, inclusive non-metallic minerals extraction. With regard to the outdated production and technical basis disordered by war considerably, it was not an easy task. Nevertheless, the Czechoslovak Ceramic Works succeded during the next years in the consolidation of all different branches in the framework of the newly established National Enterprises.

From the point of view of their organization, the Czechoslovak Ceramic Works constitute the Trust of national enterprises having their general management headquarters in Prague.

The Trust consists of 9 production enterprises:
Ceramic Works, Rakovník
CALOFRIT Works, Borovany
West Bohemian Ceramic Works, Horní Bříza
Ceramic Works, Chlumčany
Ceramic Glass Raw Materials, Karlovy Vary - Sedlec
North Bohemian Ceramic Works, Most
Ceramic Works, Břeclav - Poštorná
Moravian Fireclay and Shale Works, Velké Opatovice
Ceramic Works, Košice

The Research Institute for Ceramics, Refractories and Raw Materials in Pilsen is engaged in solving the science, research and technical development problems and the Institute for Design and Construction in Prague is solving corresponding design targets.

The individual production branches have been successively delimited and have gained independence. The production programme of the Trust of national enterprises - Czechoslovak Ceramic Works - was established in 1958 in 3 main groups of products:

1. Extracted and dressed non-metallic raw materials

   The first group incompasses namely the extraction and beneficiation of kaolins for ceramic, paper, rubber industries and for other specialized branches, further on of shales, glass and foundry sands, porous, binding white-burning, refractory, and other clays, feldspars, amorphous and crystalline quartzites, diatomite, perlite and other non-metallic minerals.

2. Building ceramics

The second group includes the production of stoneware pipes and shaped bricks, agricultural stoneware. chemical and acid-proof stoneware, ceramic wall and floor tiles, mosaic for interior and exterior tilings, industrial pavings, stove tiles, production of large-scale tilings, shaped tiles for bathrooms, etc.

3. Refractories

To the third group belongs the production of fireclay and silica bricks, mouldable refractories, heat-insulating materials, kiln furniture, chimney refractory liners, refractory binders, etc.

Also other products are being contemporarily produced, e. g. building blocks, coloured crushed materials and sands, aggregates, fillers, non-fired masonry materials, earthy colours,,products for scant market needs, such as silk lustre, painter`s coating masses, scant packed lining masses, etc.

Production and Energy Consumption

In national enterprises incorporated into the Trust of Czechoslovak Ceramic Works, the total gross production volume increased since 1950 till now four times, the interannual increments being 7.5 % on the average. Namely within the 4th Five-year Plan, i. e. 1965 - 1970, an intense increase of production and exportation was recorded. A short survey on the gross production volume increase can be seen in Diagram 1.

An information on the participation of the respectective production enterprises incorporated in the Trust of Czechoslovak Ceramic Works in the fulfilment of targets imposed upon the whole branch production for 1980 is represented by Diagram 2.

This expressive production increase has been accompanied by high rates of labour productivity growth. During the 5th Five-year Plan, i. e. in the year 1975 in comparison with 1970, an increase of 149.2 % in the production volume and of 137 % in the productivity of labour increase were achieved. During the 6th Five-year Plan, terminated in 1980, further 34 % of the productivity of labour increase were reached as shown in Diagram 3.

During the last years, many very interesting technical novelties have been introduced in production aiming especially to energy savings in different spheres. E.g. expanded perlite being produced with the trade mark VAPEX adsorbs from water or working surfaces non-polar hydrocarbons, crude oil and its derivates. One cubic meter of VAPEX is able to adsorb up to 500 l of crude oil or 300 l of fuel oil. Insulating plates for metallurgy are another new product of perlite being produced in the Ceramic Works at Košice (Eastern Slovakia). The West Bohemian Ceramic Works at Horní Bříza near Plzeň have introduced to market insulating shaped bricks PLASTIZOL HB as a very effective insulating material for industrial furnaces working at temperatures over 900°C. The Moravian Fireclay and Shale Works at Velké Opatovice have introduced the production of stoppers for steel ladles with a capacity of 200 tons. Domestic raw materials have been used for their production. The quality of floor stoppers equals to foreign products imported until lately to Czechoslovakia.

In the building industry, the three-component chimneys being produced under Schiedel-licence proved to be perfect in their function with their high heat acid and thermal shock resistance. They ensure a higher gas tightness and fire security. The Ceramic Works at Poštorná (Southern Moravia) have contributed to the innovation of sealers and hyperboloid pumps, fans, cyclone stations and fume chambers.

The sale of ceramic products produced by the Czechoslovak Ceramic Works is differentiated according to individual groups of production assortment. The sale of ceramic raw materials and

refractories for the needs of Czechoslovak national economy is balanced and controlled from the level of the general management of the Trust. The sale of building ceramics is carried out through the National Enterprise STAVIVA (Building Materials) and through the Consumption Co-operative JEDNOTA (Unity) using their regional establishments.

Ceramic raw materials, refractories and building ceramics are exported through the Czechoslovak Foreign Trade Corporation "Czechoslovak Ceramics", Prague.

The distribution of basic production assortment groups in the total export volume results from the Diagram 4.

In comparing the exports of ceramics in the first years after the World War II with recent years, its present volume is estimated ten times higher. Since 1965 the exports to Socialist Countries have increased seven times, to Non-socialist Countries six times (in franco-prices).

The growth of the export volume during the past years is shown in Diagram 5.

The basic conception to fulfil increasing export targets of the branch consists in increasing gradually the building ceramic products share, later the refractories share, too; on the other hand, raw material exports will be decreased. Czechoslovakia is interested in an effective application and valorization of domestic raw materials. Therefore, the technology of dressing and refining of non-metallic minerals is steadily being improved and the product quality for Czechoslovak needs as well as for export is substantially increased. E. g., by means of application of electromagnetic separation or chemical bleaching of ceramic and paper kaolins a reduction of metallic impurities and higher whiteness can be achieved and thus a much higher valorization of original raw material.

A very important function have continuous innovations of the production assortment ensuing from steadily increasing competition on world market on the one hand and from the equilibrium between supply and demand existing on the Czechoslovak ceramic market so that the customers' claims on quality and a wider assortment are growing up.

Their demand will be shifted towards products with top quality, namely with regard to fashion colour choice, variety of surface finish of wall and floor tiles and modern design, form and size.

The ceramic production is joint inseparably with the thermal treatment of material and, therefore, with relatively high energy consumption in comparison with other industries. The energy costs in ceramic production form about 25 % of gross sales in industrial countries. This portion is five times higher than that of mechanical and electrical engineering or of food production.

It has been ascertained by detailed analysis that about 86 % of applied energies are consumed directly in technological processes, 22 % for drying, 64 % for firing. The attention payed to the energy saving problems in the Czechoslovak Ceramic Works can be documented by the fact that during the 6th Five-year Plan (1976 - 1980) the gross production grew up by 44.7 % while the total energy consumption by 4.3 %. The development of energy consumption and gross production in the enterprises of the Czechoslovak Ceramic Works can be seen in Diagram 6. The higher increase of electricity consumption in comparison with other energies is caused by the introduction of mechanization and automation in ceramic production. The development of specific energy consumptions of selected products is shown in Diagram 7.

The production development in the field of ceramics has been supported by an extensive investment activity. A review of incurred investment costs in the respective Czechoslovak Five-year Plans is shown in Diagram 8. On the average 58 % of all financial resources have been invested in machinery equipment and 42 % in constructions. Thus the investment activities have been oriented in the first place to the modernization of factories and to the reconstruction of their technological equipment.

