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STEMS

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ENGLISH

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FINAL REPORT

UNIDO PROJECT NO.: DP/MON/88/004

DUTY STATION: ULAN BATOR, MONGOLIA

Prepared by TESCO - SZIKKTI
Budapest - Hungary

C O N T E N T S

ANNEXES

Preface

AIM OF DEVELOPMENT

The direct aim of development is the creation of the Mongolian perlite industry. Making the first significant step towards this aim will be the setting-up a mine at Zamin-Ulan perlite deposit - geologically already well-developed -, by the extension of this mine, equipping it by the required machines, ensuring the transportation roads and means and railway transloading points, constructing a modern perlite preparation and expansion plant and installation of processing equipment /technological units for manufacturing heat-insulating mortar and plaster, and gypsum-perlite partiton-wall elements/.
The above technological equipment may be considered as experimental ones because of the followings:

- According to our point of view they are adequate to expand the Mongolian perlite-rock suitable for expansion;

- In case of succesful utilization and on the basis of practical experience gained during the execution and operation further perlite-processing equipment can be installed in other areas of Mongolia near the sites of utilization;

- Technologies described in the study and products manufactured on the basis of them enable the Mongolian experts to gain local experience in perlite processing and utilization, on the basis of which new utilization methods and products adequate to the Mongolian conditons can be elaborated.

1.)

BACKGROUND INFORMATION

On the initiative taken by the Government of Mongolia and UNDP Resident Office in Ulan-Bator tenders have been invited by UNIDO for the elaboration of a feasibility study for the establishment of a perlite expanding kiln with a capacity of 87 thousand m^3 and related preparatory and further processing technologies.

Products manufactured hereby are to be utilized in the following areas:

- building industry /heat insulation, additives, mortar, plaster work/

- agriculture /plant growing and soil improvement/

- food industry /filter-aid material/.

After the bids submitted for the tender invited by UNIDO had been evaluated, TESCO/SZIKKTI received the assignment of UNIDO for the implementation of the project on the basis of the subject contract concluded in November, 1989.

2.)

CONSLUSIONS AND RECOMMENDATIONS

On the basis of the experience of the expert's team obtained on the site in Mongolia and the examinations carried out in laboratories of SZIKKTI in Budapest the following conslusions can be drawn:

- More significant perlite reserves have been found in the area of Zamin-Ulan and Eiligen Bulak among perlite deposits explored in Mongolia. From these two deposits Zamin Ulan has more homogenic raw material and also grants sufficient quantity for a long period. Category "B" 2,274 T m^3/, the perlite and tuff in Eiligen-Bulak are mixed to such an extent that their industrial separation is not advisable. Perlite resources available are more insignificant /Category "B" 532 T m^3/, hardly explored. Thus it would be advisable to base further works on the perlite deposit of Zamin Ulan. (see pages 20-25)

- Perlites met in Mongolia are elder according to their geological age, their structure is more bounded which makes expansion more difficult at a higher temperature but they are less likely to be milled and have more compressive strength than the European ones. (see pages 29-34 and Annex 7.)

- Tests have proved that perlite suitable for building industry, agriculture, filter-aid purposes can be expanded from these raw materials - even if quality parameters aimed cannot be completely fulfilled - and there is no technical obstacle to utilize these mineral resources. (see pages 29-34 and Annex 7.)

- Bounded water content of perlites found in Zamin-Ulan is high. Adequate low density could only be reached by pre-treatment in most of them.
  (see pages 29., 31 and Annex 7.)

- There is no energy supply at the deposit of Zamin-Ulan. In Mongolia no oil resource is available, the only domestic energy resource is coal, which is available but no perlite expanding kiln can be run by coal. Thus importing of energy has to be taken into consideration in the course of perlite expansion.
  (see pages 11., 12., 35.)

- Regarding utilization possibilities and fields of application the Mongolian counterpart has no related comprehensive information,so there are or could be fields of application which they consider to be solved using other materials /e.g. Ministry of Agriculture regards filter-aid works being solved by activated coal altough it is 10 times more expensive - considering the Hungarian prices - than the filter-aid perlite/.
  /see pages 11., 16-17.)

- Basic problem of the industrialization in Mongolia is how to transfer the population of the country, running still today nomad shepherding in majority, in industry. Shortage of qualified labour causes problems in every field of life.
  (see page 11.)

- The location determined for the establishment of the perlite expanding plant /between town of Nalajh and one coal-mine/ should be ragarded the most suitable from all the locations surveyed: there are roads, railway, electric transmission-line at disposal nearly on the frontier of the plot and water pipeline is available wihtin 1.5-2.0 km.
  (see page 1., 36., 37.)

- The application of technological line developed by the Hungarian Ore and Mineral Mines for mining and grading of perlites and technology of the Austrian Perlite Österreich GmbH for the expansion may be considered. Both technological suppliers wish to test perlite of 1 truckload quantity on their own machines before starting the design work. (see pages 37-61.)

On the basis of the above conclusions the following recommendations are to be made:

- Based on Cagan Delger deposit one perlite mine should be opened up in Zamin-Ulan. Mining technology must be elaborated in a way, that for a whole year operation of the processing plant the required quantity and output of selected raw materials could be provided within a short period of time /7 months/ due to the prevailing climatic conditions.
(see pages 35., 37-41.)

- Characters of Mongolian perlite differing from the European ones make it impossible to reach product features determined in the Annexes of the Contract, however, materials suitable for building industry, agriculture, filter-aid purposes can be produced from them. (see pages 26-34, Ann.7.) The higher compressive strength is advantageous both for building industrial and agricultural products. In the technology prior to the expansion dehydration at 200-300 C^{o} temperature pre-heating adaquate to the given type of perlite has to be fulfilled.
(see pages 30., 32. and Annex 7.)

- It is proposed to mine raw material in the deposit of Zamin-Ulan only. To provide required electric power a diesel generator should be run. All other

processing phases must be carried out in the preparatory works built in the expanding plant /Nalajh/. Products are to be delivered on road by truck /65 km/ and by railway /cc.200 km/. Suitable transshipping station must be constructed on the railway station of Choir.
(see pages 35-37.)

- In order to provide expertise, longer training period would be required and training of the key personnel on the site of the suppliers of technologies is advisable. Proposal is made hereby toward the Government of Mongolia that in case of delegating their experts to Hungary on their own expenses, TESCO/SZIKKTI are prepared to organize their professional programmes with the Hungarian factories and institutions.
(see page 7.)

- Prior to investment the necessary infrastructure /transport, water, energy/ must be provided by the Mongolian Government extending to the border of the plant to be established. Inside the plot frontier all public utilities, construction of road and railway network could be begun as part of the investment.

Implementation of the project is expected to be fulfilled under specific conditions.

Under climatic conditions mentioned above a relatively short period - about 7 months - is available for the project implementation. This fact requires starting the works not later than in the first days of April, execution of construction according to a pre-determined schedule, ensuring the necessary equipment, materials and auxiliary materials, and making government and other authority decisions in due time.(page 11.)

During starting implementation of site works energy, road, railway, potable water, telephone and machines, equipment and vehicles necessary for the construction are required.

Decisions of the government, UNDP and other authorities in connection with the project are to be made in due time in order that site measurements, staking out, etc. necessary for preparation of the detailed drawings can be performed before unfavourable climatic conditions/November/. In this case drawings can be prepared during the previous winter period /from December to March/.

Perlite industry is unknown in Mongolia. According to our point of view there is no adequately qualified personnel available. Thus it is required that the key personnel and workersbe trained in Hungarian and Austrian factories before the start-up. Personnel may be selected by qualification only.

The Government of Mongolia has to decide on the financing of the project and ensuring research and development funds, hence

this decision can form the base of the other ones.
For this purpose the Government has to prepare calculation of the price of perlite on the basis of our present report, by which local utilization and export capacity can be estimated.

An effective market research is required to determine export volume of perlite.

3.)

ECONOMY OF MONGOLIA

Mongolia lies in the middle of East-Asia, its territory is 1,565 thousand km^2. The country in North and West is bordered by the Soviet Union, in South and East by China. On its Western part the mountains of 2000-4000 m height surround sanded, stepped, marshy and outletless basins. In the East plateaus of 1000-2000 m height with sandstone and clay deserts can be found. On the Southern - South-Western part of the country lies the Gobi desert.

Population of Mongolia was 1.25 million in 1970, 1.66 million in 1980, 2.03 million in 1987, and in the future 20 years it is expected to double.

In 1986 the industry employed 96,000 persons, the construction industry 31,000 and the industry of transportation and telecommunication employed 42,900 persons.
The main field of subsistence is agriculture for the majority of the population /i.e. for the nomad herdsmen/.

Export turnover of Mongolia was 436 million USD in 1986. The main items of export are as follow: mineral raw materials, mining products, meat, leather, cotton, fur, livestock, food.
Import turnover of the country reached 655 million USD in 1986, consisting mainly of machines and equipment, vehicles, manufactured goods, pharmaceutical products and food.
80% of exports and 91% of imports is realised with the Soviet Union.

Capital of Mongolia is Ulan-Bator with 480,000 inhabitants. The main cities are: Darhan /65000 inhabitants/ and Erdenet /40 000 inhabitants/.

The currency of the country is tugrik /1 USD = cca. 6 tougriks/. GNP in 1984 reached 2.0 billion USD /1,000 USD/person/.

The infrastructure necessary for the development of industry is exceptionally unfavourable: length of railways is 1,423 km /the Mongolian part of the Irkutsk-Ulan Bator-Peking railway line/, paved road network is of 1,500 km /data of year 1984/ and the number of telephone sets is 44,600 /1983/.

3.1.)

SITUATION OF ECONOMY OF MONGOLIA FROM THE VIEW OF PERLITE UTILIZATION

Economic situation of Mongolia is basicly characterised by underdevelopment of the industry and infrastructure. The majority of population is subsisting on the nomad shepherding accustomed to during centuries, they ride on horse-back and their life is unambiguously linked to sheep-farming. Production of industrial factories, standard of equipment is relatively insignificant compared to the requirements of developed countries. Natural conditions of the country /great fluctuation of temperature - minimum winter temperature in January and February sometimes is 40°C below zero, while maximum summer temperature reaches plus 40 C°, although during the warm summer time night frost is not infrequent -, unfavourable soil condition and small volume and unequal distribution of precipitation are disadvantageous for agriculture - particularly for plant cultivaton. Plant cultivation is characterized by growing wheat, oat, barley and potatoes, a small quantity of vegetable and melon is raised in the Khovd area, in the valleys of mountains in West-Mongolia rich in water resources.

The food industry and its ancillary industry - where perlite can be used as filter-aid material - is in close connection with the agricultural cultivation. /According to information obtained from the Mongolian Ministry of Agriculture and Food activated coal is used for this purpose, which taking into consideration the Hungarian price ratios is ten times more expensive than filter-perlite./ Effluent treatment in the food industry - particularly in the meat industry - is an unsolved problem.

Construction of flats can be characterized by domination of panel method, and the same method is followed in the outlook of the buildings in the case of brickwork as well. Recently one third of settled urban population is living in yurtas /e.g. in Ulan-Bator/. /People prefer yurtas, they consider them more healthy type of housing. Yurtas are manufactured in small factories, but the future - according to our opinion - will be the prevalence of dwelling-houses./

Construction of flats is exclusively in the hand of the government, role of privateflat construction can be neglected. Mongolia has substantial mineral resources but its energy base is one-sided. Coal of excellent quality, i.e. of 29,000-35,000 kJ/kg /7,000-8,500 kcal/kg/ calorific value can be found in the country, from which 400,000 tons are lifted to the surface annually. There is neither oil field, oil processing work, nor gas layer. Oil supply of Mongolia depends on the supply of the Soviet Union, some oil industrial products, oil-products are transported in tank vehicles from the Soviet Union. Due to the total economic bandinage with the Soviet Union the overall decrease in the Soviet oil exports will probably have disadvantageous effect on Mongolia.

By products of the perlite expansion plant to be established, substantial energy saving and improvement of cultivation capacity of agriculture can be reached. However, for the manufacturing imported oil-products /heating materials and fuel/ are required, while energy saving will be observed in case of coal of indigenous origin.

3.2.)

POSSIBILITIES OF PERLITE UTILIZATION IN MONGOLIA

BUILDING INDUSTRY

In Mongolia every kind of development is hindered by the lack of infrastructure. In respect of transport there is no possibility for ship transportation, there is one railway line only /on the route of Moskow-Irkutsk-Ulan Bator- Peking/, roads with high-set pavement can be found for 30-50 km round the major towns and their is air service between the settlements and the capital of the country.

The following figure No.1. demonstrates a characteristical Mongolian road structure Essential conditon of development and industrialization of every kind is the basic improvement of transport and telecommunication.

Figure No.1.: Characteristical road structure for Mongolia

An other essential condition of industrial development is settling the nomad population which results in fundamental change in style of living requiring reformation of aknowledgement of the quality of live from the side of the polulation on one side and imposing hard task of construction - including flat constructions - on the state among the recent conditions of ownership and management system on the other. In Mongolia at present 200 Tm^3 keramzit and 60 Tm^3 rock filter ase manufactured per year as insulation materials. The Mongolian Ministry of Construction denominated the perlite demand of 150 Tm^3/year, however an utilization of this volume can be realized after running-in during several years and recognition of characteristics of the material, its opportunities and methods of utilization. The present quantity of demand is estimated by the Ministry of Construction as to the following:

Perlite-concrete	25 Tm^3/year
Insulation mortar and plaster	25 Tm^3/year
Partition walls	5 Tm^3/year
Utilization of acoustical purpose	5 Tm^3/year
Other	5 Tm^3/year
TOTAL:	65 Tm^3/year

For meeting the above demand the perlite kiln recommended is suitable itself. Taking into consideration that other types of equipment satisfy a higher capacity than the above stipulated / there is no equipment of smaller capacity or if there is, then the utilization will be disproportionately expensive projected on a unit of quantity/ there is possibility for increasing the capacity

by including one more kiln into the technological phase if there is higher demand for the product. In the case of further increase in utilization - because of the relative high costs - in relation to the price - and unfavourable conditons of transportation - it is suggested to further equipment of perlite expansion near the site of utilization and transporting the prepared raw perlite to the same. By using perlite as constructing material - including for flat construction purposes - besides of increase in the insulation effect energy saving of 5-20 per cent can be reached. The inexpensive and easy to handle perlite-mat may get an important role in the insulation of ceilings.

AGRICULTURE

There are substantial prospects for the utilization of perlite in agriculture of Mongolia. Climate of the country is dominated by drought - with periodical heavy rains -, the water balance of the soil can be greatly improved by the water in-take and storage ability of perlite which means that the water stored leaks slowly. According to the European experience the expanded perlite improves the temperature, air and water balance of soil, enhances rooting of plants, makes possible faster growing and passes the necessary microelements to the roof of plants. The Mongolian perlite - being elder according to its geological age and with more thick and stronger cell-walls - is adequate for this purpuse, because tests proved that the stronger arenoses resist better the pounding effect of soil. In Mongolia of 1,565 Tkm^2 territory there is cultivable area of 13,000 km^2.

Growing samplings in perliteous circumstances can play substantial role in increasing cultivable area and development of agriculture. By pricking them in, the soil can be ameliorated and further areas can be enroached upon the steppe.

Development of green-house cultivation is also a significant field of utilization, by which occures possibility for spreading the hydroponic method of fruit and vegetable cultivation, growing of certain kinds of fruit /strawberry, wilde strawberry/ and vegetables /cucumber, paprika, tomato/ in greenhouses - from rooting and plant growing to cultivation phase -. A further opportunity is represented by cultivation papilionaceous plant improving nitrogen supply of the soil, making possible perfection of cultivation conditions by using expanded perlite. In Mongolia there is a lack of ornamental plants, thus by using perlite pinks and roses can be grown.

The pre-condition of all the above developments is the vigorous progress of the Mongolian agriculture and food industry, switch-over from animal keeping to agriculture in respect of a part of the population.

FOOD INDUSTRY

In present structure of the food industry perlite can play an important role if transformation from activated coal - used as filter-aid material - to filter-aid perlite will be performed in manufacturing 9 million litre beer and 20 million litre spirit per year. This quantity supports the filter-aid perlite demand of 2,000 m^3/year projected by the Mongolian experts.

By developing the industry this quantity can be increased. The possibility of utilization will be further extended by using this mineral in sugar industry, where 900 m^3/year quantity of filter-aid perlite would be used for processing 40 Tt sugar, and in milk industry as well.