The production possibilities of the trust have been substantially enlarged by new factories being put into service step by step and equipped by high-quality Czechoslovak and foreign technological equipment. As example the following plants can be mentioned: New kaolin working plants at Kaznějov and Božíčany in West Bohemia, feldspar extraction and dressing plant at Halámky in South Bohemia, new glass sands dressing plant at Střeleč in Central Bohemia and Michalovce (East Slovakia), stoneware production plant at Borovany (South Bohemia), at Tomášovce (South Slovakia) and at Duchcov (North Bohemia), chemical stoneware production plant at Poštorná (South Moravia), wall tile production plant at Lučenec (South Slovakia) and at Rakovník (Central Bohemia). The wall tile production plant at Horní Bříza (West Bohemia) has been reconstructed and modernized.

By the extensive investment activities the following production capacities have been put into operation:

wall tiles and tiling materials	8,300 000 m^2
ceramic floor tiles	4,200 000 m^2
stoneware	184 000 t
fireclay	188 600 t
washed kaolin	315 000 t
shales	260 000 t
bentonite	135 000 t
expanded perlite	150 000 m^3

Important tasks in the investment activities are expected in the field of ceramics during the 7th Five-year Plan, i.e. in the years 1981-1985. The total investment programme includes obligatory targets such as the construction of a silica production plant at Svitavy (Central Moravia), quartzite dressing plant at Lahošť (North Bohemia) and shale dressing plant at Vyšehořovice. Further gasification of heat consuming units in the production plants and all environmental protection measures are being preferred.

To ensure an increased number of investments, reconstructions, modernizations and smaller constructions the Layout Planning Institute in the framework of the Czechoslovak Ceramic Works was established in Prague. Apart from layout planning, it is engaged in designing machinery for non-traditional production processes. Some hundreds of different layout plans have been elaborated during its existence. The more important ones are e. g. the project of foamed fireclay production plant at Děčín (North Bohemia), "Fillers" Work of the national enterprise CALOFRIG at Borovany (South Bohemia), expanded perlite production plants, new building for the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Division at Karlovy Vary-Všeborovice, etc. The Layout Planning Institute worked out also different projects for the construction of social equipments, computer centres, railway sidings, transformer stations, training centres, kindergartens for the children of employees, etc.

The setting-up of ceramic industry in Slovakia where building ceramics had not been produced formerly, belongs undisputedly among the most important achievements of the Czechoslovak Ceramic Works. Putting to use Czechoslovak and foreign experiences and modern technology, a new industry was created in Slovakia during the past 20 years which is steadily developed and enlarged.

Research and Technical Development

The scientific-technical development at the present stage of socialist construction in Czechoslovakia has a very important target: to ensure a high dynamism of the development of Czechoslovak national economy and to increase its effectivity and at the same time to limit the energy and material demands, namely as far as imported raw materials are concerned. That is why the technical development of the branch being carried out namely by the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials at Plzeň, is oriented to the following main targets:

- to decrease energy demands in the production proper by introducing new technological processes, e.g. by one-layer firing or by one-fire technology, or by elaboration of new body recipes to achieve lower firing temperatures by keeping the values of product quality. In this connection also consistent exploitation of residual heat has to be applied. An extraordinary attention is paid to the technical development of refractories and insulating materials production aiming to enable the decrease of energy exigency of all heat consuming units, where this refractory material is to be used.
- to introduce automation means into the production process aiming to introduce separate and complex systems for automatic control of individual machines, production lines and whole factories to achieve manpower reduction and to increase the productivity of labour.

- to decrease with high economy the materials consumption imported from abroad and to verify the possibilities of substitution by materials of domestic production, such as e.g. dyes, spare parts of mechanical technological equipment etc.
- to seek for new possibilities of dressing and beneficiation of domestic raw materials and to achieve by new dressing methods their high quality and to exploit more effectively the dump or lower quality raw materials; this problem coheres with the complex exploitation of prime mineral sources and deposits.

A highly qualified scientific and research base of the Czechoslovak Ceramic Works consists in the Research Institute for Ceramics, Refratories and Non-metallic Raw Materials in Pilsen, established in 1951. It contributes substantially to the solution of all tasks of scientific - technical development. Successful results of research assignments solved in the last 30 years in the framework programmes of the Czechoslovak Government, Ministry for Construction and Building Materials, Czechoslovak Ceramic Works and their enterprises, and the results of further activities of the Institute, such as coordinator of research and development within the Trust and its all-state authorization for technical development of ceramics, create solid foundation of the whole Trust.

The experts of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials have acquired rich experience in extending technical assistance and consultancy abroad. Excellent results of their work geared to the development of local ceramic industry on the goodwill of their foreign partners and of the United Nations

Industrial Development Organization /UNIDO/. A long tradition of ceramic manufacture in Czechoslovakia and successful results in the work of the Institute for developing countries and the least developed countries induced in 1978 the establishment of the UNIDO-ČSSR Joint Programme for International Cooperation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries in Pilsen.

All these facts highlight the present purport and position of the Research Institute for Ceramics, Refractories and Non-metallic Materials in Pilsen not only in the framework of the Czechoslovak Ceramic Works but also withing the whole Czechoslovak national economy.

The Headquarters of the Institute are in Pilsen. They include also the Division for Technical and Research Assistance extending technical and engineering services and consultancy to foreign partners. The division is predominantly engaged in power-engineering related to heat consuming units applied in ceramic industry, diagnostic measurements of this equipment, intensification, optimation and economization of its operation.

The Research Division at Horní Bříza is specialized in the research of building ceramics /ceramic wall tiles and glazes, ceramic floor tiles, stoneware/ and the research of refractories /shaped dense and lighted materials, high alumina and special products, refractories for monolithic linings/. The research is concerned both with technological

processes and development of technological machinery, design, lay-out planning, mechanization and automation of ceramic manufacture.

The Research Division at Karlovy Vary pursues the research of winning and beneficiation of ceramic and glass raw materials (kaolin, clays, bentonite, diatomite, quartz sands, feldspars) and the development of laboratory equipment. One of the results of its research activities is the introduction of the up-to-date beneficiation process for non-metallic raw materials. The application of high intensity electromagnetic separation enables e.g. the industrial utilization of the kaolins that have been difficult to process till now, and prolongation of life time of deposits.

The Research Division at Rájec -Jestřebí is aimed at the development of special refractory bodies for metallurgy (spouts and nozzles from fused quartz, lubricating and separating agents for pressure casting of metals) and utilization of liquifiers and SiO_2gel in ceramic indus[illegible] Also new deposits of refractory claystones from the [illegible] of Moravian chalk are utilized. The research center is engaged, too, in the research and introduction of dense and high-duty silica based on crystalline quartzites and in the development and research of graphite products.

The research divisions of the Institute are equipped with modern instruments and machinery for laboratory tests and semi-industrial trials. They can simulate every type of technological processing in the ceramic production. The Institute being engaged in energy savings in ceramic industry possesses a modern diagnostic unit by means of which diagnostic measurements of heat-consuming units are taken in the ceramic industry in ČSSR and abroad .

Due to the fact that these problems are going to be dealt during this Technical Workshop, I take it for indispensable to deal it more in detail in a special chapter on energy management and on its relevancy and level of care for heat consuming units in the whole trust of Czechoslovak Ceramic Works.

Long-years professional experience of the Institute and its technical outfit qualifies the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials in Pilsen to offer its technical and research assistance and engineering services not only to Czechoslovak, but also to foreign production plants, central laboratories and specialized institutions. Many tens of industrialized and developing countries of all continents have taken advantage of them, such as: Algeria, Bangladesh, Bolivia, Botswana, Bulgaria+, Caribbean area+, China, Colombia, Egypt, Fiji+, Gambia, Great Britain, GDR, India, Iraq, Jordan, Kuwait, Lebanon, Libya, Lesotho, Malta, Mozambique+, Niger, Nigeria, New Guinea+, Surinam, Swaziland, Syria, Thailand, Tanzania, Turkey, Uganda, USSR, VSR, Zaire+ and Zambia.
Note: + through UNIDO - Czechoslovak Joint Programme.