In food industry treatment of wash water and waste water resulting from processing 200 Tt meat per year has an environment protectional importance. Wash water containing meat particles causes serious demages by penetrating to the soil /i.e. sodification, alkalescency, bacterium cultures and polluting water will result in significant increase of KOI and KOI_5 values, perishing of fish, expanding of marsh-lands/ hence multi-phase treatment of waste water and removing micro- and macro-wastes are of essential importance. In the first phase filter-aid perlite of great filter capacity - e.g. K-115 * - can be used for removing waste of several microns size - for example meat particles - /this means utilization of further 200 m^3/year of perlite/, and in the following phases biological treatment - removing micro-waste - by pushing micro-organisms onto the perlite can be performed.

Among the objectives of the Government of Mongolia exporting of expanded perlite and perlite products has been determined. This is not impossible but substantial obstacles have to be considered. Perlite - being a very inexpensive mass product - highly depends on the costs of transportation, so transportation to great distances is uneconomical. There is no certain information on the perlite industry of China, but it is possible that there will be demand for perlite in North-China which is near the Mongolian border and exporting from Mongolia may be cheaper than transporting perlite to this

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* K-115 filter-aid perlite: density: 80-140 kg/m^3
flow-time: moore than 50 sec
percentage of floating parts: 0%

part of the country from the inner side of China.
The Soviet Union has a developed perlite industry with centres in Ukraina, Armenia and in the environs of Moskow. It is conceivable that South-East Siberian part of the country can be a market for the Mongolian perlite. For projecting export opportunities - mainly in respect of the above areas - a valuable market research has to be conducted.

To make decision on the practical implementation of the project is the task of the Government of Mongolia.
The investment - because of the relative low level of national income - will greatly burden the national economy of the country, but resulting substantial achievments in the energy utilization, agriculture and food industry, may effect the transformation of national economy of Mongolia - including flat construction, transformation of agricultural activities and spreading plant cultivation. Thus - according to our point of view - support of interntational organizations like UNIDO and UNDP is required.

In Mongolia prior to the present work the utilization of the perlite resources of the country was intensively investigated between 1964 and 1978 with the assistance of Soviet and Czechoslovakian institutions. The following reports have been made /which are known for UNIDO/ in that period:

1/ Report of VNIISTROM, USSR, Kraskov /1964/
2/ Report of Central Scientific Laboratory, Mongolia, Ulan-Bator /1965/
3/ Report of Crgtestroi, USSR, Irkutsk /1967/
4/ Report of NIISMI, USSR, Kiev /1970/
5/ Report of Techn oexport Foreign Trade Co., USSR, Kiev /1973/
6/ Report of Keramické Závody, CSSR, Mihalovce /1974/
7/ Report of Scientific Institute of Building Materials, Mongolia, Ulan Bator /1976/
8/ Report of Scientific Institute of Building Materials, Mongolia /1977/
9/ Report of Geological Minstry of the Mongolian People's Republic, Eiligen-Bulak deposit, Ulan Bator /1977/
10/ Report of Scientific Institutie of Building Materials, Mongolia, Ulan Bator /1978/
11/ Report of Geological Ministry of the Mongolian People's Republic, Zamin-Ulan deposit, Ulan Bator /1978/

The Hungarian team leader had studied all the reports provided /1., 3., 4., 5., 7., 9. and 11/ in the period of 31st January - 14th February, 1990 in Ulan Bator, prepared works of the Hungarian experts' team in Mongolia and in the course of survey on site made together with the Mongolian counterpart,

a proposal has been elaborated for the most suitable site from those investigated. Cold weather in winter time /15-30°C below zero/ made it impossible to carry out any field work /sample collection/ which was indicated by the Mongolian partner by the first week of April.

The team of experts /Ede SOBOR, team leader, technologist; János LINGAUER, geologist; János PAP, expert of applied technologies and economics/ carried out the necessary sample collection on the sites, determined the adhesive humidity of each sample, conducted negotiations with the organizations concerned and collected all data required for economic calculations.

Brief introduction of the geological situation of perlite deposits in Mongolia

In the middle areas of Mongolia, County of Middle-Gobi respectively vast vulcanic effusive formations can be found in different areas originating from the Jurrassic and Cretaceous periods, among them various types of vulcanic glasses can be met connected with vulcanits with acid composition.

These are perlite, vitrificated tuff with perlite and vitroclasted tuff. Their expansions and thisness are varying to a great extent from some decimetre to some 10 metres.

Survey and investigation of possible utilization of perlite formations has been started in the mid 1960-ies. Upon some affirmative results the geological surveys became more

intensive in the 70-ies and in the mid 70-ies thoroughful geological investigation of two deposits was performed. These are deposits in Zamin-Ulan and Eligan Bulak.

Perlite deposit in Eligen Bulak

In widest surrundings of this deposit geological surveys with the aim to explore perlite formations had been executed since 1964. In this area the low Ozunbain effusive rocks of Cretaceous period /lyparite, andesite, andesito-basalt and basalt/ are wide-spread.

The vulcanic rocks deposited on about 240 km^2 are almost of horizontal arrangement, their greatest thickness is of 100-300 m. 50-60 per cent of the vulcanic complex consists of lyparite. Among the lyparites vitorclasted tuff was found in several places. This raw material had been examined and qulaified according to different aspects of utilization in several Soviet research institutions for 10 years.

Different reports evidence that various problems occured during the endurance test of the samples examinded, often samples of uncertain origin and inadequate quantity were tested. The main purpose of geological survey performed in Eligen Bulak deposit in 1975 was the following:

- sample collection of adaquate quantity for the purpose of tests in industry; and

- determination of quantity of mineral resource.

During the works 7 drillings had been deepened in total depth of 139.3 rm /the depth of drillings varied from 15.9 to 24.0 m/. Industrial sample of 2 t had been obtained by aggregating drilling core samples.
On the basis of drilling survey the formerly problematic stock calculation have been revaluated.

The raw material stock in this deposit - in respect of categories "B" and "C_1" - totals 736 Tm^3 - from which category "B" bulks up to 532 Tm^3.

This deposit can be found on 155 km from Ulan Bator and about 10 km far from the railway line. This deposit is well situated according to transportation aspects, but it is not worth further examining because of the mixed structure of raw material /vitroclasted tuff mixed with perlite/ it is not suitable for manufacturing perlite products determined among objectives.

Perlite deposit in Zamin-Ulan

The deposit is located in the county of Middle-Gobi, 260-km south-east of Ulan Bator, 65 west of the railway station of Csoir. The nearest habitation to the deposit is the village of Cagan Delger in 9 km.

In this region a large area is covered by formations of middle-upper sedimentary, effusive complexes originating from the Jurrassic period, among those perlite rocks can be explored related to vulcanits with acid composition.

In this deposit a detailed geological survey was carried out between 1975-77 in the course of which a large quantity of perlite resources has been discovered with extremely huge

research facilities and geological mapping of vast area.
Raw materials examined involve the following 3 types:

- perlite
- vitrificated tuff with perlite and
- vitrificated tuff.

This research resulted mineral resources shown herebelow as follows:

In category "B+C_1" perlite and vitrificated tuff together: 5,636 Tm^3 from which category "B" 2,274 Tm^3, category "C" an additional 8,455 Tm^3 was determined.

The most perspective part of this deposit is a cc. 50-70 meter wide zone extending in south-west direction in the middle of this area where pure perlite can be met.
South of this zone vulcanic lyparite can be found while north of it vitrificated tuff with perlite and more north pure vitrificated tuff occur.

Raw material of this zone is dependably determined by survey facilities /prospect-shaft, graben, drilling/ the total volume of the mineral resource is 1,106 Tm^3 in category "B including

- perlite	928 thousand m^3
- vitroclasted tuff with perlite	127 thousand m^3
- tuff	51 thousand m^3.

The lowest limit of the stock calculation is the water level of the soil which depth is ranging from 22,2 to 33,2 m.
Thickness crossed by drilling of the useful raw material is around 11.5-30.4 m, in average 22 m.
The 1.7-meter average thickness of the covering loose sediment is insignificant /ranging from 0.2 to 3.0 m/.
In case of a possible mine opening in the future there will be no obstacle against mining.

According to the present conceptions mineral resource determined in the central zone could meet requirements of raw materials for production of expanded perlite for 70 years.

Raw material explored in the most perspective central zone of the deposit was sampled in details in order to provide rock material required for examination partly on site but majorily in Hungary. A total number of 16 pieces was collected dependably representing types of raw materials occuring in this area /see site drawing of sample collection and sample list/.

Figure No. 3.demonstrates perspective view of the deposit from North.

Figure No.2.: Eiligen-Bulak deposit

Figure No.3.: Zamin-Ulan deposit

4.)

ELABORATION OF TECHNOLOGY FOR THE PRODUCTION OF THE DETERMINED PRODUCT ASSORTIMENT

Previous examinations

Previous technological experiments described in reports provided were aimed at production of so-called perlite gravel with big graine size, big mass density domesticated in the Soviet Union.
This work has a great significance in producing of goods substituting keramzit, however, it considerable differs both in its technology and character of the product from the one aimed to realize. The Article C of Terms of References, i.e. "Technology" of contract no. 49/149 which is the basis of present work summarizes requirements as follows:

APPLICATION	DENSITY kg/m^3	MAX.GRAIN SIZE mm
Losse insulation	60-80	1.5
Cement-bound perlite	80-120	2.0
Masonry mortar	80-100	2.0
Rendering mortar	60-100	2.0
Partition walls	80-120	2.0
Acoustic units	80-120	2.0
Pipe-line thermal insulation	60-100	2.0
Amelioration of soil	80-130	5.0
Filter-aid material	35-50	0.3

Among the most valuable for this purpose /largest quantity, repectively homogenic/ deposit of Zamin-Ulan /Report of Geological Ministry of the Mongolian People's Republic, Zamin-Ulan deposit, Ulan Bator 1978/ materials collected as samples were expanded with and without pre-heat treatment at 15-60 sec intervals of expansion and density between 540-1480 kg/m^3 was determined. Expanding equipment used in the laboratory did not meet the principle of equipment used in industry for similar purposes. Obviously, we had to start from basis completely different from the previous surveys declaring those as being correct and proper ones, however, those surveys were done with consideration of other aims.

Examinations covered by present report

According to the described above and also thoroughness of the sorvey we concentrated the activity on the deposit of Zamin-Ulan. For our examinations we have collected samples /except ZM 14/ from those research fields /grabens, drillings/ where samples of previous examinations had originated /see Sample List as Annex 3/.

Adhesive moisture content of the samples, jointly collected with the Mongolian counterpart /Dorshsuren chief geologist, Scientific Institute of Building Materials, Ulan Bator/ from locations stipulated in Sample List, was determined directly upon sample collection in the laboratories of Scientific Institute of Building Materials, Ulan Bator.

Each sample was divided into two parts and tha smaller parts were delivered to the laboratories of AL-MEO-SZIKKTI in Budapest, where the following parameters have been tested:

raw perlite

- chemical composition
- thermal analysis
- adhesive and bound moisture content
- granulometric composition after grinding
- density
- milling, specific surface
- moisture content after pre-heatment

expanded perlite

- granulometric composition
- density
- milling
- ineffective content /proportion of grains not expanded/
- compressive strength ..

Examinations have been made on the basis of Hungarian Standards, i.e. MSZ no 18298/2 - 79,
MSZ no 16011 - 87
MSZ no 16015 - 1988
and also those of COMECON i.e. ST no 5066.
Results of the tests are summarized on the page 34.

Survey evaluation of perlite samples and fields of application

Expansion tests made in the expanding kiln of the laboratory of the Department for Heavy Clay and Insulating Materials of SZIKKTI have unambigously shown that perlite samples collected from the deposit of Zamin-Ulan are expandable, the optimum expansion can be reached in case of water content of 3.5-4.5 per cent.
In 5 cases samples are classified in the category of "Light raw perlite". These are:

Zu-4
Zu-9
Zu-10
Zu-15
Zu-16.

Parameters gained during the examinations of these samples are promising /average value/:

Bounded water content after drying		5.3%
Specific output		11.1 m^3/t
Grain size distribution	0-1 mm	53.5%
	1-4 mm	46.5%
Compressive strenght at 40% compression /as to Microbrouk/		5.54 daN

According to data the expanded product made of this perlite rock can be used for building purposes.
Fine fraction /0-1 mm/ derivable from the total stock

comprises nearly the half of the whole production that can be utilized for purposes as follows:

a/ production of cement-based heat insulating mortars. In Mongolia with the exception of perlite all the components for this are at disposal /cement, blust, chemical additives for super plastisizer purposes/.
Finess of the fraction facilitate both manual and mechanical applying of wall insulation.

b/ for loose filling-up insulation /core insulating/ for double-layer brick wall structure. /In this case fine fraction should be hydrofobized wiht silicon oil./

c/ production of clay-bounded heat insulation moulds of medium heat resistance /450-700 ^{o}C/.

d/ production of partition wall board units.

e/ floor insulation of heat insulating perlite mat.

The rougher fraction /1-4 mm/ can be applied for the following purposes:

a/ production of perlite concrete for light floor insulation, manufacturing of heat-resistant insulating concrete blocks with special cements.

b/ production of water-glass or plastic bounded acoustic sound insulation units for false ceiling on wall coveriny.

In 9 cases samples could be classified in the category of "Heavy raw perlite ore". These are:

Zu-1
Zu-2
Zu-5
Zu-6
Zu-7
Zu-8
Zu-11
Zu-12
Zu-14.

Since specific weight and dead content of samples Zu-12 and Zu-14 were shown so high, we took them into consideration to a limited extent during evaluation. /They can be used only mixed with Zu-5 after a pre-heatment at 300°C./.

Parameters listed above regarding these samples are formed as follows /average/:

Bounded water content after drying		3.6%
Specific output		7.0 m^3/t
Grain size distribution	0-1 mm	62.8%
	1-4 mm	38.2%
Compressive strength at 40% compression		10.0 daN

As these data show these properties are more disadvantageous from the point of view of expandibility as those in case of the previous 5 drilling samples.

These parameters could represent advantage for utilization of perlite in the field of agriculture. Considering its geological age perlite resources are elder than those in Europe which means a disadvantage from technological aspects, as it requires higher flame temperature and consequently higher specific energy consumption, but it is advantageous if applied in agriculture owing to favourable values of three important parameters such as:

- specific weight
- grain size distribution
- compressive strength.

Electronmicroscopic tests have shown also the thick cell-walls thus being also an advantage.

These characteristics prove both long lifetime and mechanical resistance of the expanded perlite that could be adopted for those fields of application and climatic and soil circumstances of Mongolia. The average specific surface of product based on BET nytrogen adsorption method is

$$\Omega = 0.43 - 0.58 \ m^2/kg.$$

It also corresponds to European perlites and thus compared to specific mass unit it shows moisture adsorption character of 3-5 kg adsorbed water/kg of expanded perlite. By this it is able to improve water balance of soil significantly.

Results of chemical analysis /oxide analysis/ show that samples contain a large quantity of magnesium-oxide,

potassium-oxide, calcium-oxide, titan-oxide and ferrous/III/-oxide components to the detriment of their Al_2O_3 content. Proportion of elements listed above is higher than those in European perlites. These features give a preference to utilization for agricultural purposes, calcium and magnesium-oxide /CaO and MgO/ have good effect - within certain limits - for plant structure. Potassium-oxide improves sap content of plant, while titan-dioxide advantageously influences the immune system of plants. Of course, it is generally specific for perlite that these elements are able to be solved out from expanded perlite grains slowly, in directed way, continuously and to be absorbed in the plants' root after releasing. By the improvement of moisture balance these features could result accelerating of plant development and improvement of average yield.

Filter-aid perlite can be gained from further grinding fine fraction of expanded perlite. This procedure is protected by know-how supplied by the manufacturer of the perlite expanding kiln. Final products must have given grain distribution and specific surface. Fine fraction usually occurs as a waste material of the production so processing of it could improve rentability of the production.

Samples of Zu-3 and Zu-13 were not expanded. This fact has no importance from the point of view of the mine since Zu-13 coincidences with the line of limitation and Zu-3 falls outside.