The technical assistance afforded includes in the sphere of extraction and processing of raw materials:

- complex evaluation of non-metallic raw materials obtained through geological survey and prospection, assessment and determination of their potential applications
- investigations of new methods of extraction, dressing and refining
- dressing tests of all types of non-metallic raw materials with project of lines and plants for their treatment;

in the sphere of technological processes of production:

- research into and development of working masses, with elaboration of technological processes of manufacture of ceramic articles, such as facing tiles, floor tiles, sewerage and industrial stoneware, table ware,
- research and development of working masses with elaboration of technological processes of manufacture of refractory materials, such as fireclays or high-alumina products, silica of high density on the basis of crystalline quartzites for coke, metallurgical and glass industry, magnesites and others ;

in the sphere of mechanical and technological equipment:

- development and design of machines and equipment for mechanization and automation of technological processes in production of ceramic articles
- development and technical conception of instruments and apparatuses, e.g. automatic control of temperature in furnaces;

in the sphere of thermal power engineering:

- setting, optimation and intensification of operation of furnaces and kilns
- application of refractory solid and light-weight insulating materials in industrial furnaces ;

in the sphere of engineering activities and technical assistance:

- prognostic studies in the line of ceramic and glassmaking raw materials, of ceramic articles for building industry and of the refractories
- for capital investment projects involved in modernization of old and construction of new plants of ceramic industry
- assessment of projects of ceramic plants

- all kinds of consulting activities, training-in of experts and other kinds of technical assistance in the line of ceramics
- assistance afforded to developing countries during introduction of ceramic industries within the scope of activities of the Research Institute for Ceramics, Refractories and Non-Metallic Raw Materials in Pilsen and of the UNIDO-Czechoslovakia Joint Programme for International Cooperation in the Field of Ceramics, Building Materials and Non-Metallic Minerals Based Industries;

in the sphere of active licenses:

- affording of production licenses concerned with various ceramic and technological production processes, mechanical and technological equipment, checking and control instruments .

The era of 30 years has perfectly verified the abilities of the Research Institute for Ceramics, Refractories and Non-metallic Raw Materials in Pilsen. The implemented results of hundreds of solved research assignments have contributed substantially to the development of the technical level of manufacture in the production plants of the Czechoslovak Ceramic Works, to the successive innovation of equipment, the raise of production capacities and productivity, the extension of assortment, the high quality of products and last but not least to a considerable economization.

To further technical development of the trust contributes nevertheless by its activities not only the Research Institute, but also the Technical Development Sections in the respective production plants, event.

their bases for science and research, cooperating very closely with the Research Institute . This close cooperation originated in the past years some important solutions appreciated by Czechoslovak central authorities by the honorary title "Pioneer Work".

To ensure a steady technical progress in the field of ceramics high financial means are being expended every year. Nevertheless, the basic value consists in stimulative activity of scientific research base specialists and of all other workers of the trust - engineers, technicians, foremen and innovators.

The innovation programme related to the production assortment will continue during the next years in the framework of the Czechoslovak Five-Year-Plan. In the sphere of raw materials the continuous production of mixed kaolins will be started. They are characterized by elevated green strength and will help to solve the production of PE-fillers for rubber and plastics industry as substitutes for imported raw materials. An important measure consists in the introduction of TS 40 glass sands production. Their application shortens the glass melting times, so that valuable energy savings can be achieved and the melting aggregates capacity increased by 20 %.

In the sphere of refractories the innovation plan includes the light-weight construction materials and high-alumina refractories development of new gunite mortars, ramming and filling masses, refractory concrete and kiln furniture .With great interest is expected the production of corundum refractories for induction furnaces, silicon

carbide refractories for melting furnaces, ladle stoppers for manganese steel alloys castings etc.

The perspective orientation in the sphere of building ceramics, concerning the products decoration and surface finish innovation has been solved.

The rationalization of the tile setting calls for larger sizes in the production of floor and wall tiles. That is why their sizes of 10x20 cm, 20x20 cm, 20x30 cm and 30x40 cm will be verified.

Concurrently with building ceramics assortment innovation the cooperation between the production works and designers and architects is being intensified aiming to individual design of different representative buildings in Czechoslovakia, e.g. the INTERCONTINENTAL and PRAHA hotels in Prague, the attendance hall of the central railway station in Prague, some of the subway stations in Prague, the new Czechoslovak television building in Prague etc.

The sewerage stoneware assortment will be enriched with 200 cm tubes, dia.30 to 60 cm, the chemical stoneware with 200 cm tubes, dia to 120 cm.

3. OPTIMIZATION OF ENERGY CONSUMPTIONS

The Czechoslovak Ceramic Works with about 20,000 employees and with their yearly production volume of about 4 billion Czechoslovak Crowns contribute directly by their production to a smooth function of Czechoslovak national economy and take a significant part in Czechoslovak exports. Three quarters of the export tasks of the Czech Ministry for Bulding Industry are covered by this Trust.

The consequential application of energy management in ceramic industry enables the Czechoslovak Ceramic Works to increase the production with limited energy consumptions. The annual total energy consumption in the Czechoslovak ceramic industry amounts to $1.4 \cdot 10^4$ TJ.

The task of energy management is rather complicated in ceramic industry due to the large production assortment, thermal units variety and large scale of fuels used. Therefore, about one hundred of specialists and engineers are engaged in the sphere of energy conservation in ceramic enterprises. In addition, the team of specialized research engineers of the Research Institute for Ceramics, Refractories and Raw Materials in Pilsen ensures completely the research works in the field of energy conservation.

The objective of energy management is the systems-oriented integration and quantification of all factors which influence primary energy and costs in order to make energy and costs manageable as a whole. The application of energy management in production plants of the Czechoslovak Ceramic Works is based on thorough analyses of the rationalization problems in the sphere of fuel and energy consumption, on many-year experience in diagnostic measurements of thermal processes and equipment

and on the successive development of the technology in ceramic production.

The energy management board of the Trust is represented by the General Director, his Advisory Board for Energy Management, composed of 15 specialized experts of power engineering, the Production Directory, his Chief Energy Engineer and the Trust Committee for Energy Problems and the staff of energy specialists in production enterprises and plants.

The energy management in ceramic industry comprehends the following principal activities:
- non-traditional technologies with lowered energy demands,
- thermal processes optimization according to the limiting conditions and according to the unit output,
- diagnostics of the heat consuming units,
- thermal units - technical level and modernization,
- waste heat utilization,
- climate conditions.

The complex rationalization programme on fuel and energy consumption is concluded by the Trust Committee for Power Engineering in the form of a time schedule of individual rationalization measures being successively implemented.

Reduction of Energy Consumption in Technological Processes

The body being blended of several sorts of raw materials, the reduction of energy demands by body composition comes into account. On the base of raw materials available such production technology must be chosen which is the most advantageous from the energy consumption point of view. Low energy consumption can also be reached either by the use of new

methods of body preparation or by combination of the bisque firing and glaze firing to one-fire process. Non-traditional raw materials utilization can bring about new technologies with shortened firing cycle or with lower firing temperatures.

The new technologies are based on the use of non-traditional fluxes, such as sodium oxide and calcium oxide. These fluxes being used, the physical and structural changes of the fired ceramic body are speeded in comparison with traditional fluxes.

Optimization of Thermal Processes

A According to limiting conditions

During the thermal treatment, the changes of the structure and properties of material occur. These changes should pass in proper conditions to avoid quality lowering. The knowledge of limiting values of the thermal changes in dependence on time for each type of products is of a high importance for the introduction of new composed materials into production. It is also important for the design and construction of new types of driers and kilns and for quality retaining.

The research of limiting conditions for preheating, firing and cooling is considerably complicated, demanding the use of devices for automatic adjustment of thermal changes and for product testing. The limiting thermal cycle represents the shortest thermal treatment possible by the use of which all the desirable properties of the product are obtained. The values gained by laboratory tests must be transferred to the production conditions, i. e. to the conditions and heat transfer possibilities of the respective production unit.

B According to output of the unit

There is the dependence between specific energy consumption of the unit and its production for definite material and technology.

/See Figure 9/. It is caused by the heat transfer efficiency for various types of the setting. It means only one type of the setting exists having the best conditions and highest efficiency of heat transfer. Together with the time necessary for thermal treatment of the material this type of setting determines the optimum output of the unit.

The knowledge of this optimum output of the thermal unit is important for the planning of new investments. From the output required and optimum output of one unit, the number of units can be determined.

The fundamental task of energy management in this field is the determination of the optimum thermal treatment conditions and the determination of production units outputs with minimum energy consumption.

Diagnostics of Heat Consuming Units

The responsible analyse of the contemporary stay of the technical equipment and its energetical demands requires sufficient objective data. To obtain these data, the diagnostic measurements are performed. For this purpose, the diagnostic mobile unit of the Research Institute for Ceramics, Refractories and Raw Materials in Pilsen is used. It is the mobile laboratory equipped with all the necessary measuring instruments, recorders and evaluating apparatuses enabling to perform analyses of thermal processes and heat balances of production units. All the data obtained are processed in an evaluation centre with a portable computer.

The diagnostic measurements are focused either to energy consumption minimization or to the technological process improvement. The complex of the data obtained together with the technical and economical evaluation of possible improvements serve as the base for the decision about the level of modernization. The complex statement with all suitable and recommendable

adjustments and changes which are to be realized for the perfect and effective service of the unit are then prepared for its user.

The main contributions of diagnostic measurements are as follows:

- energy conservation
- output increase
- reduction of reject occurrence
- quality improvement

Thermal Units - Technical Level and Modernization

A The first-stage optimization - operation adjustment

The requirements on thermal units output volume occur during the time of their service. The changes of the output volume are not always respected properly by the adjustment of regulation elements. Therefore, the specific energy consumption of the unit increases. It can be reduced considerably by the optimum adjustment (after the diagnostic measurement). This type of optimization requires no investments.

B The second-stage optimization - partial reconstruction

The requirements on the output level being too different from the optimum, the unit should be partially reconstructed to reach the optimum again. The effect of partical reconstruction must be documented by previous technical-economical study. This type of optimization covers for example the change of burner system, the equipment of the cooling zone by new fans, the installment of mixing fans in preheating zone, etc. All the changes should be realized with regard to the latest findings and construction principles. Partial reconstruction require the application of some investments.

C The third-stage optimization - complex innnovation of the equipment

This type of optimization requires the application of high investments but the possibilities of improvement are considerable. The traditional lining is usually replaced by new types of heat insulating materials, light-weight fireclays, ceramic wool, etc. Kilns and driers are equipped with automatic regulation and constructed on the base of perfectly elaborated technology of thermal treatment respecting the limiting conditions! Also this stage as well as two previous must be proceeded by diagnostic measurements and by objective analysis of the situation.

Waste Heat Utilization

Waste heat is the heat rejected from a process at a temperature high enough above the ambient temperature to permit the extraction of additional value from it. The most significant sources of waste heat in ceramic industry are: combustion gases, the air from cooling zones of kilns and drier outlets. The waste heat is utilized either directly - usually the heated air from cooling systems - or indirectly - transferred in a heat exchanger. The most advantageous system of waste heat utilization is joining thermal units in lines, with the waste heat at higher temperature used in the unit with lower operating temperature (e. g. system kiln - drier). The possibilities of waste heat utilization must be taken into account during the planning of new production plants.

The decision on waste heat utilization must be founded on careful technical-economical study with previous diagnostic measurement.

Climate Conditions

Besides the parameters of the aggregate, the conditions of operation must be taken into account in the design of the equipment. These conditions comprehend the climate conditions as well, i. e. temperature, pressure and relative moisture content of the air must be respected. It is important especially in the countries of tropical climate where the changes of ambient are considerable.

4. FINAL NOTE

The energy conservation is in the focus of interest of the Czechoslovak Ceramic Works traditionally. The programmed energy savings are therefore reached in Czechoslovak ceramic industries in recent years.

The application of energy management in the Trust of the Czechoslovak Ceramic Works proved to be the most effective method ensuring the task of energy conservation. It represents a quite new idea from the point of view of the world level of technique, applied in silicate industry where the social and industrial interests in Czechoslovak conditions are fully in conformity.

The energy conservation is of a high importance for developing and least developed countries as they import a great deal of energy consumed.

This Technical Workshop has been organized by the UNIDO-Czechoslovakia Joint Programme in Pilsen to provide the participants from developing and least developed countries with instructions and suggestions for their further work in the field of energy management in ceramic industries.