SUMMARY TEST REPORT

Raw perlite			Expanded perlite				
Sign of Sample	Water content after drying at temperature of 105°C	Temperature of dehydration	Water content after dehydration	Specific weight	Dead Content	Measurement on expansion	Measurement on breakage	Evaluation of raw perlite ore by Hungarian Standards
	m %	°C	m %	g/l	m %			
ZU-1	4.63	200	3.45	126	5.0	10.87	8.27	heavy r.p.
ZU-2	9.60	250	4.11	173	15.5	6.86	4.26	heavy r.p.
ZU-3	18.12	300	4.71		not expanded			
Zu-4	5.64	200	3.87	89	2.5	15.35	6.48	light r.p.
ZU-5	13.44	300	4.44	165	6.2	4.90	5.72	heavy r.p.
ZU-6	7.51	230	3.75	142	6.0	9.10	4.73	heavy r.p.
ZU-7	10.27	250	3.81	202	39.0	5.87	2.44	heavy r.p.
ZU-8	5.59	200	3.66	128	6.5	10.26	10.17	heavy r.p.
ZU-9	5.74	200	4.20	98	6.0	13.96	4194	light r.p.
ZU-10	4.92	200	3.85	81	4.0	16.48	24.05	light r.p.
ZU-11	5.17	200	3.56	131	4.0	10.44	4.32	heavy r.p.
ZU-12	11.60	280	3.67	230	38.0	5.07	4.12	heavy r.p.
ZU-13	16.43	300	3.80		not expanded			
ZU-14	13.32	300	3.67	365	54.5	3.09	2.97	heavy r.p.
ZU-15	5.59	200	3.66	102	4.0	13.35	14.15	light r.p.
ZU-16	4.87	150	3.99	89	4.0	16.53	12.51	light r.p.
EB-1	4.18	105	4.18	164	44.50	7.28	4.70	heavy r.p.
EB-2	3.47	105	3.47	305	67.0	4.41	4.71	heavy r.p.

Remarks to the Table "Summary Test Report" on the page 34.

r.p. = raw perlite

Temperature of expansion: flame temperature: 1240 °C
wall temperature: 1060 °C

Summary

The final results of experimental expansion show that from the aspects of utilization methods the stock meets the raw material requirements. The results of derivatographic tests indicate that water-pass necessary for expansion proceeds at 250-400 °C temperature range. This supports the results of expansion as the mass-loss diagrammes show an intensive water-pass from 250°C temperature range which gives driving force to expansion.

The results of tests demonstrate reasonable parameters both for purposes of building industry, agriculture and food industry. Since - demonstrated by the results - the quantity of expanded perlite suitable for agricultural purposes probably exceeds the projected quantity, it is worth considering this field for agricultural utilization.

In practice some less advantageous results may be anticipated compared with the ones reached in laboratory tests. However, this difference does not influence significantly the proper and adequate use of tested perlites for specific purposes.

4.1.)

TECHNOLOGIES RECOMMENDED

In elaboration of technologies main features of the site, labour available and climatic conditions have to be taken into consideration.

In the environs of the Zamin-Ulan deposit the nearest settlement is in about 9-10 km far which is called Cagan-Oelger. Because of the poor energy supply of the settlement and of great distance from the deposit the costs of construction would be high, so it can not be taken into consideration. Cagan-Oelger can be a communication and catering basis only. Thus energy demand of the mine has to be minimised. This means that constructing the preparation works here will be not practical. The only mine and a transitional storage facility are to be constructed at this place and energy demand will be met by using diesel generator. As to our opinion climatic conditions make possible production during 7 and half months /from the middle of March to the end of October/, thus machines, vehicles have to be used for other purposes in winter time, or the required maintenance works, repairs followed by special storage have to be arranged.

Transloading

For transloading the mining prodocts from trucks into railway wagoons a transloading facility is to be constructed at the Choir station which at the same time will serve as storage facility and will equalize the different rate of truck and railway transportation.

Preparation plant

The preparation plant would be constructed connected to the expansion plant to be set up on the site demonstrated on figures no. 4 and 5 below.

Figure No.4: The site of preparation and expansion plants at Nalaik
/from mine-side/

Figure No.5: The site of perlite expansion and preparation plant at Nalaik
/from the road- and railway-side/

At this site energy, public utilities, road of transportation, railway and labour force can be ensured. Taking into consideration the climatic conditions we do not plan operation of the preparation plant from the middle of December till the end of February. For the sake of ensuring continuous operation of the expansion plant storage facility for the quantity proportionate to the temporary closing down is to be secured.

The annual capacity of the mine, transloading facility and preparation plant is 20,000 t, which enables increase of the capacity of the expansion plant - now determined in 87.000 m^3/year.

The expansion plant and the auxiliary equipment will be located in a work-shop, heating of which can be solved thus ensuring operation all the year.

Surface mining plant

1. Production technology and selection of machines

Main aspects of selection are as follows:

- initial data determined in article 2.
- required capacity, distance of transportation, reliability,
- mobile machine system,
- development characteristics of upper bed and the raw material.

2. Production quantity and capacity of the mining plant

The parameters are as follows:

Mining product required for the preparation plant		20,000 t/year
Factors effecting the raw material production are:		
- moisture content: initial data	max.	6%
data of the end-product	max.	0.4%
- production, storage, transportation loss /on the basis of data from the literature/	max.	2%
- dust-shield loss for the complete technology		3%.

Description of mining technology

Mining is performed at two levels. At levels designed for mining rock-chopped breaking will be arranged depending on the hardness of rock.

The following levels are to be designed in the mine:

Level	Height /m/
0	5-7
I	1.5-3

Slump angle of mine-wall will be 70^{0} or. 90^{0} in case of waugh perlit development.

In case of unfavourable rock conditions the slump angle will be decreased to an extent stipulated by the the chief technical manager-in-charge.

During planned mining perlite development can be performed at one level and dead rock removal at the other. Both types of breaking are performed by explosion and rock chopping depending on the hardness of the rock.

Formulating of drill holes can be executed by drilling machine of type BÖHLER. The BÖHLER type drilling machine is erected onto a light steel structure with 3 tyres, and is operated by compressed air. The drilling machine requires a mobile compressor of 550 m^{3}/hour capacity and p=6 bar pressure.

Drilling in the useful material is performed downwards.. Dead bands are exploded separetly by using explosion holes drilled downwards or in horizontal level.

For explosion paxyte-catridge of 100 and 1000 g and bulk ando or in 1000 g package is used.

Starting the explosion material is performed by using equipment of RKG type or electric cap type PAG.

The exploded useful or dead material is loaded on truck of type KAMAZ by excavator type BRYOT X42. Then useful material is transported to a transitional storage facility /on west of the mine/ while dead material is delivered to the eastern part of the mine.

Height of the refuse dump is 12-15 m. Around the dump warning sign-boards have to be set up.

Rock-chopped breaking is expected to be 30÷40% of total production.

Type of machine is KOMATSU D 155 A-1.
Working by the machine on an area slope-angle of which exceeds 25^{0} or incline angle of which is more than 35^{0} is forbidden. The maximum angle of cross-inclination can be 15^{0}.

The edge of the site bordering the mine-yard and the ramp of dump is to be marked out by a barrier of 1m height and 2 m width.
The machine pushes the material already loosened by explosion or rock-chopping by its push-plate to the constructed barrier thus getting through the mine-wall and forming an other barrier there.

At the bottom of mine-wall within the territory of the mine loading and other handling activities are allowed to be performed on 10 m distance from the normal projection of the machine at mine-yard or on distance equal to the height of the mine-wall.

Safety requirements of mining

Mining may be executed on the basis of actual technical development plan.
The supervisor engineer has to ensure that all the technological stipulations and safety requirements be met.

The technical development plan - apart from the main parameters of production - has to contain the following data:

1. Maps
2. Production losses
3. Occured mining demages during the planned mining activity
4. Porar content
5. Mouldering danger
6. Drainage
7. Communication and lighting
8. Other health care provisions
9. Labour-safety training.

Machines required for the operation of mine

Excavator:	BROYT X42 EL /Norwegian origin/	1 pc
Drilling machine:	BHOLER TKD 2/35 /Austrian origin/	1 pc
Compressor:	DK-660 /Czech and Slovak origin/	1 pc
Truck:	KAMAZ of 10 t capacity /from USSR/	3 pcs
Rock-chopping machine:	KOMATSU D 155 /Japanese origin/	1 pc

PERLITE PREPARATION PLANT

TECHNOLOGICAL DESCRIPTION

Crushing, middling, drying.

Raw perlite of 0-600 mm grain size is delivered to the covered loading mill by truck type KAMAZ. The loading mill is equipped with a 280 mesh breaking grid thus rock of greater grain size has to be bumpered. Loaded perlite is put through a feeding vibrator screen from the loading mill to the jaw-breaker then crushed into 0-60 mm grain size to the conveyor. Material separated by the vibrator screen passing round the jaw-breaker is getting to the conveyor as well.
Perlite fracture on the conveyor is put through the switch-shute to one of the feeding tanks and through one of the feeding vibrators to one of the breakers executing post-breaking.
From the gravity chute perlite broken to 0-5 mm size is put on the conveyor then through the throw-off end to the cylindrical drier. Dried perlite will get to the vibrator riffle located under the discharge work of the cylindrical drier, then is put to the transloading conveyor. Through the throw-off end of the conveyor the material is put onto the elevator then delivered to the bumping table.

Taking into consideration the strict regulations of environment protection, technology considers requirements of both the flue gases and dust control at the work-site. For this 2-phased intensive dedusting system, cyclon plant for dedusting and heat-resistant sack dust filter have been installed for dedusting of flue gases, from which filtered flue gases

are exhausted throughventillators to a chimney of 36 m height and then pushed to the air.

Post-breaking and bumping plant

Material broken into 0-5 mm size is conveyed to bumper on the top level of the work-shop. The bumper is of double-section, and is equipped with steel screens of 2.5 and 1.6 mm .. +2.5 mm grain set of the bumper is put onto 2 pieces of cylindrical breaker operating as a continuous post-breaking system. The closed circule of grinding and bumping is supplemented by the conveyor and the elevator passing the broken material back onto the screen of 2.5 mm.
The product of 2.5-1.6 mm size of the screening equipment is an end-product which is directly put to the storage bin.
The lower product pushes the material to the loading mill of the second bumper through the conveyor. The second bumper is equipped with screens of 1.0 and 0.5 mm size.
Both the middle product and screenings are put to the storage bin no. III and IV as end-products.

General dedusting of work-places and delivery points is ensured by 1 piece of intensive sack dust-filter of JET type, through which filtered air is transmitted to the air through the chimney on the top level by ventillators.

A horizontal long conveyor will be built in under the storage bins delivering the keen-bumpeted perlite to the first vessel of the perlite expansion plant through a slant conveyor.

Location of architectural facilities

Location of facilities is to be arranged according to the drawings.

Main technical data of facilities

Building for raw material passing

- internal area:	7.50 x 5.50 m
- basic area:	30.25 m^2
- cubic space:	444.6 cm
- number of levels:	2 /+2.20; +6.30/
- building height:	+11.60 m
- web height:	+14.70 m

Building for middle breaking

- internal area:	7.50 x 5.50 m
- basic area:	41.25 m^2
- cubic space:	589.8 cm
- number of levels:	3 /+4.50; +7.65; +9.75/
- building height:	+12.50 m
- web height:	+14.30 m

Building for electric switch-gears

- internal area:	4 x 8.27 m
- basic area:	33.0 m^2
- cubic space:	70.0 cm
- roof height:	4.5 - 3.1 m

Environment protection

Technological planning meets the requirements of provisions of environment protection and air pollution in force. There was no reason for deviation from the provisions.

After technological installation there will be 1 dust emission source at 30-50 m height /for flue gases/. Permissible dust emission of limit value of category is as follows:

$E = E_f \times K_1 \times K_2 = 0.7 \times 100 \times 0.8 = 56{,}0$ kg/h

$C = 56 \times 10^6 / 24 \times 10^3 / = 2330$ mg/h

Technical data of dust emission source

Height:	H= 35.8 m
Diameter:	Ø 1280 m/m
Quantity of exhaust air:	2 x 12,000 m^3/h = = 6.6 m^3/sec
Air velocity:	5.18 m/sec
Dust load expected:	2640 kg/h = 110 g/m^3
Dedusting efficiency:	99.9%
Permitted exhaust dust concentration:	C= 2330 mg/m^3
Calculated dust concentration:	C= 125 mg/m^3
Separator:	2 pieces of IF-JC 50/3-2 type INTENSIVE FILTER
Surface:	2 x 175 m^2
Manufacturer:	VENTIFILT Hajdunánás
Material of filter sack:	NOMEX NX-RA-V 600 H+S

The most up to date dedusting equipment available at present guarantees dedusting to appropriate extent.

Material delivery points are connected to the technological dedusting system, cross section of pipes and air quantity of which are adequatly calibrated.
In case of maintenance services or break-down dust protection of the workers is to be ensured.
For this purpose the dust filter respirator is to be used.

PERLITE EXPANSION PLANT

Perlite expansion plant joins the raw perlite preparation plant at a level of +8.40 m after leaving the mixing conveyor located under the storage bins containing 4 different fractions of the prepared raw perlite. Raw perlite mixed in reasonable manner for perlite to be produced during expansion is passed to the preheatment drum where required adjustment of the bounded water content of perlite is executed.

Dehydrated raw material passes to the furnace area through a feeding hole located on the side-wall of the shaft kiln, where expansion is performed from downwards by the help of heat transmitted by an oil burner. The expanded material is put to the separation cyclone, where it is distributed according to different sizes, then is delivered to the storage bin of end-products from where it gets to the sack-feeding equipment.

Sacks full of perlite are then loaded on pallets, forming bulks and the bulks are delivered to the store-house by electric-driven hand-car.

A perlite grinding mill can be installed between the cyclone and the storage-bin of the end-product for producing filter-aid perlite. However, it is not necessary since 2000 m^3 filter-aid perlite per year can be extracted from the dust-separator.

The complete technology of the Austrian Perl Mineralstoff GmbH, St. Pölten have been chosen, which meets the required capacity. This is the most energy saving system among the known types of equipment, its separation accuracy is good, and can ensure operation at higher temperature than that of

the routine procedure.

Basic data of technological equipment

Type of equipment is PEA -650 HP.
The parts of the equipment are as follows:

Shaft-kiln for perlite expansion: /Type PEA-650 HP/

Expansion capacity: about 8-30 m^3/h depending on the quality and grain size of perlite.

Expansion temperature: maximum 1200 ^oC.

Fuel demand: 10-25 l/m^3 of extra light fuel oil calorific value of which is 10,200 kcla/kg.

Maximum hourly oil demand: 250 l/h.

Built-in electric capacity: 50 kW /220/380 V, 50 Hz/

Inclined tubed preheatment kiln: /SRV 450 type/

Permeability: cc. 2t/h raw perlite
Temperature: 200-350^oC
Specific energy demand: cc. 25 kg/h extra light fuel oil

Fuel equipment: /type PEA-650 HP/ for the expansion kiln

Pressure:	2-3 bar with constant calibration
Energy demand:	see Shaft-kiln for perlite expansion plant
Viscosity of fuel at the burner :	cc. 1.5 ^{o}E
Pressure demand of air mixing:	cc. 0.3-0.4 Nm^3/kg.

Radial ventillator of air necessary to burning

Delivery capacity:	cc. 76 Nm^3/min.
Total pressure difference:	20 mbar
Operating motor:	
capacity:	5.5 kW
revolution:	2800 r/min
voltage:	220/380 V
frequency:	50 Hz
form of set up:	B 3
method of protection:	IP 44

Electric switch-box

Built-in equipment are as follows:

- self-control system, 220 V
- automatic control equipment, switching is performed according to DIN 4787/88, 220 V

- electric wire-system unit with signal instruments and operating elements

Separator of high-capacity /type PEA-650 ZY/

Main dimensions: 1090 mm x 5280 mm

Cooler of free fall /type PEA-650 MK/

Main dimensions: 600 x 600 x 1100 mm

Ventillator for cooling air /Type PEA -650-AXU/

Free-exhaust ventillator

Air capacity:	cc. 4200 m^3/h
Motor capacity:	0.55 kW
Revolution:	1400 r/min
Voltage:	220/380 V

Cellular cut-off unit /Type PEA-650-ZS/

Operating motor: 2.2 kW - chain driven type

Ventillator for cooling air /Type PEA-650 AXU/

Free-exhaust axial ventillator

Air capacity:	cc. 4200 m^3/h
Motor capacity:	0.55 kW
Revolution:	1400 r/min
Voltage:	220/380 V

References of the outlined perlite expansion equipment are as follows:

	Pieces
1. Perlite GmbH, St. Pölten, Austria	4
2. National Ore and Mineral Co., Hungary	1
3. Wittersdorffer und Pegauer Zementwerke	
Pegau	2
Wittersdorf	2
4. Steierische Montanwerke A.G.	
Leoben	1
Bad Aussee	1
5. Schmidt und Co. Wopfinger Kalkwerke	1
6. Saudi Suspended Ceiling Col. Ltd.,	
Saudi Arabia	1

/Further 9 kilns are in the phase of order./

PLANT FOR MORTAR AND PLASTER MANUFACTURING

TECHNOLOGICAL DESCRIPTION

Basic materials are delivered to the site by tankers and are put into storage tank by using pneumatic method.
Chemical additives are transported to the site in sacks and lifted to the level of chemical tank by the help of elevator.
Determination of characteristical data of both the basic materials and chemicals is performed by electronic measuring devices. The determined materials are homogenized by mixer, and are distributed into sacks by sack-filling equipment.
The sacks are put onto pallets and are delivered to the store-house by manual fork-lift. The plant is operated automatically by process-controll. The coordinator of processes monitors the manufacturing process from the centre by the help of signal and controll units located on the controll-board. The plant is equipped with devices for technological and environment dedusting thus being totally dust-free.
Capacity: 25.000 t/year

Conditions to be ensured

1. Electric connection:	Voltage:	380 V/50 Hz
	Capacity:	400 KVA
2. Compressed air supply: /without re-feeding/	Pressure:	6 bars
	Capacity:	200 Nm^3/h
	Quality:	oil-free

3. Delivery of basic material is executed by tanker suitable for pneumatic method of delivery.

PLANT FOR PARTITION WALL MANUFACTURING

Parameters of plaster-perlite partition wall-panel

It can be used for separating living-areas and constructing partition walls /see Annex/.