5. REFERENCES

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A N N E X E S

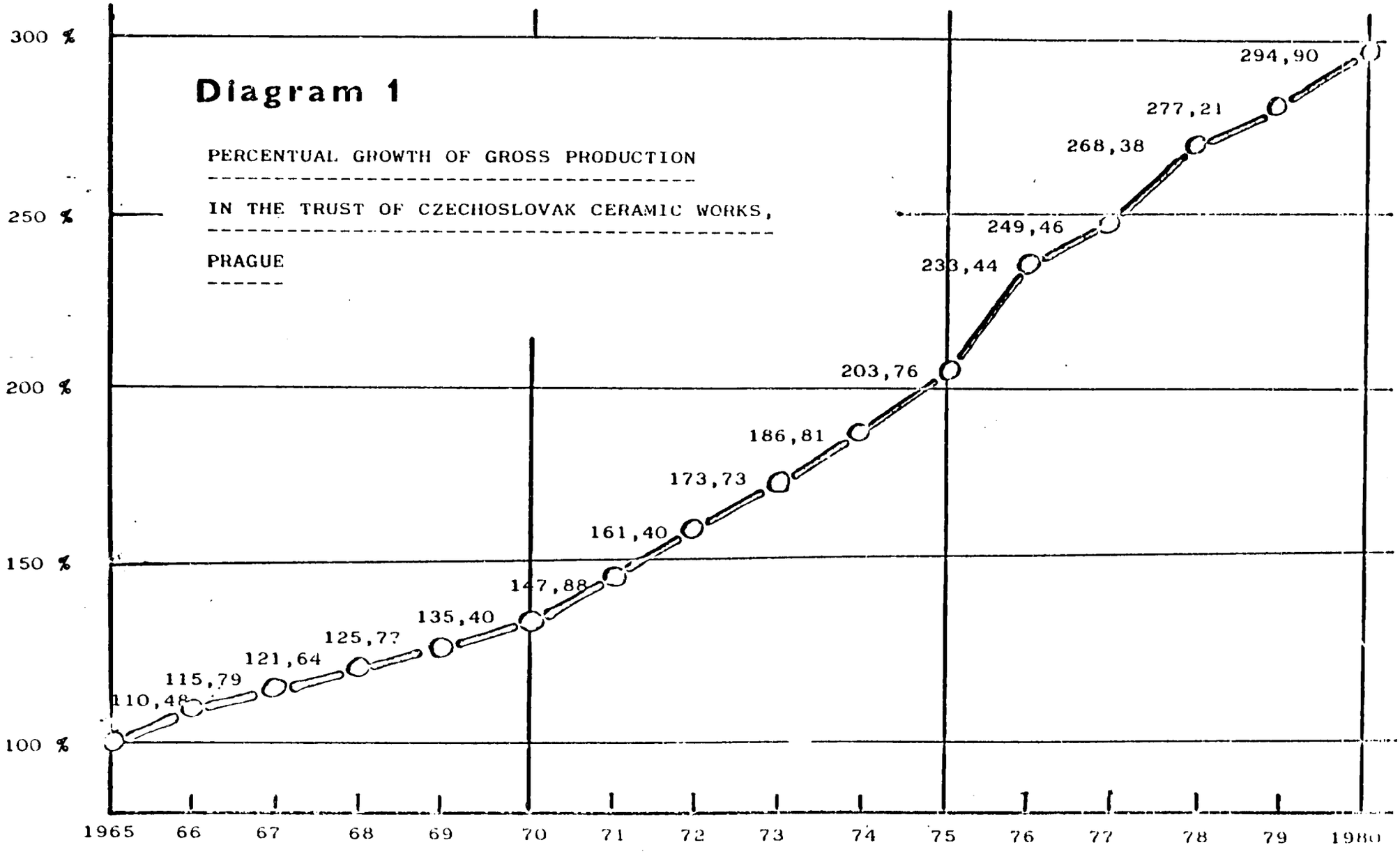


Diagram 1
PERCENTUAL GROWTH OF GROSS PRODUCTION
IN THE TRUST OF CZECHOSLOVAK CERAMIC WORKS,
PRAGUE
300 %
250 %
200 %
150 %
100 %
110,48
115,79
121,64
125,77
135,40
147,88
161,40
173,73
186,81
203,76
233,44
249,46
268,38
277,21
294,90
1965
66
67
68
69
70
71
72
73
74
75
76
77
78
79
1980

Diagram 2

PERCENTUAL CONTRIBUTION OF THE RESPECTIVE PRODUCTION PLANTS OF THE TRUST OF CZECHOSLOVAK CERAMIC WORKS, PRAGUE TO THE 1980 PLAN FULFILMENT

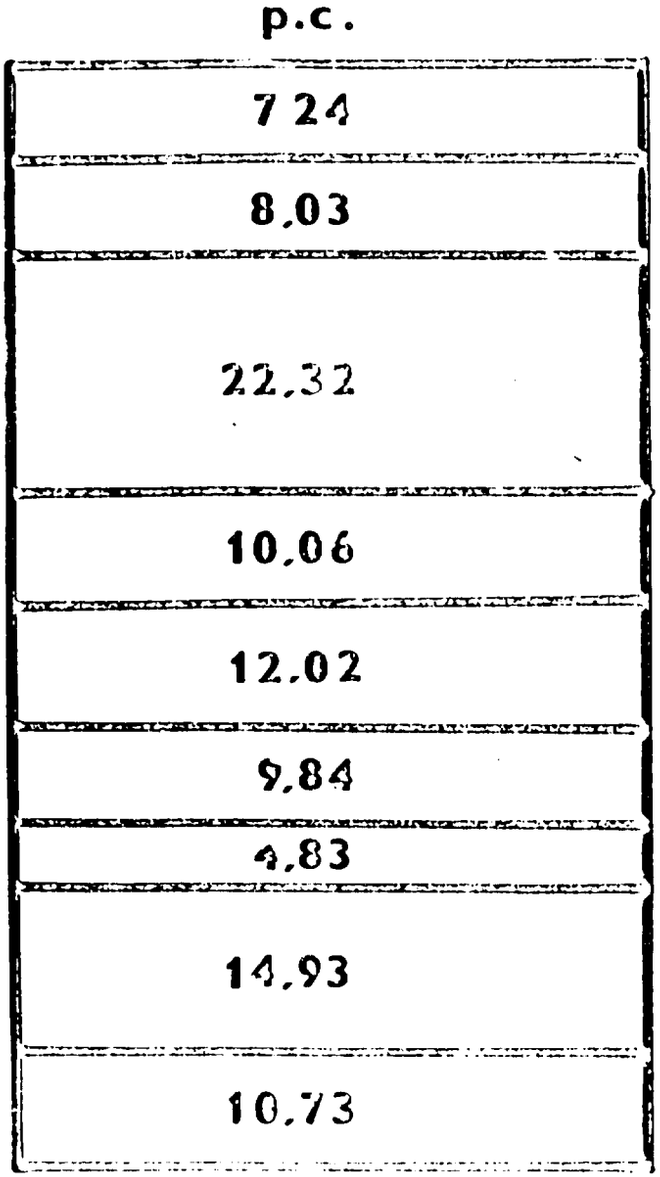


Diagram 3

PERCENTUAL GROWTH OF THE PRODUCTIVITY OF LABOUR

PER MAN IN THE TRUST OF CZECHOSLOVAK CERAMIC WORKS, PRAGUE

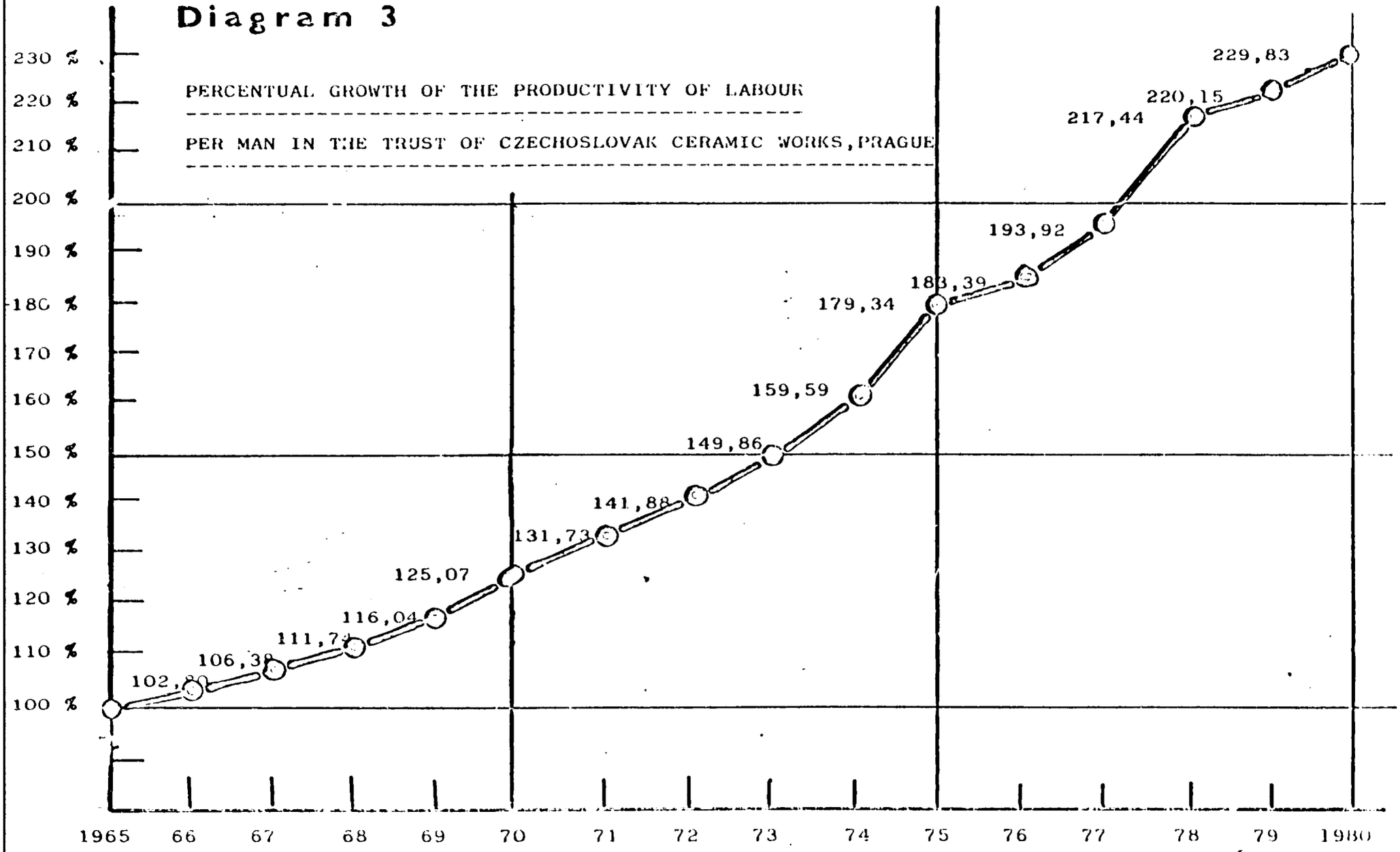
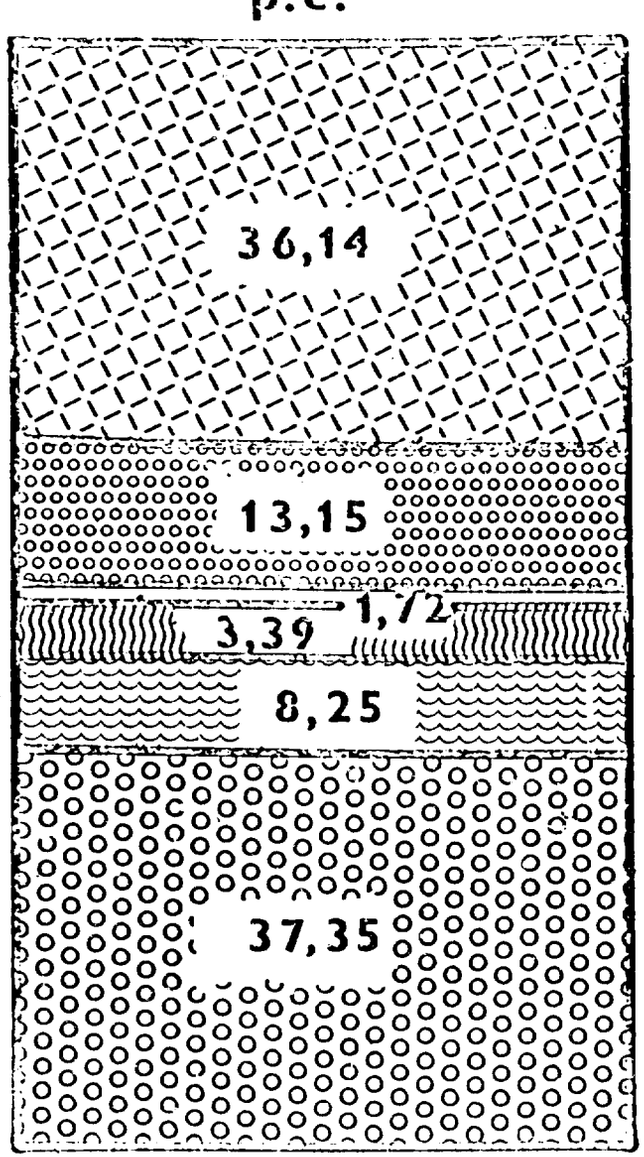


Diagram 4

DISTRIBUTION OF BASIC PRODUCTION ASSORTMENT IN THE TOTAL EXPORTS VOLUME OF THE TRUST OF CZECHOSLOVAK CERAMIC WORKS, PRAGUE



FLOOR TILES

WALL TILES

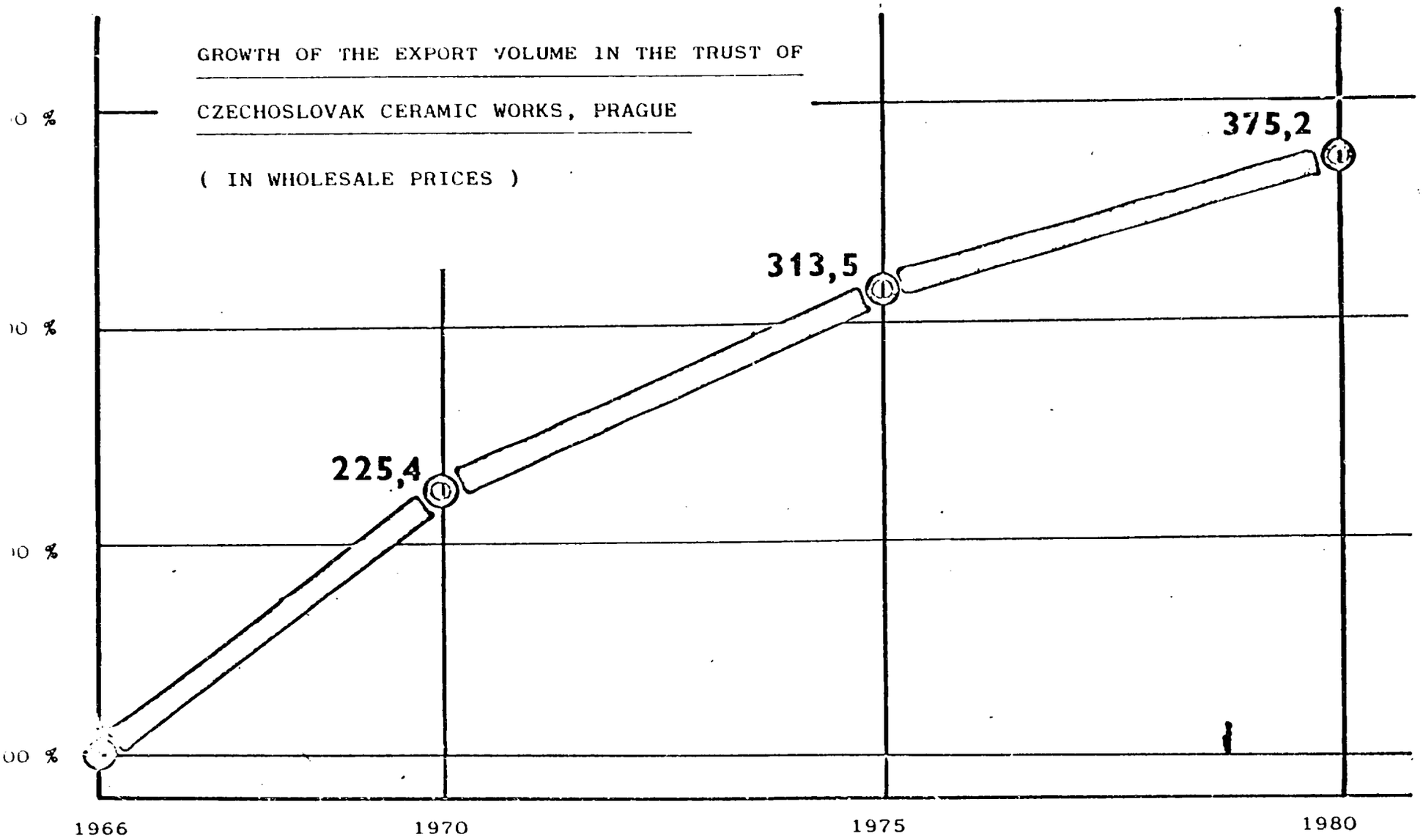
STONEWARE

FIRECLAY

SHALES

KAOLINS

Diagram 5


GROWTH OF THE EXPORT VOLUME IN THE TRUST OF
CZECHOSLOVAK CERAMIC WORKS, PRAGUE
(IN WHOLESALE PRICES)
375,2
313,5
225,4
1966
1970
1975
1980