The main parameters are as follows:

Basic material:	plaster, perlite and water
Dimensions:	333 + 2 mm x 500 + 2 mm x 80+1mm
Weight:	15-18 kg/panel
Bending strength:	1.5 MPa
Fire-resistance limit:	T_H > 1.5 hour

Parameters of basic materials

- Technical parameters of plaster have to meet the requirements of standard DIN 18180.

- Technical parameters of perlite /type P1/ are as follows:

Loose agglomeration:	80-120 kg/m^3
Nominal grain-size:	0.5-2.0 mm
Rate of fractions under 0.32 mm	< 20 mass per cent
Rate of fractions between 1.0-2.0 mm	> 15 mass per cent

Dead material content: <5 mass per cent
Temperature of application: 800°C
Imflamable

Technological description and data

Dimensions of work-shop necessary for the installation of manufacturing line are 54 x 9 m, minimum inside height is 3.4 m with minimum 1 piece of door of 2.5 x 3.0 m size on one of the longitudinal frontages.

The end-product storage-house equipped with drainage system, is covered with concrete. Its dimensions are 50x75 meters for storing bulks - loaded on pallets of type EUR /size 800x1200 mm/ covered with sintered folie - during the 14 days of post-solidification.

Transportation of basic materials can be executed by road or railway tankers. In case of railway transportation extraction is performed by extracting bridge and fluidization transportation device.

Basic materials will be stored in metal silos of 94 m^3 volume in case of perlite. Powders are put to the measuring and mixing unit by the help of screw conveyors. Material mixed with water is forwarded to the moulding system through a homogenizator where 2 pieces of impression beam operating facing each other and equipped with profiled impression sheets agglomerate the filled-in mixture into partition-wall units. The just agglomerated units have to be kept in ageing equipment for 3 hours, requiring no artificial drying

/energy consumption/.
Transloading of walling elements onto pallets of EUR type followed by packing into sintered folie will be performed in the collecting and packing unit.
The manufacturing line is controlled by a free-programmable electronic system.
Bulks packed onto pallets are delivered to the store-house and transportation vehicles by manual fork-lifts.

In order to re-utilize the waste materials and defected panels resulting from the manufacturing of the partition-wall panels they will be crushed into grain-size easy to handle and will be stored in metal silos. According to practical experience the quantity of these materials is cc. 3-5 mass per cent.

Energy demand

The main parameters are as follows:

Forced draft network:	0.9 MPa pressure 9 Nm^3/h
Electric capacity demand:	120 kW
Industrial water supply:	70 l/min
LP-gas demand:	3.6 kg/shift

Labourforce demand

6 persons-manual worker plus
2 persons supervisors are required per shift.

Manufacturing capacity

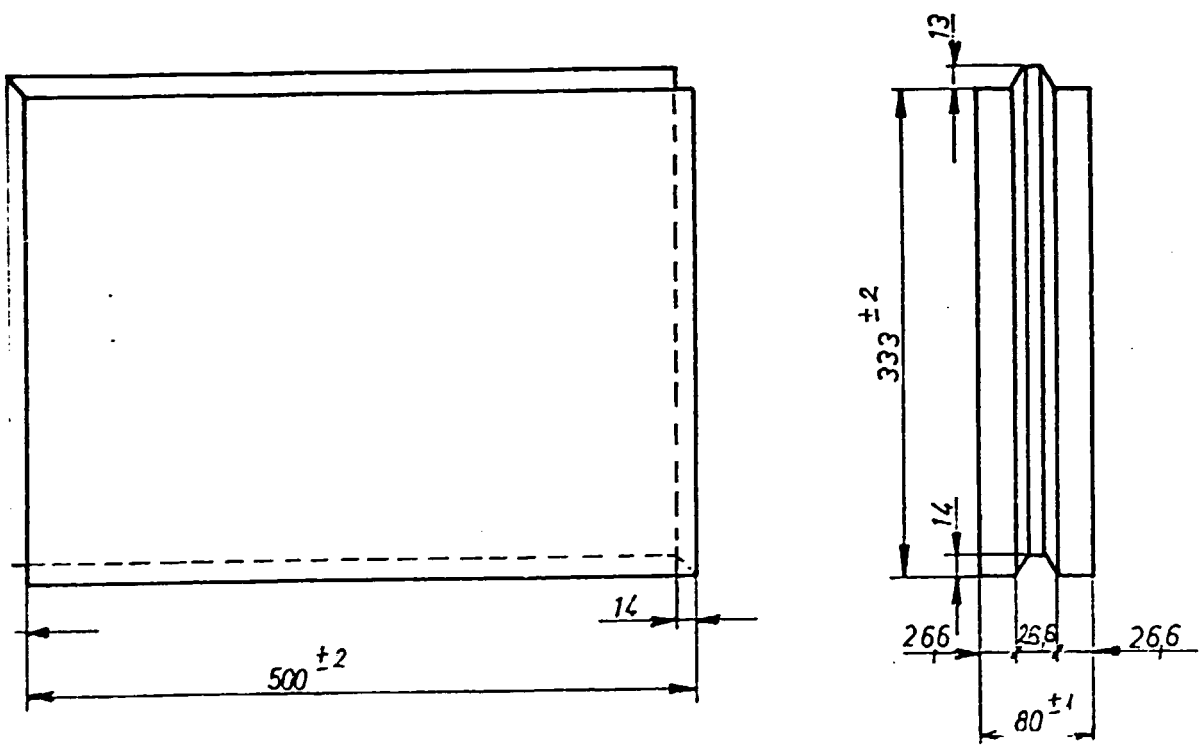
The moulding equipment mouldes 18 pieces of partition-wall panel in every 3 minutes.
Operating in 2 shifts and calculating 870 minutes of effective working period the capacity will be as follows:

/870 min/3 min/ x 18 pieces x 0.5 m x 0.333 m = 869 m^2/ 2 shifts

Capacity of the manufacturing equipment in case of 2 shifts is 869 m^2/day.

Figure No.6: Partition-wall panel requiring no artificial drying

Bending strength: 1.5 MPa
Fire-resistance
limit: $T_H \rangle$ 1.5 h
Mass: $\sim$ 15-18 kg



MANUFACTURING JOINT AND CEMENTING MORTAR

For the erection of partition-wall panels into walls joint and cementing mortar made of special gypsum-mix is used. Producing this special powder-mix is performed according to the following:

a. Basic materials

The mixture consists of the same gypsum as that used during manufacturing partition-wall panels.
More than 98% of this mixture consists of gypsum.
Proportion of other additives is so insignificant that it not necessary to construct a separate storage device for it.

b. Technological data

For the installation of the mixing plant a building of 60 m^2 basic area and 16 m inside height is required, and shall consists of 2 levels.

The gypsum is stored in a metal silo of 220 m^3.
It is delivered to the measuring unit by a screw-conveyor than to a powder-mixing equipment through a chute.
The other additives are delivered here by manual manipulation. The mixed powder will be passed to the measuring packing unit where distribution into sacks is performed.

c. Energy demand

Compressed air network: 0.9 MPa

Electric capacity demand: 12 kW

d. Labourforce demand

3 persons-manual workers plus
1 person supervisors

e. Manufacturing capacity

The capacity of the plant is 10 t/shift.
/This capacity is enough for twice as much quantity of partition-wall as offered for the partition-wall panel manufacturing machine./

Description of building structures

Earthwork:	Trench excavated to the load level.
Foundation:	Made of monolithic bulkhead and unit pier according to the foundation drawings.
Steel structure:	Supporting structure manufactured according to unit drawings, situated on angle frames in each level, struted by wind-brace in each level and of hot-rolled section ensuring support of the technological equipment at the same time.
Roof:	Rolled section steel beam covered with corrugated iron.
Roof covering:	Aluminum trapezoidal corrugated plate.
Outer coating:	Aluminum trapezoidal corrugated plate.
Doors and windows:	Doors - made of steel plate.
	Windows - with double glass, of belt-system setting in, fixed to the steel structure.
Ventillation:	In a routine way, using balance-windows.

5.)

IMPLEMENTATION SCHEDULE

1. Raw, gravel mining product
   The following activies are required for the out-put:

   1.1. Creation of the mine, designing the mine-site — 3 months
   Company responsible:
   Consultant-engineers

   1.2. Procurement of mining, transporting and service equipment — 6 months
   Company responsible:
   Contructor

   1.3. Set-up, arrangement and putting into operation of the site buildings — 2 months
   Company responsible:
   Contractor
   The expert of UNIDO
   Consultant-engineers

   1.4. Construction of the transportation road and railway transloading point — 4 weeks
   Company and persons responsible:
   Constractor
   The expert of UNIDO
   Consutlant-engineers

1.5. Ensuring railwy transportation 2 weeks
Company and person responsible:
Contractor
Mongolian Railways Co.
Customer

2. Raw perlite prepared for expansion
The following activites are required for the out-put:

2.1. Technological designing 3 months
Company responsible:
Consultant-engineers

2.2. Manufacturing steel structure in Mongolia and supervising the designers and key-personnel 2.5 months
Company and persons responsible:
Contractor

2.3. Procurement of machines 6 months
Company responsible:
Contractor

2.4. Implementation of construction works 6 months
Company and persons responsible:
Contractor
Consultant-engineers
Experts of UNIDO

2.5. Erection of technological equipment for receiving raw material, drying and preparation — 3 months

Company and persons responsible:

Contractor-
Designers, technology suppliers
Experts of UNIDO

2.6. Trial run — 2 weeks

Company and persons responsible:

Contractor
Designers
Technology suppliers
Experts of UNIDO

3. Expanded bulk perlite

The following activities are required for the out-put:

3.1. Technological designing — 2 months

Company responsible:

Technology supplier

3.2. Manufacturing steel structures in Mongolia and supervising the designer and key-mounters — 3 months

Company and persons responsible:

Contractor

3.3. Procurement of machines Company responsible: Contractor	6 months
3.4. Implementation of construction works Company and persons responsible: Contractor Experts of UNIDO	6 months
3.5. Erection of perlite expansion plant Company and persons responsible: Contractor Technology supplier Experts of UNIDO	5 months
3.6. Trial run Company and persons responsible: Contractor Technology supplier Experts of UNIDO	2 weeks

4. Gypsum-perlite partition-wall units
The following activities are required for the out-put:

4.1. Technological designing — 6 weeks
Company responsible:
Consultant-engineers

4.2. Procurement of machines — 6 months
Company responsible:
Contractor

4.3. Implementation of construction works — 6 months
Company and persons responsible:
Contractor

Experts of UNIDO

4.4. Erection of partition-wall and cementing material manufacturing plant — 4 months
Company and persons responsible:
Contractor
Technology supplier

Experts of UNIDO

4.5. Trial run and training — 2 weeks
Company and persons responsible:
Contractor

Technology supplier
Consultant-engineers
Experts of UNIDO

5. Pre-manufactured, perlite-base, dry mortar and plaster mixture

The following activities are required for the out-put:

5.1. Technological designing — 2 months

Company and persons responsible:
Consultant-engineers

5.2. Procurement of machines — 6 months

Company responsible:
Contractor

5.3. Implementation of construction works — 6 months

Company and persons responsible:
Contractor

Experts of UNIDO

5.4. Manufacturing steel structures — 2,5 months

Company responsible:
Contractor

5.5. Erection of technological equipment — 6 months

Company and persons responsible:
Contractor
Technology supplier
Consultant-engineers
Experts of UNIDO

5.6. Trial run and training 2 weeks

Company and persons responsible:

Contractor

Experts of UNIDO

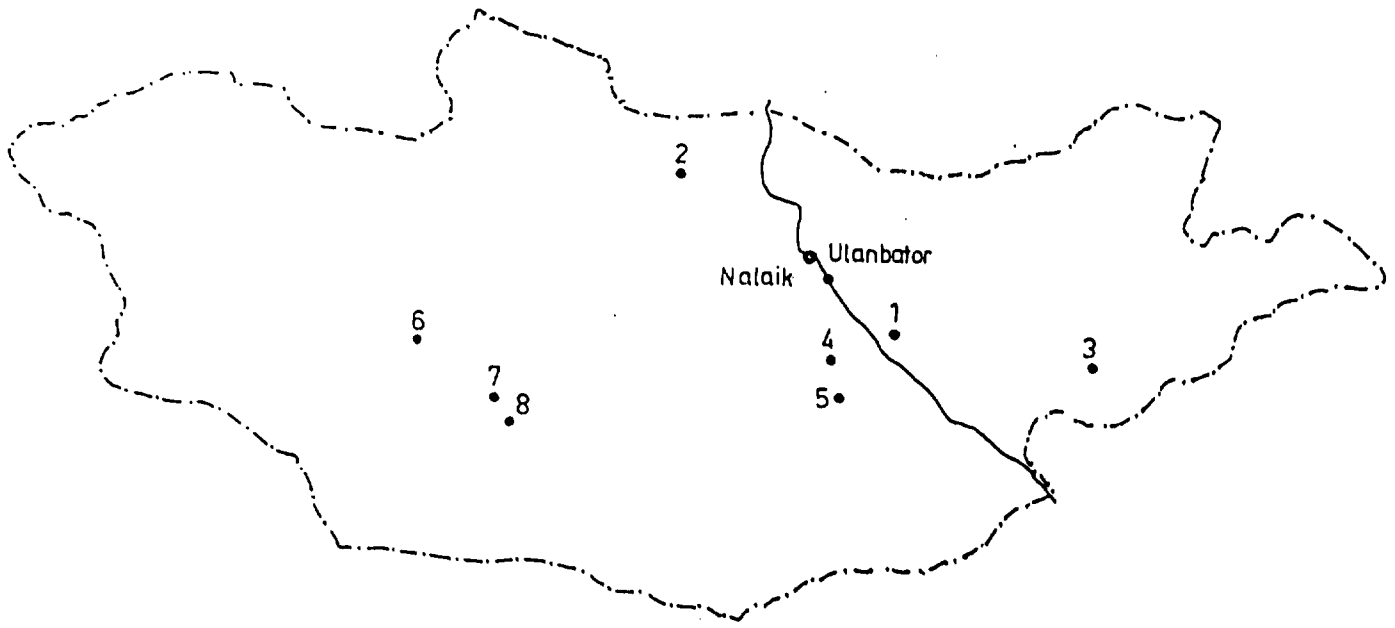
ANNEXES

EXPLANATION OF EXPRESSIONS AND PHRASES

adhesive water content	-	chemically not bound water to be found in perlite rocks (mine humidity , moisture etc.)
annealing loss	-	loss of mass of perlite rocks due to loss of bound water when heating up to annealing temperature
bound water content	-	chemically bound water in perlite rocks
cell wall	-	solid frame between the pores of expanded perlite
dehydration	-	decrease of bound water content of raw perlite
dead material content	-	portion of not expanded perlite
rate of expansion	-	rate of multiplication of volume of perlite grains in the course of expansion.
floating part proportion	-	proportion of filtering aid materials floating during filtering
flow time	-	period under which 100 ml water (in 13.3222 Pa vacuum, through a sieve of 40 μm holes) overpasses a suspension of 70 ml filtering aid material
grain size distribution	-	number of pieces a raw perlite grain splits into during expansion
gross dry mass	-	total weight of fully expanded perlite and the pattern together (dry perlite)
gross wet mass	-	total weight of wet raw perlite and the pattern