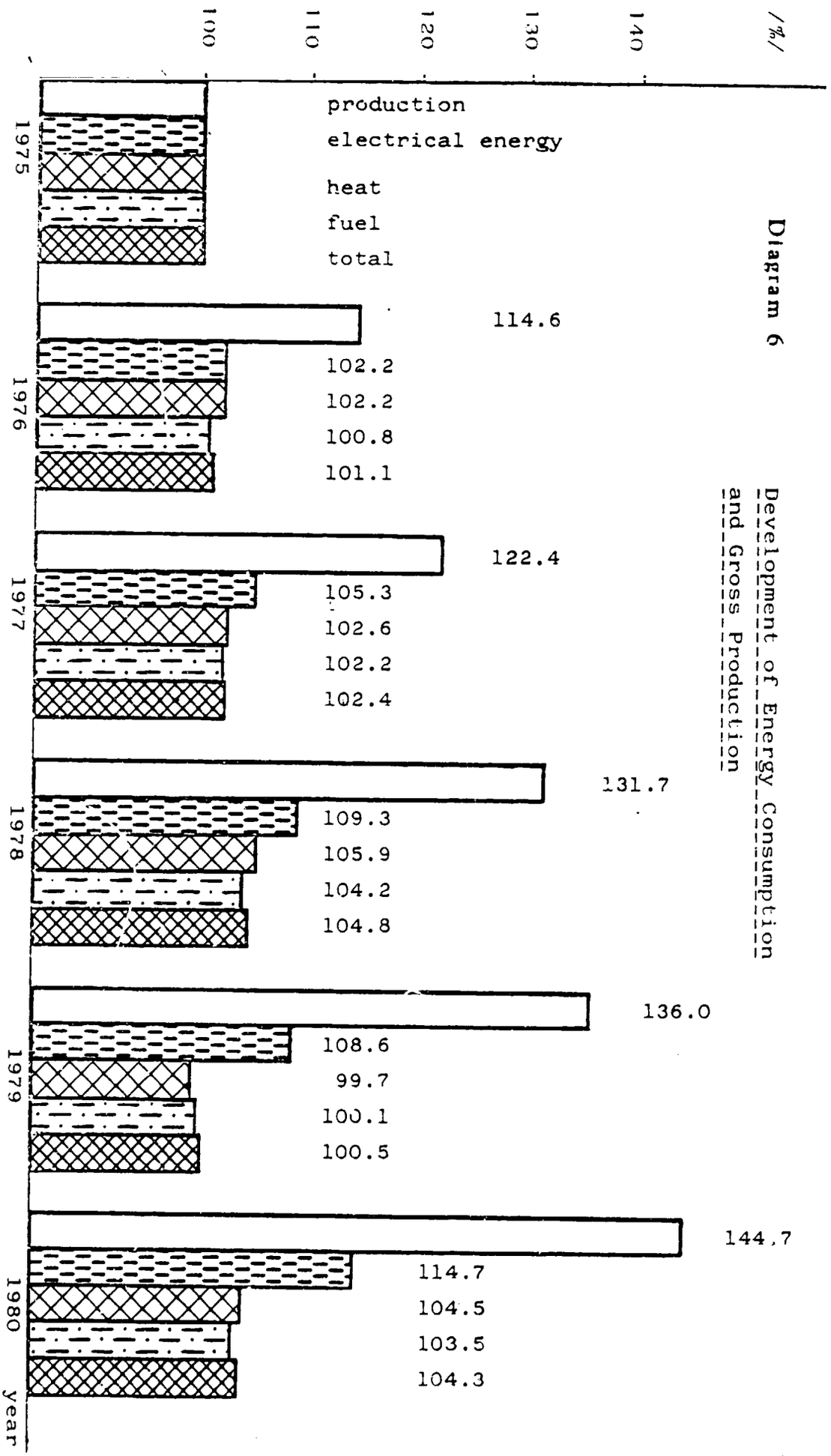


Diagram 6

Development of Energy Consumption and Gross Production

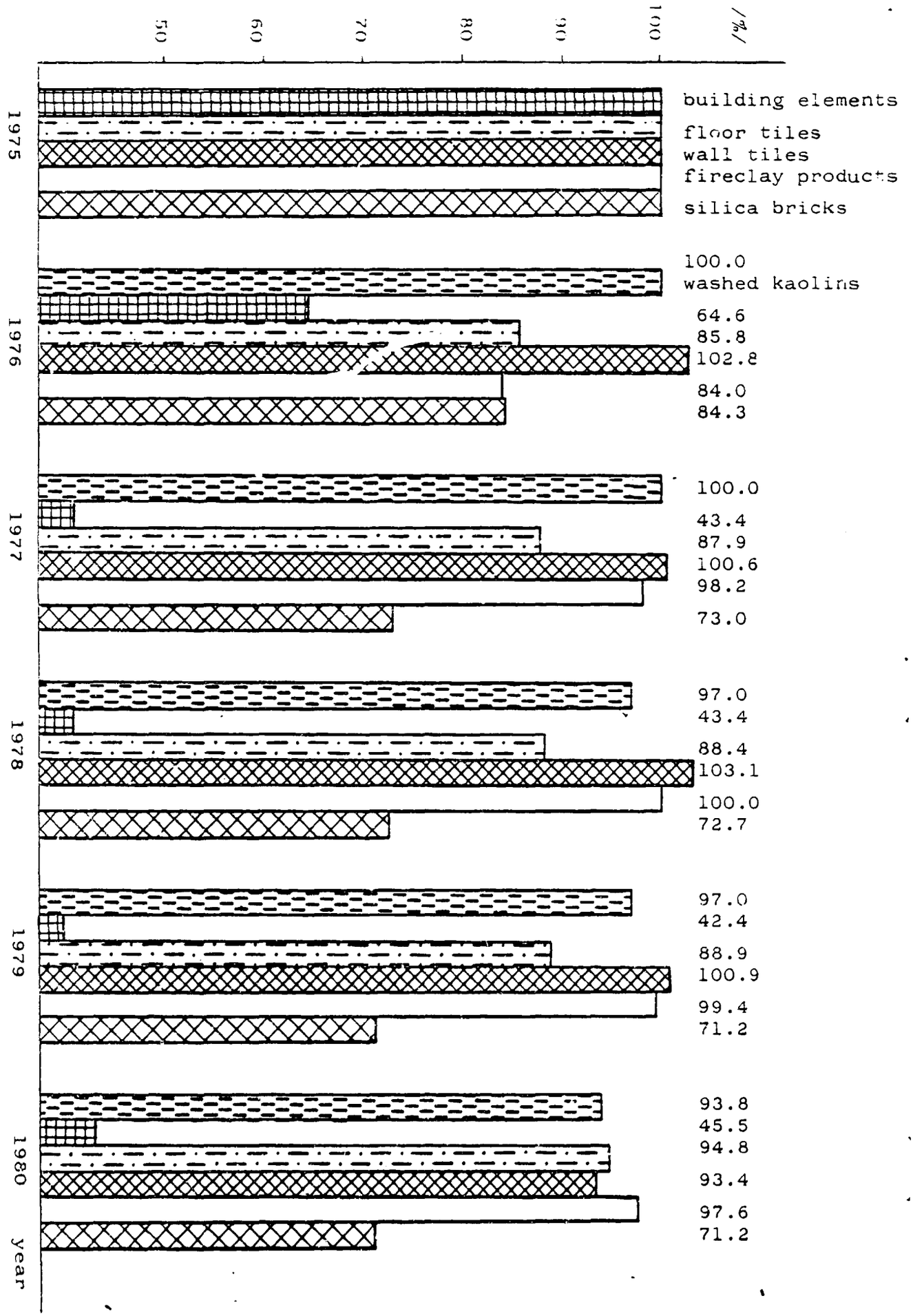
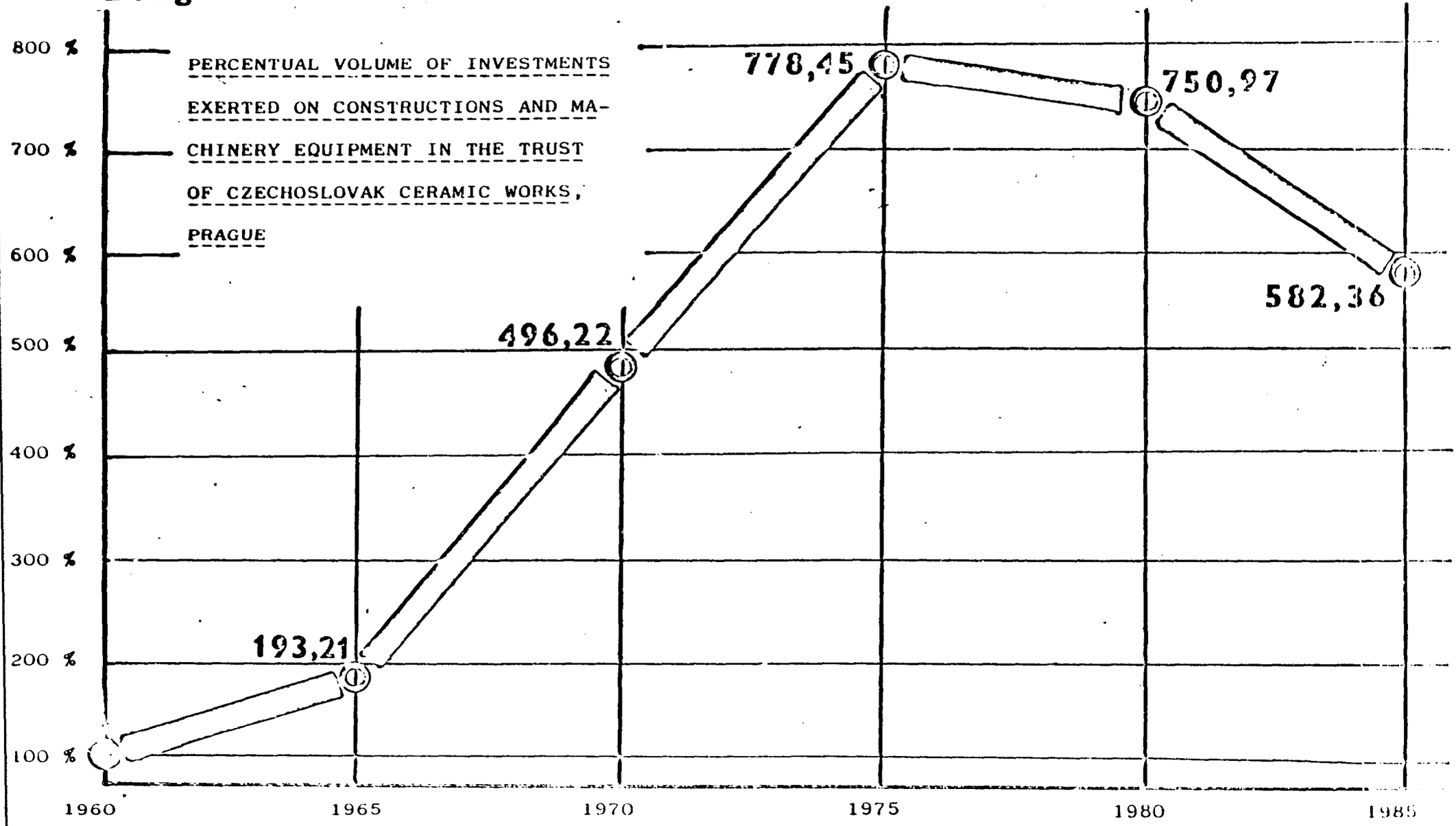