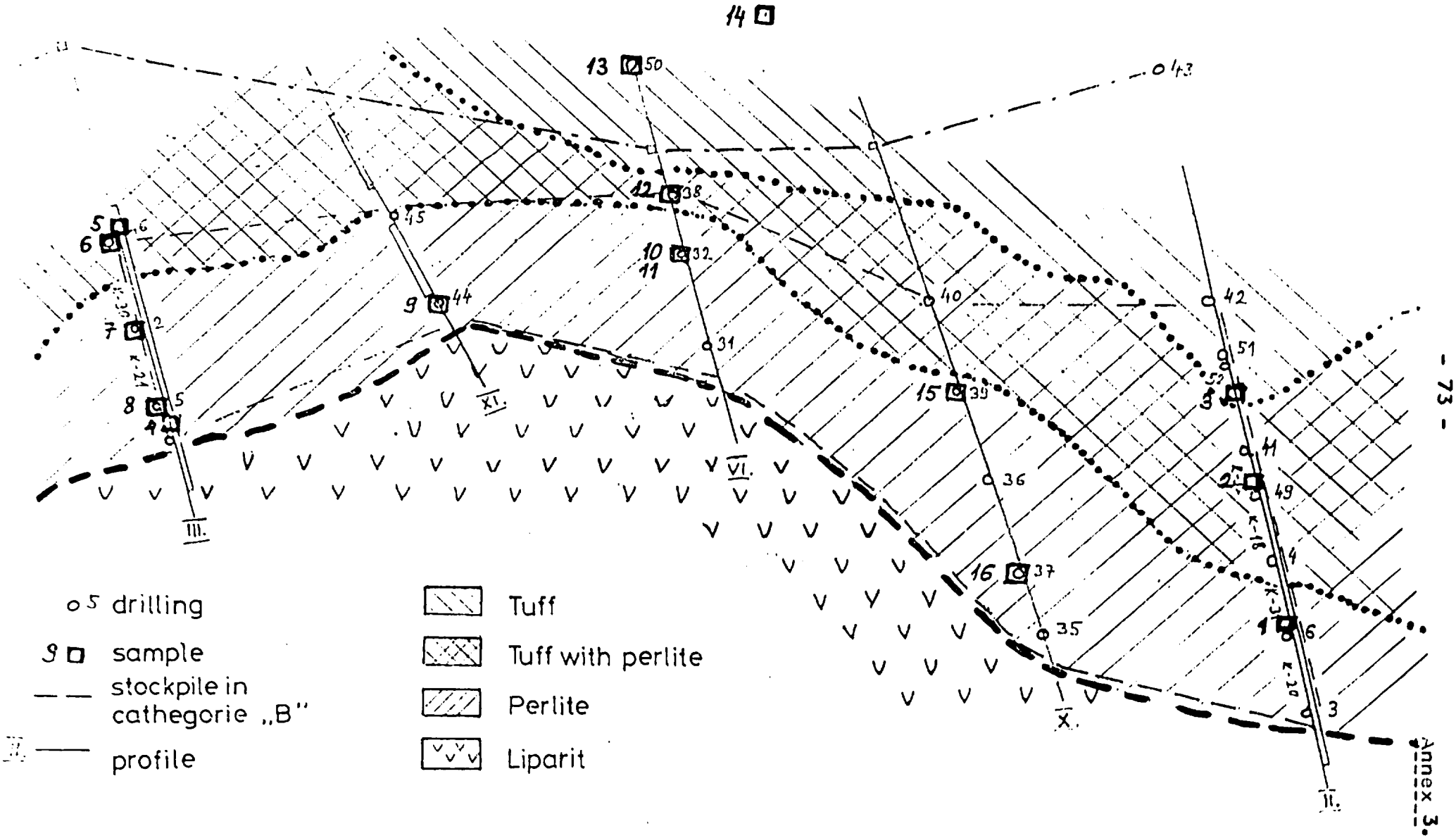
heavy expanded perlite	-	expanded perlite with density over 150 kg/m^3
heavy raw perlite	-	raw perlite from which expanded perlite with density over 100 kg/m^3 can be reached under specific conditions
light expanded perlite	-	expanded perlite with density under 100 kg/m^3
light raw perlite	-	raw perlite from which expanded perlite with density under 100 kg/m^3 can be reached under specific conditions
loose density	-	density of not expanded perlite
medium expanded perlite	-	expanded perlite with density between 100 - 150 kg/m^3
net dry mass	-	fully dried raw perlite witout pattern
pre-heatment drum	-	equipment to decrease or eliminate the adhesive and bound water content of raw perlite
specific surface	-	normal surface of unit weight of material
solid density	-	density of perlite reached by vibration or shaking , i.e. compacting till constant volume

PERLITE DEPOSITS IN MONGOLIA



1. Eiligen - Bulak
2. Boian - Ul
3. Ceran - Oboo
4. Cahiur - Ulan
5. Zamin - Ulan
6. Bulgan - Ul
7. Mandan - Oboo
8. Hola - Teg

DRAW OF DEPOSIT WITH SAMPLES 1:2000



Annex 3.

Annex 4.

SAMPLE LIST

Sign of Sample	Segment	Location of Sample Collaction	Type of the Rock
ZU-1	II.	Graben, North of Drilling 6.	Perlite (black)
ZU-2	II.	Graben, North of Drilling 49.	Tuff with perlite
ZU-3	II.	Graben, from the side of shaft 76.	Tuff
ZU-4	III.	From South end of Graben 30 m North	Perlite
ZU-5	III.	From North end of Graben 10 m South	Tuff with perlite
ZU-6	III.	Drilling 46.	Tuff with perlite
ZU-7	III.	Drilling 2. Drilling 5.	Tuff with perlite
ZU-8	III.	Drilling 5.	Perlite (grey, a bit globular)
ZU-9	XI.	Drilling 44.	Perlite (dark greenis grey-black)
ZU-10	VI.	Drilling 32.	Perlite (dark greenis grey, partly globular
ZU-11	VI.	Drilling 32.	Perlite (reddish)
ZU-12	VI.	Drilling 38.	Tuff with perlite
ZU-13	VI.	Drilling 50.	Tuff
ZU-14	VI.	Marmot-hole, 60 m East-North-East of Drilling 50.	Tuff
ZU-15	X.	Drilling 39.	Perlite (black, strongly globular)
ZU-16	X.	Drilling 37.	Perlite (black)
EB-1	From the deposit explored		Tuff with perlite
EB-2	"		Pieces of perlite taken out

Annex 5.

Adhesive water content of perlite samples collected in Mongolia

Sample	Tara g	Gross wet mass g	Gross dry mass g	Net dry mass g	Desorption water g	Adhesive water content %
ZU- 1	680	2052	2052	1372	0	0
ZU- 2	686	2052	2030	1344	22	1,6
ZU- 3	682	1890	1850	1168	40	3,4
ZU- 4	508	1910	1910	1402	0	0
ZU- 5	518	1515	1478	960	37	3,85
ZU- 6	666	2115	2100	1434	15	1,05
ZU- 7	722	2175	2142	1420	33	2,32
ZU- 8	497	1440	1440	943	0	0
ZU- 9	485	1910	1910	1425	0	0
ZU-10	590	2026	2026	1436	0	0
ZU-11	603	1660	1658	1055	0	0
ZU-12	618	1600	1580	962	20	2,08
ZU-13	608	1766	1725	1117	41	3,67
ZU-14	460	1201	1180	720	21	2,92
ZU-15	642	2041	2041	1399	0	0
ZU-16	177	1213	1213	1036	0	0
EB- 1	357	1222	1212	855	10	1,17
EB- 2	650	2295	2295	1645	0	0

Chemical analysis of the mongolian perlite

	ZU-1	ZU-2	ZU-3	ZU-4	ZU-5	ZU-6	ZU-7	ZU-8	ZU-9	ZU-10	ZU-11	ZU-12	ZU-13	ZU-14	ZU-15	ZU-16	EB-1	EB-2
Na_2O	3,24	2,10	0,31	3,08	1,41	2,67	2,39	3,08	3,30	3,34	3,27	1,85	0,83	1,69	3,44	3,31	2,99	2,99
MgO	0,25	0,67	1,12	0,30	0,88	0,48	0,47	0,29	0,25	0,25	0,26	0,81	1,15	0,88	0,26	0,22	0,29	0,13
Al_2O_3	13,29	12,68	11,64	13,08	12,46	12,92	12,65	13,25	13,20	13,18	13,24	12,54	11,62	12,33	13,04	13,31	12,27	11,93
SiO_2	71,19	68,47	65,05	70,45	65,37	69,35	67,39	70,65	70,49	71,11	70,97	67,05	65,83	66,03	70,73	71,17	73,55	74,58
SO_3	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
K_2O	4,89	3,89	1,85	4,79	3,12	4,58	4,28	4,61	4,63	4,87	4,80	3,50	2,52	3,34	4,53	4,76	4,54	4,92
CaO	0,96	1,62	2,97	1,15	2,72	1,12	1,17	0,89	0,90	0,92	0,92	1,66	2,03	1,57	1,07	0,87	0,60	0,52
TiO_2	0,18	0,18	0,16	0,18	0,17	0,18	0,15	0,18	0,18	0,19	0,18	0,18	0,15	0,17	0,18	0,19	0,11	0,11
Fe_2O_3	1,11	1,07	0,65	1,06	1,15	1,12	0,86	1,02	1,11	1,17	1,13	1,17	0,72	1,10	1,14	1,06	1,00	1,01
loss on ignition	4,88	9,34	16,27	5,91	12,75	7,60	10,62	6,04	5,96	5,31	5,24	11,26	15,15	12,90	5,62	5,14	4,66	3,82

Annex 6.

ANNEX 7.

TEST REPORTS

Test report

[illegible] sample: Zn- 1

Properties of raw perlite ore								
Loss on ignition %	Grain size distribution m%						Specific weight	Specific area
900 °C	-0,15	0,15-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm²/g
4.63	7.5	8.4	12.8	21.4	13.2	36.7	-	112.24
expanded		25	25	25	25	-	1366	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200°C	°C	105 °C	200 °C	°C	°C	pa	pa
4.63	3.45	-	158	126	-	1240	230	80

properties of expanded products								
Sign	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.ns.
105 °C	m%							
	kf%							
200 C	m%	10.9	15.2	30.6	43.3	126	5.6	3.37
	kf%							

Signs	measurement on expansion	specific yield of product	compressive strength da/N		evaluation by the N.S.
		m³/t	20 %	40 %	
105 C					
200 C	10.34	7.947	3.74	9.62	Heavy raw perlite ore.

Test report

Type of perlite sample: Pn-5

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
9.60	8.6	7.2	11.8	20.0	11.5	40.7	-	114.10
expanded		25	25	25	25	-	113	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	250 °C	°C	105 °C	250 °C	°C	°C	pa	pa
9.60	4.11	-	238	173	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
250 C	m%	8.6	18.6	34.8	38.0	173	15.50	4.26
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/J		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
250 C	6.86	5.773	3.44	9.52	heavy raw perlite ore

Name of perlite samples: Pv-7

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
18.12	9.4	9.1	11.8	19.2	13.1	37.2	-	137.75
expanded		25	25	25	25	-	1090	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	300 °C	°C	105 °C	300 °C	°C	°C	pa	pa
18.12	4.71	-	no exp	592	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
300 C	m%	-	-	-	-	-	-	-
	tf%							

Signe	measurement of expansion	specific yield of product	compressive strength da/l		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
300 C	-	-	-	-	Dead perlite ore

Test report

Name of perlite sample: Zu-4

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
3.87	6.4	8.4	12.8	20.5	13.6	38.3	-	104.94
expanded		25	25	25	25	-	1366	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200 °C	°C	105 °C	200 °C	°C	°C	pa	pa
5.64	3.87	-	95	89	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
200 C	m%	5.9	10.4	28.5	55.2	89	3.5	6.49
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	15.35	11.203	1.99	4.91	Light raw perlite ore

Test report

Name of perlit sample: Ta-5

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-3	g/l	cm^2/g
13.44	9.1	8.2	13.1	21.5	14.7	33.4	-	1[illegible].1[illegible]
expanded		25	25	25	25	-	1138	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	300 °C	°C	105 °C	300 °C	°C	°C	pa	pa
13.44	-	4.44	4.10	165	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
300 C	m%	11.9	15.2	35.1	37.8	165	6.2	5.72
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
300 C	6.90	6.058	4.28	11.02	Heavy raw perlite ore

Test report

[illegible] perlite sample: [illegible]

Properties of raw perlite ore								
Loss on ignition %	Grain size distribution m%						Specific weight	Specific area
900 °C	[illegible]-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
7.51	8.5	10.8	20.6	19.5	13.1	[illegible].3	-	138.67
expanded		25	25	25	25	-	[illegible]92	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	230 °C	°C	105 °C	230 °C	°C	°C	pa	pa
7.51	3.75	-	205	142	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	[illegible]-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.ss.
105 °C	m%							
	t/%							
230 C	m%	[illegible].2	14.7	35.0	43.1	142	[illegible].0	4.73
	t/%							

Signe	measurment on expansion	specific yield of product	compressive strength da/l		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
230 C	9.10	7.032	2.47	5.28	Heavy raw perlite ore

Test report

Name of perlite sample: Su-7

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm²/g
10.27	7.1	6.5	11.8	20.0	14.3	41.3	-	94.79
expanded		25	25	25	25	-	1189	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	250 °C	°C	105 °C	250 °C	°C	°C	pa	pa
10.27	3.81		382	202	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.ss.
105 °C	m%							
	tf%							
250 C	m%	5.4	19.0	45.4	30.2	282	39.0	2.44
	tf%							

Signe	measurement of expansion	specific yield of product	compressive strength da/i		Evaluation by the H.S.
		m³/t	20 %	40 %	
105 C					
250 C	5.87	4.96	2.76	9.56	Heavy raw perlite ore

Test report

Item: Typical sample "In-"

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
5.59	5.5	6.7	11.4	20.4	13.1	37.9	-	91.38
expanded		25	25	25	25	-	1314	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200 °C	°C	105 °C	200 °C	°C	°C	pa	pa
5.59	3.66	-	203	128		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	t%							
200 C	m%	14.3	16.1	38.6	31.0	128	6.5	10.17
	t%							

Signe	measurement of expansion	specific yield of product	compressive strength da/l		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	10.26	7.839	2.73	7.55	Heavy raw perlite ore

Test report

Name of perlite sample: Zs-9

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm²/g
5.74	6.2	7.8	13.1	15.7	13.0	44.2	-	180.23
expanded		25	25	25	25	-	1368	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200 °C	°C	105 °C	200 °C	°C	°C	pa	pa
5.74	4.2		156	98		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
200 C	m%	4.8	12.1	28.7	54.4	98	6.0	4.94
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	13.96	10.202	1.95	5.34	Light raw perlite ore.

Test report

Name of perlite sample: Tu- 10

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm²/g
4.92	6.4	7.4	11.7	20.0	15.5	38.0	-	100.52
expanded		25	25	25	25	-	1335	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200 °C	°C	105 °C	200 °C	°C	°C	pa	pa
4.92	3.85		90	81		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
200 C	m%	21.4	18.5	26.0	34.1	81	4.0	24.05
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	16.48	12.033	1.50	3.75	Light raw perlite ore.

Test Table 2

Name of perlite sample: Zs- 11

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm²/g
5.17	7.0	7.6	12.4	22.7	11.3	39.0	-	105.4
expanded		25	25	25	25	-	1368	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200 °C	°C	105 °C	200 °C	°C	°C	pa	pa
5.17	3.56		203	131	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	t%							
200 C	m%	5.6	14.1	35.2	45.1	131	4.0	4.32
	t%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	10.44	9.574	2.96	9.21	Heavy raw perlite ore.

Test report

Name of perlite sample: No- 12

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
11.60	7.6	7.0	11.9	21.3	15.7	36.5	-	106.98
expanded		25	25	25	25	-	1167	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	280 °C	°C	105 °C	280 °C	°C	°C	pa	pa
11.60	3.67	-	336	230	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
280 C	m%	11.2	26.4	36.9	25.5	230	38	4.12
	tf%							

Signe	measurement on expansion	specific yield of product		compressive strength da/l	Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
280 C	5.07	4.182	4.01	10.56	Heavy raw perlite ore.

Test report

Name of perlite sample: Zu- 13

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
16.43	10.01	8.1	12.3	19.6	13.2	36.70	-	127.27
expanded		25	25	25	25	-	1072	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	300 °C	°C	105 °C	300 °C	°C	°C	pa	pa
16.43	3.80		no.exp.	804		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	t%							
300 C	m%							
	t%							

Signe	measurement on expansion	specific yield of product	compressive strength da/l		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
300 C	-	-	-	-	Dead perlite ore

Test report

Name of perlite sample: Zu- 14

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
13.32	6.6	6.8	11.5	18.4	10.7	46.0	-	96.28
expanded		25	25	25	25	-	1130	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	300 °C	°C	105 °C	300 °C	°C	°C	pa	pa
13.32	3.67	-	-	365		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
300 C	m%	13.4	26.8	41.9	17.9	365	54.5	2.97
	tf%							

Signe	measurement of expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
300 C	3.09	2.755	-	-	Heavy raw perlite ore

Test report

Name of perlite sample: Zu- 15

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
5.59	6.6	7.3	12.5	21.5	14.5	37.6	-	101.9
expanded		25	25	25	25	-	1362	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	200°C	°C	105 °C	200 °C	°C	°C	pa	pa
5.59	3.66		137	102		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.ss.
105 °C	m%							
	tf%							
200 C	m%	15.5	13.0	28.5	43.0	102	4.0	14.15
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength dN/ll		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
200 C	13.35	9.736	2.88	7.29	Light raw perlite ore.