Diagram 7 Development of Specific Energy Consumptions of Selected Products

Diagram 8


PERCENTUAL VOLUME OF INVESTMENTS EXERTED ON CONSTRUCTIONS AND MACHINERY EQUIPMENT IN THE TRUST OF CZECHOSLOVAK CERAMIC WORKS, PRAGUE
800 %
700 %
600 %
500 %
400 %
300 %
200 %
100 %
193,21
496,22
778,45
750,97
582,36
1960
1965
1970
1975
1980
1985

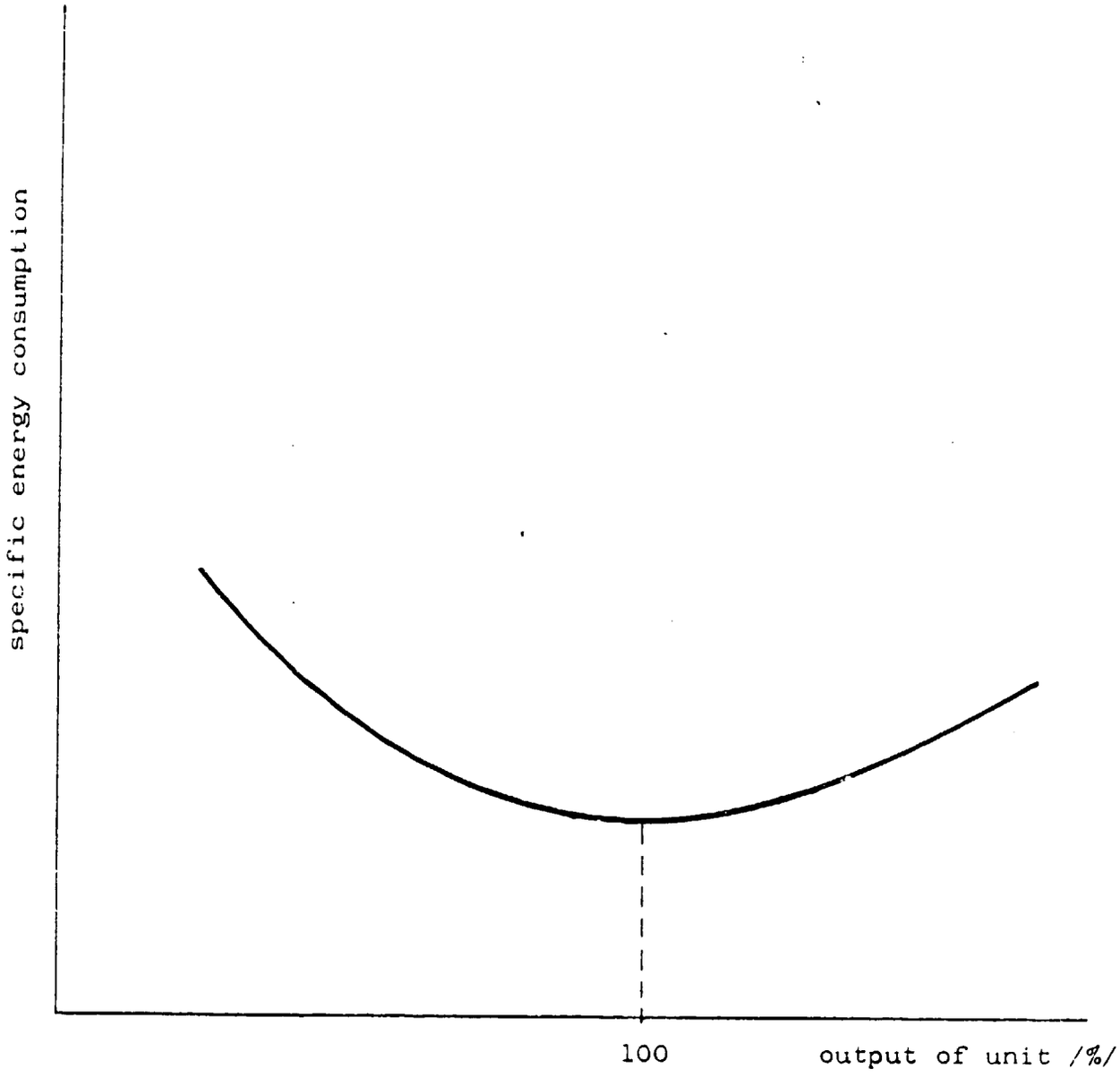


Figure 9 Dependence between Specific Energy Consumption of the Unit and Its Output