Test report

Name of perlite sample: Zu- 16

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
4.27	6.6	7.8	12.9	21.5	13.6	37.6	-	104.06
expanded		25	25	25	25	-	1372	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	150 °C	°C	105 °C	150 °C	°C	°C	pa	pa
4.87	3.99		113	89		1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%							
	tf%							
150 C	m%	10.8	15.7	27.7	45.8	83	4.0	12.51
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/l		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C					
150 C	16.53	12.000	2.58	6.40	Light raw perlite ore.

Test report

Name of perlite sample: Eb- 1

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
4.18	7.5	9.3	15.5	27.6	7.4	33.7	-	113.89
expanded		25	25	25	25	-	1194	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	°C	°C	105 °C	°C	°C	°C	pa	pa
4.18	-	-	164	-	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%	8.8	22.3	43.3	25.6	164	44.5	4.70
	t%							
-	m%							
	t%							

Signe	measurement or expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C	7.28	6.089	3.38	8.58	Heavy raw perlite ore.

Test report

Name of perlite sample: Bb- 2

Properties of raw perlite ore								
Loss on ignition m%	Grain size distribution m%						Specific weight	Specific area
900 °C	0-0,125	0,125-0,25	0,25-0,5	0,5-0,8	0,8-1,0	1-2	g/l	cm^2/g
3.47	3.5	4.6	15.1	24.2	15.6	35.0	-	80.92
expanded		25	25	25	25	-	1344	-

water content			specific weight			parameters of expansion		
After dehydration m%			After expansion g/l			Temperature	air pressure	gas pressure
105 °C	- °C	°C	105 °C	°C	°C	°C	pa	pa
3.47	-	-	305	-	-	1240	230	80

properties of expanded products								
Signe	Grain size distribution mm					Specific weight	dead content	measurement on breakage
	measuring unit	0-0,25	0,25-0,5	0,5-1	1-4	g/l	m%	m.sz.
105 °C	m%	15.2	23.5	44.7	16.6	305	67.0	4.71
	tf%							
-	m%							
	tf%							

Signe	measurement on expansion	specific yield of product	compressive strength da/N		Evaluation by the H.S.
		m^3/t	20 %	40 %	
105 C	4.41	3.271	9.96	26.93	Heavy raw perlite ore.

DERIVATOGRAPHICAL TESTS

Samples collected from the Eligen-Bulak deposit are interesting from the point of derivatographical tests.

In case of sample EB-1 no serious exothermal and endothermal reactions have been noticed when heated.
In case of sample EB-2 about 50° and 300°C the derivatograph shows substantial decrease in the mass of the sample, which is probably in connection with the water discharge. A slight exothermal peak can be noticed around the temperature of 650-750°C connected with the oxidation reaction of ferrite.

A practical connection can be observed between the derivatogramme and the expansion capacity. Crystalline bound water-content of the expanded perlite escapes between a temperature range of 180-350°C, showing a substantial endothermal /heat-absorbing/ peak in the derivatogramme.
This can be extremly monitored in the case of the following samples:

ZU-1	320°C
ZU-4	310°C
ZU-6	320°C
ZU-7	300°C /a small quantity of natural crystal water/
ZU-8	310°C
ZU-9	300°C
ZU-10	320°C
ZU-11	310° C
ZU-15	300°C
ZU-16	310°C

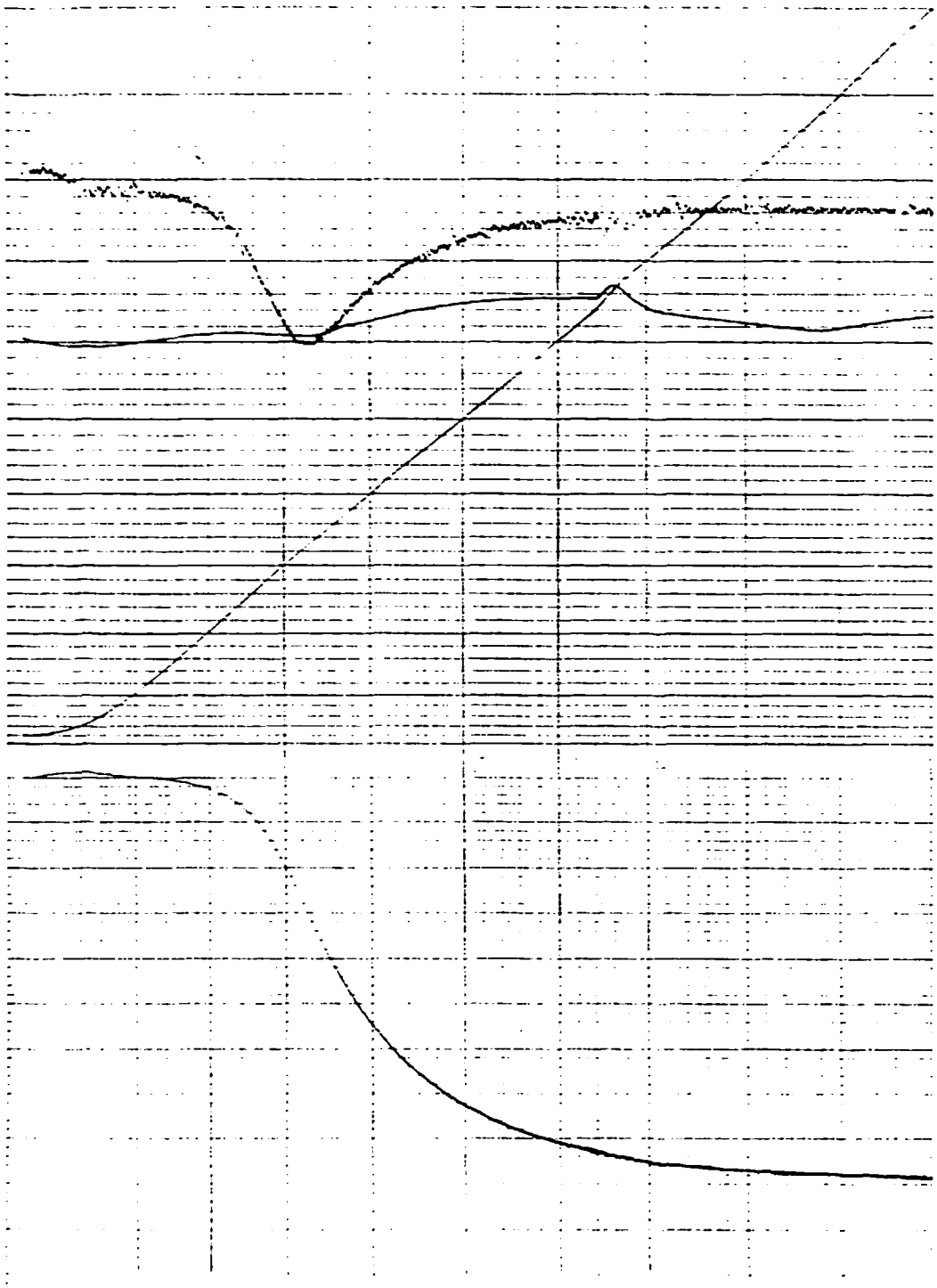
This evaluation of samples is in conformity with the results of the expansion tests and indicates that vitroclasted tuffs from samples ZU-2, ZU-3, ZU-13 and ZU-14 - showing no expansion during the laboratorial expansion tests - loose their minimal bound adhesive-water content on the surface only and the bound water escaping on low temperature will give insufficient power to the expansion.

In the diagramms of derivatograph in case of all the samples a slight exothermal peak can be monitored between the temperature range of 600-750°C being in connection with the oxidation reaction of FeO /ferrite II oxide/ of the sample, i.e.:

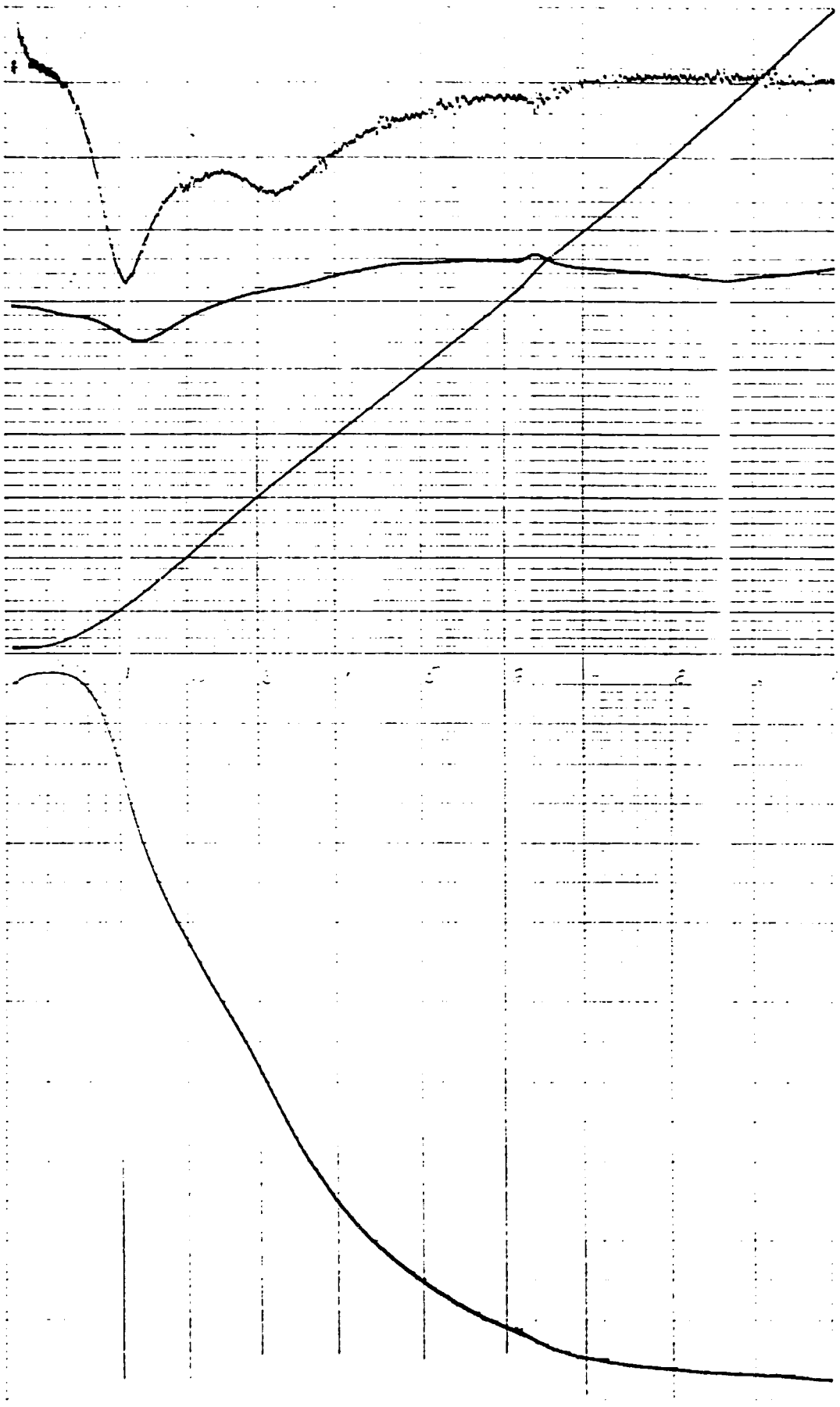
$$4\ FeO + O_2 = 2\ Fe_2O_3$$

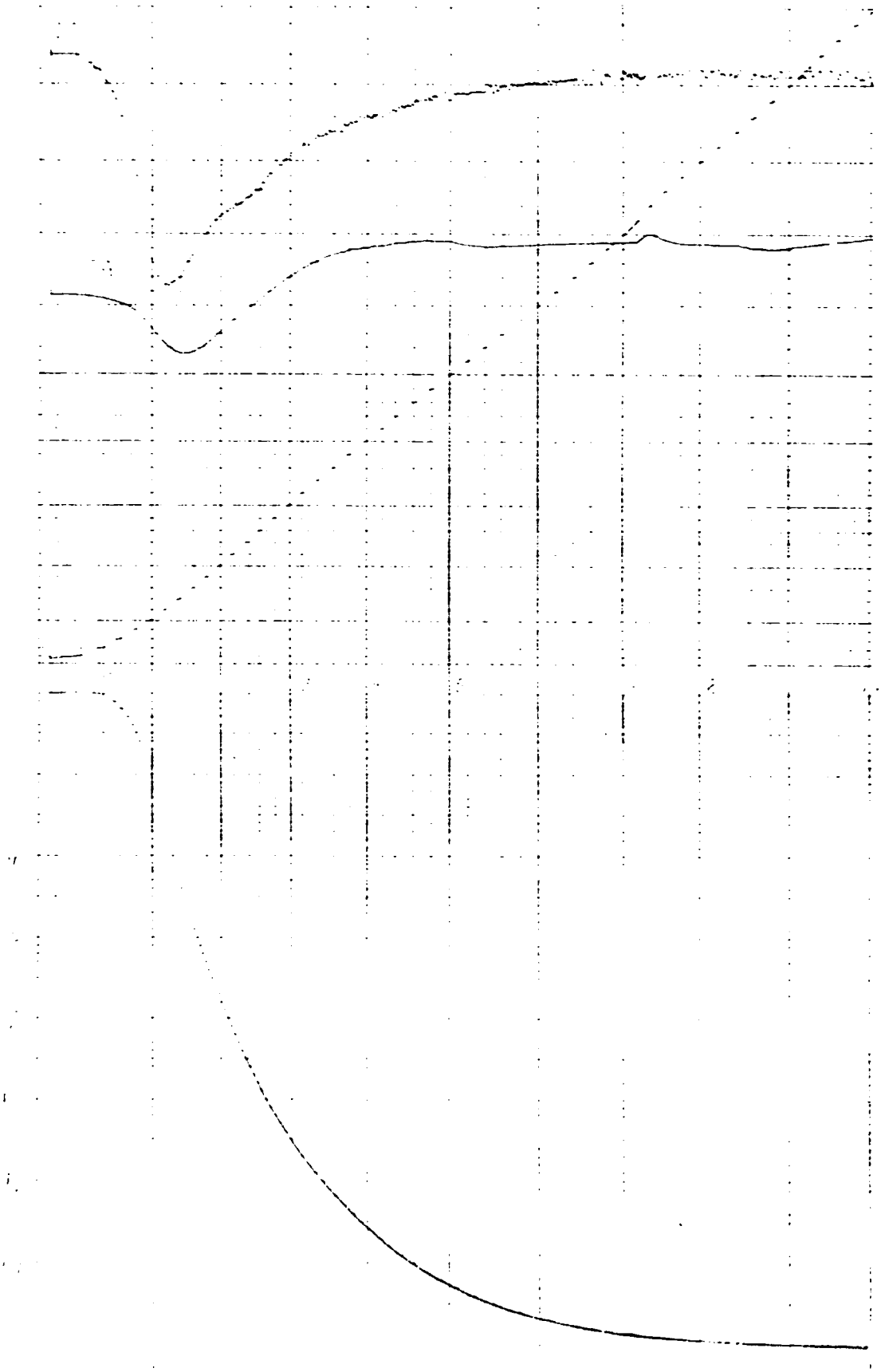
which confirms FeO content found during oxidation analysis.

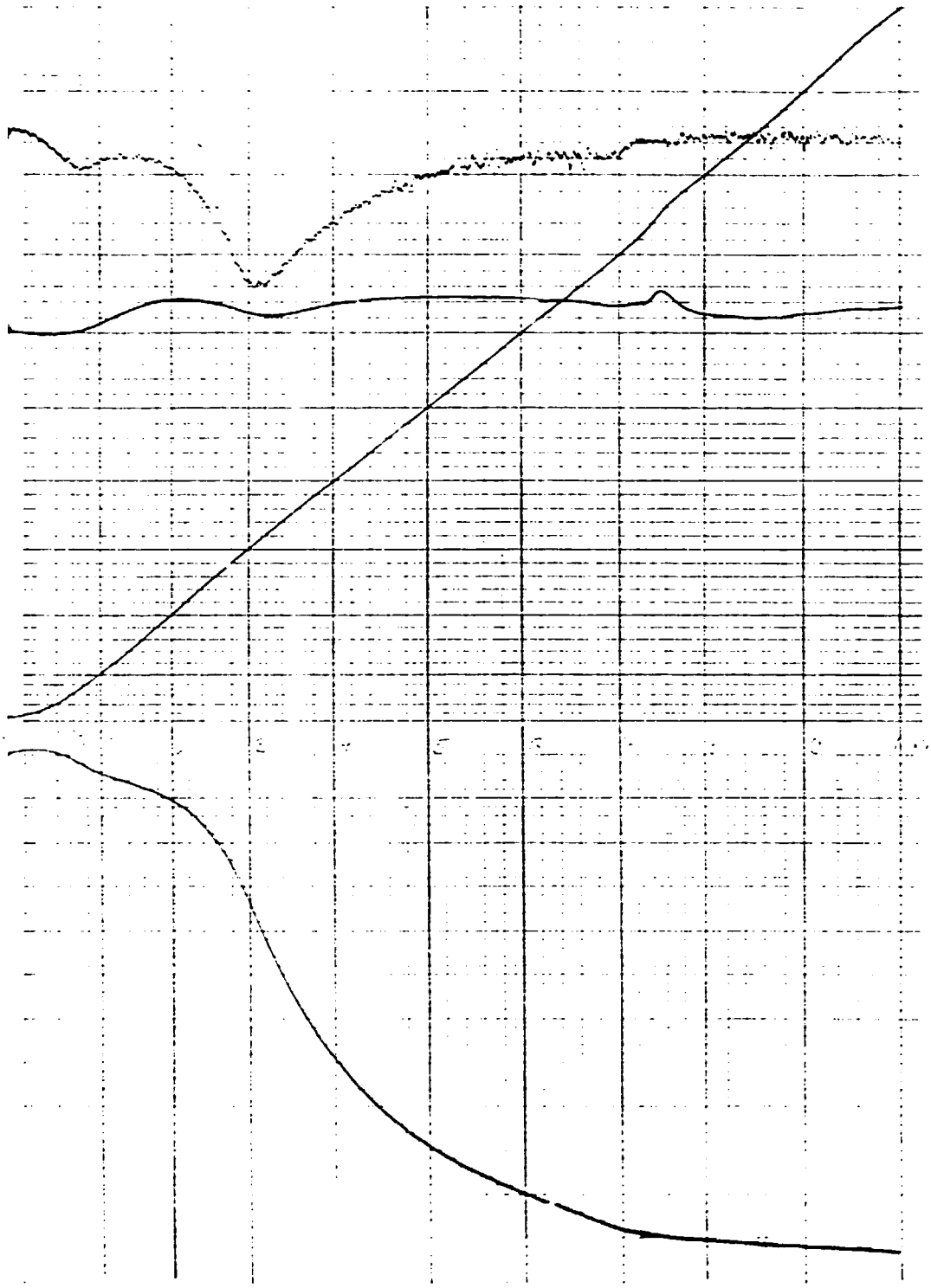
Results of the laboratorial expansion tests are confirmed by the derivatographical tests as well.

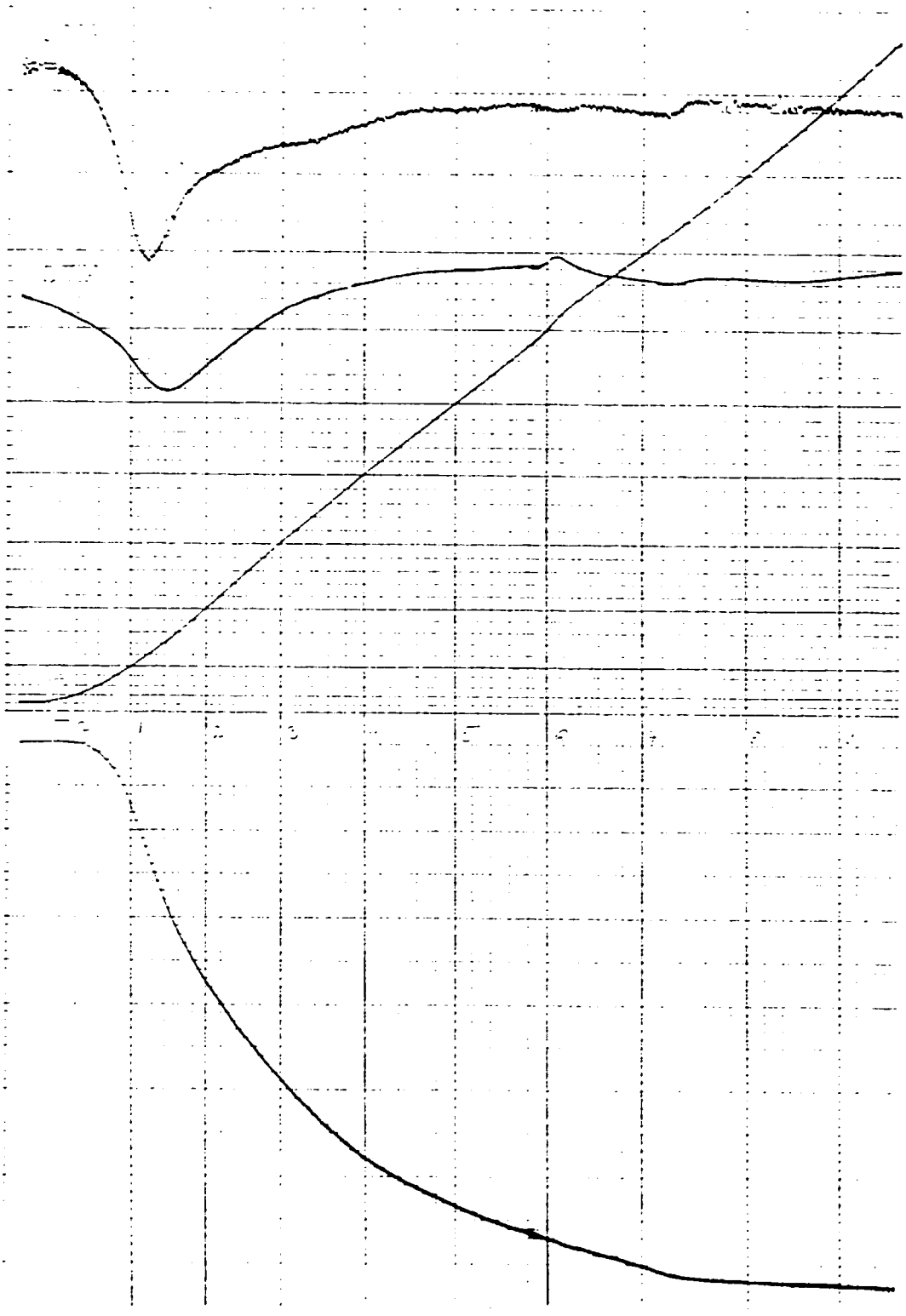


ZV-2









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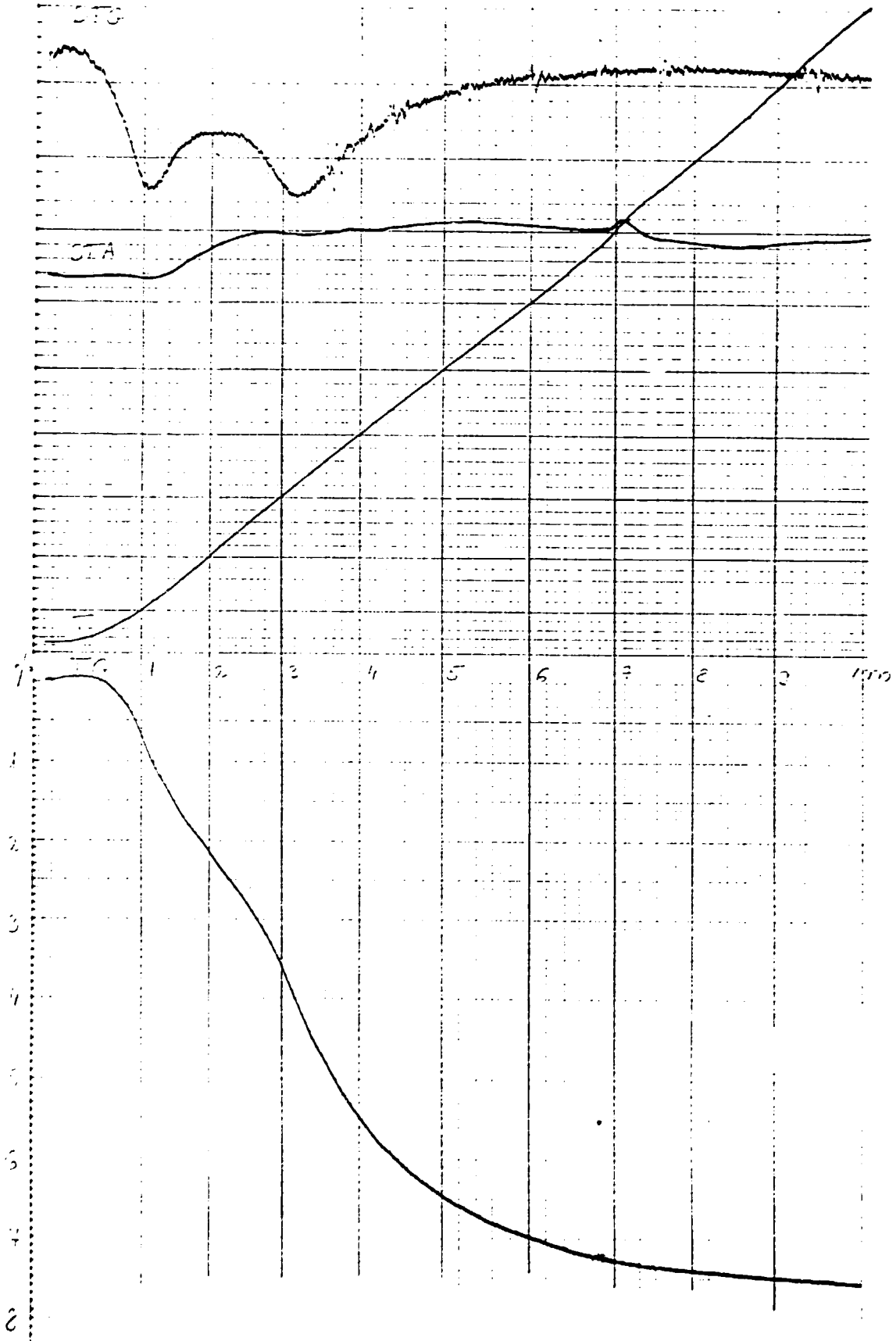
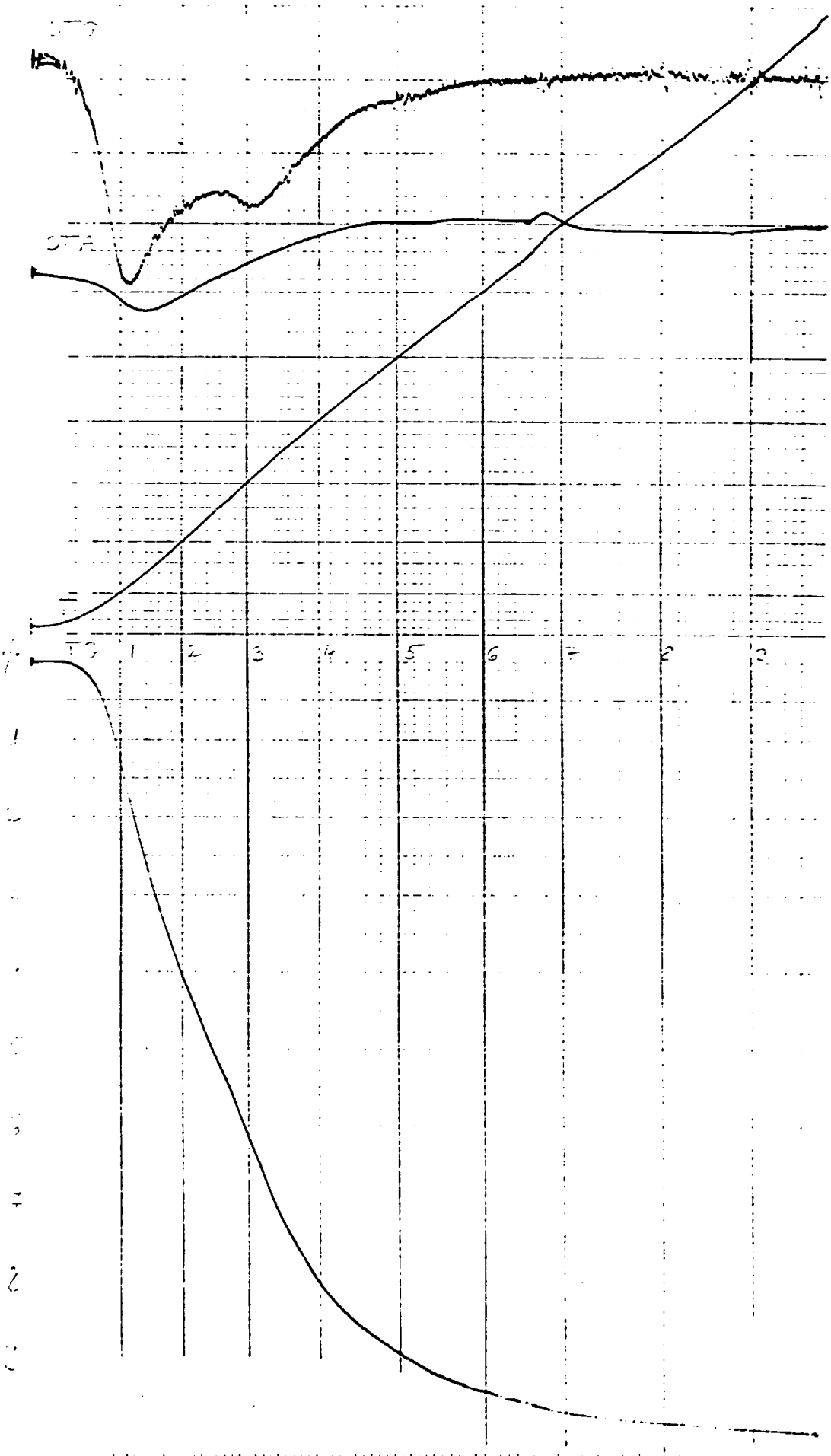
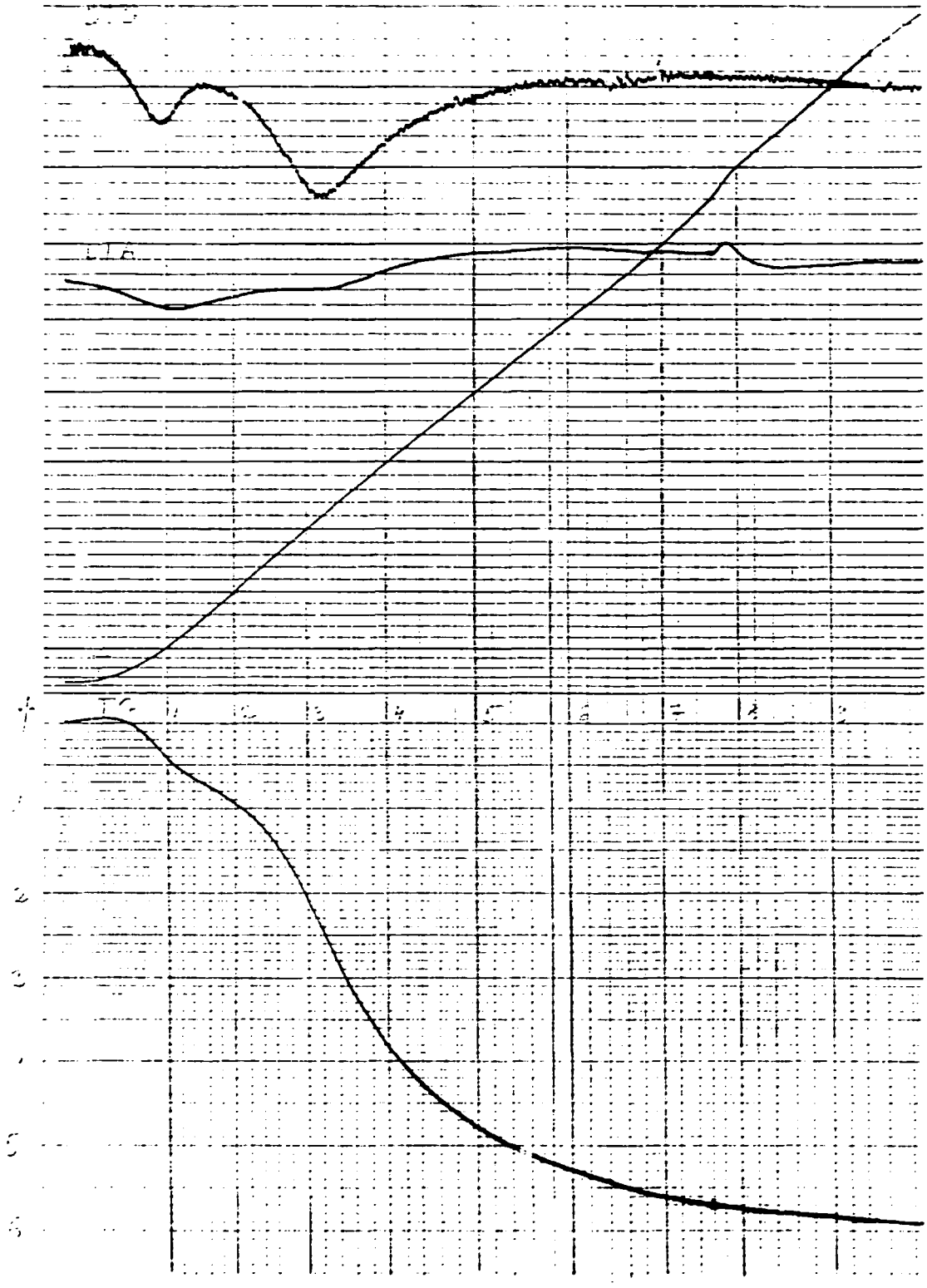
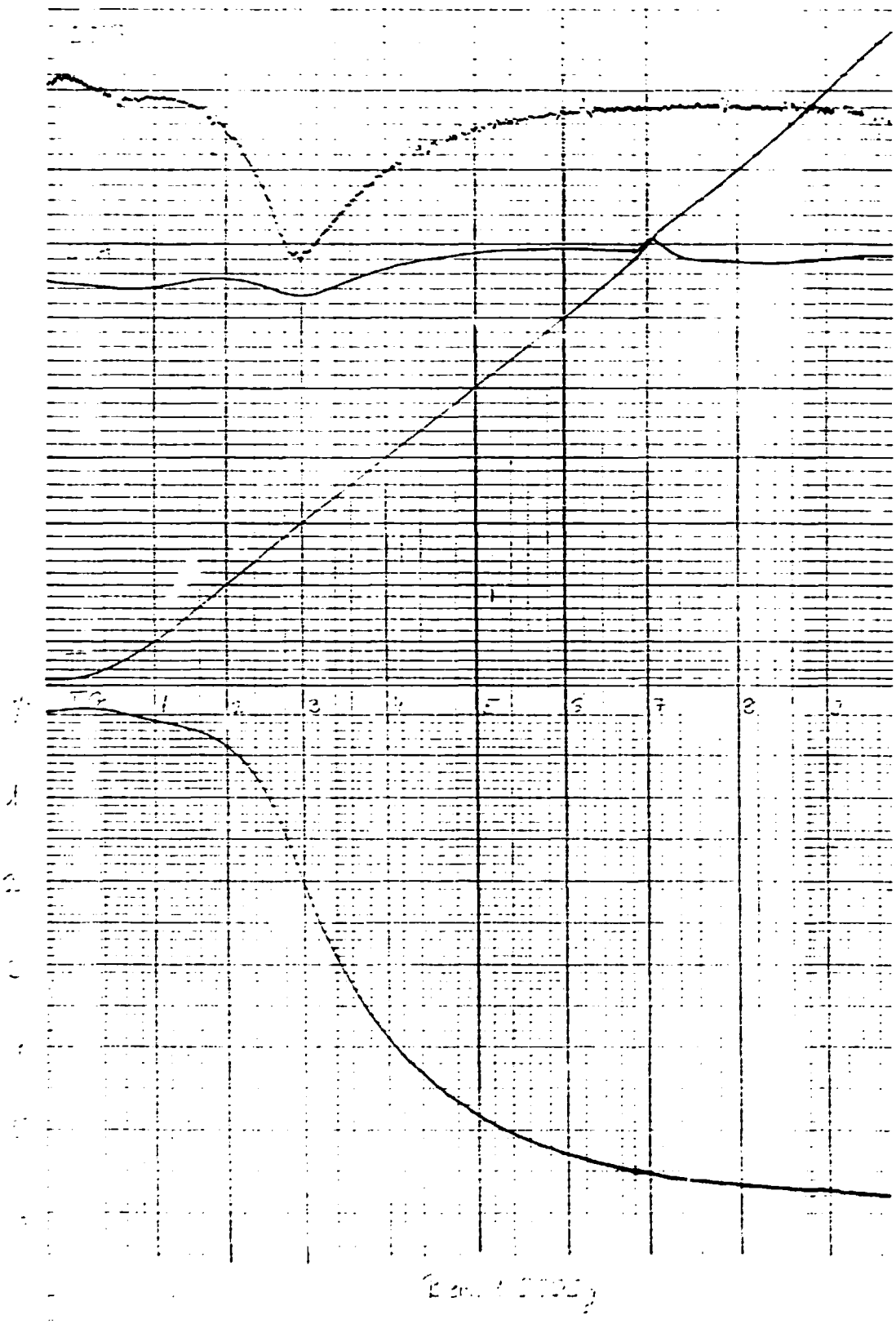


Zu-7

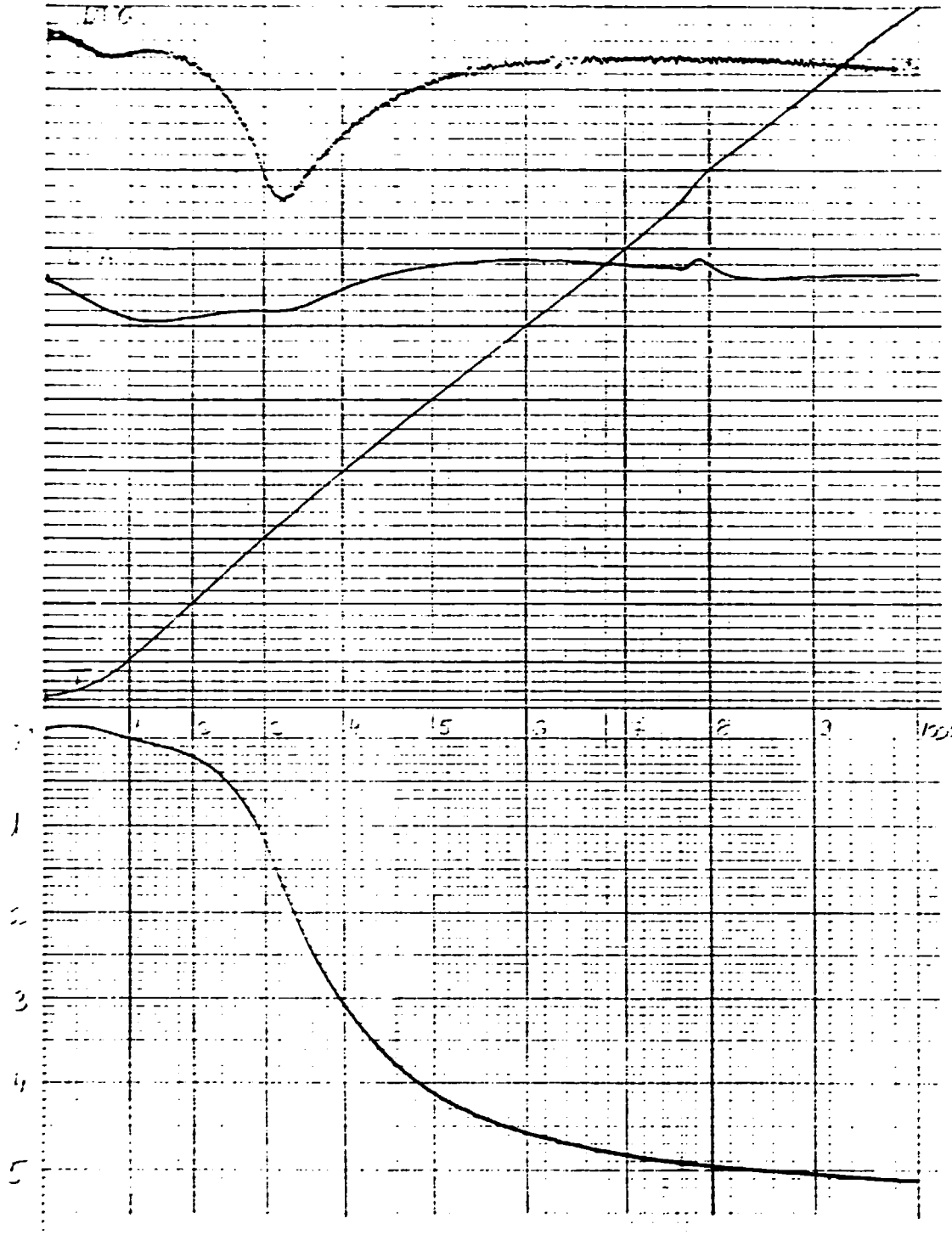


Zu-8





ZU-10



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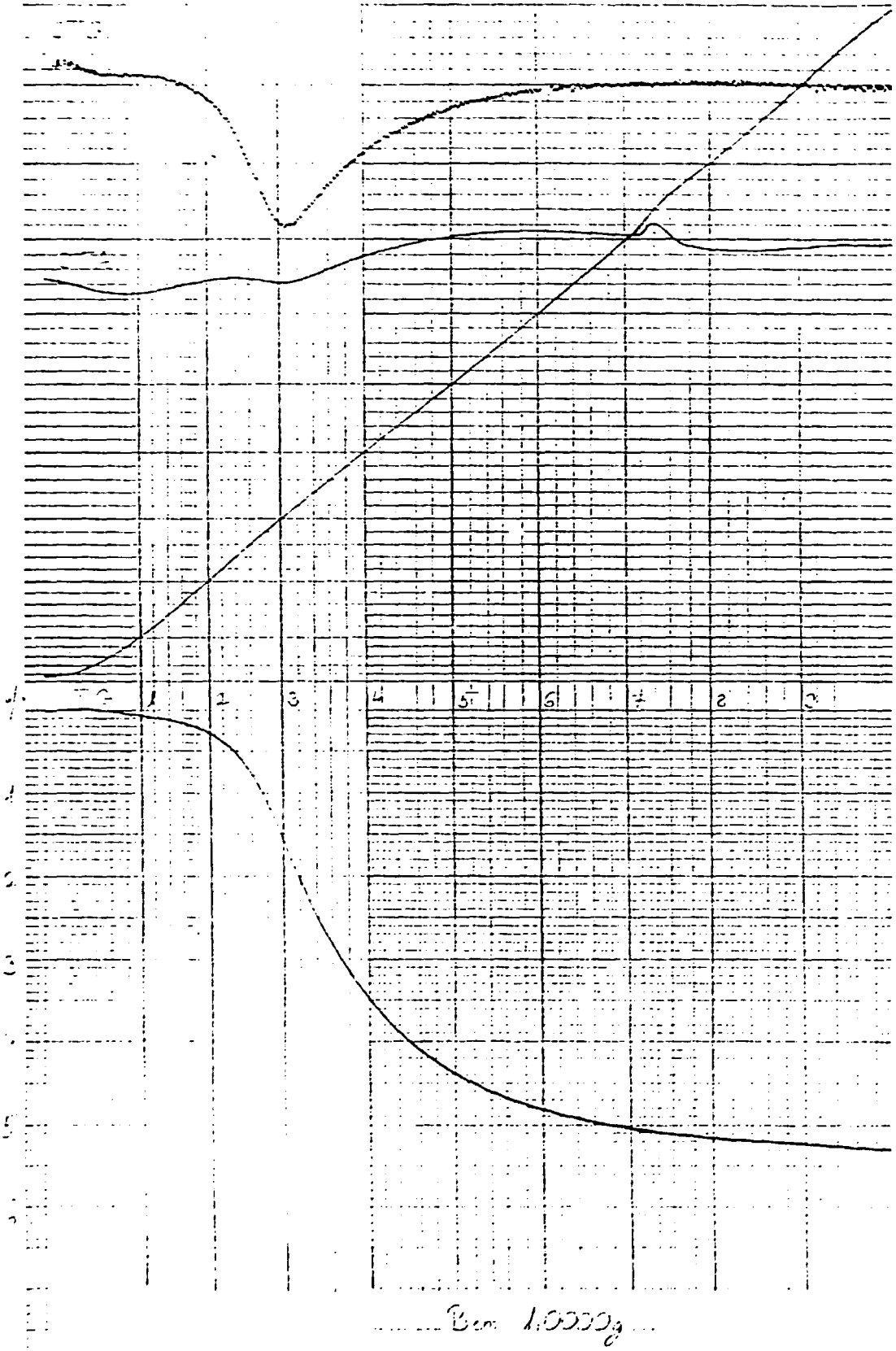
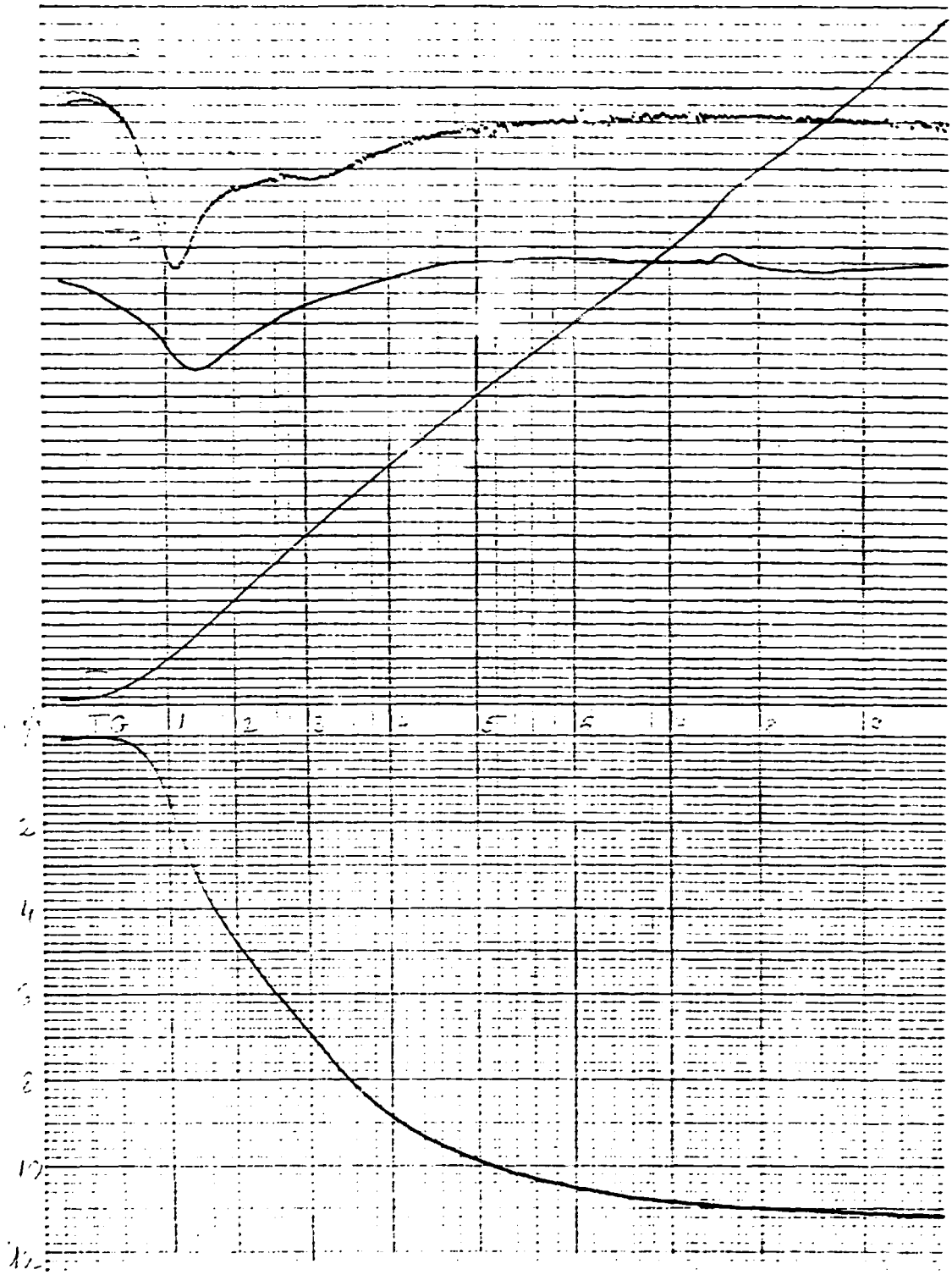
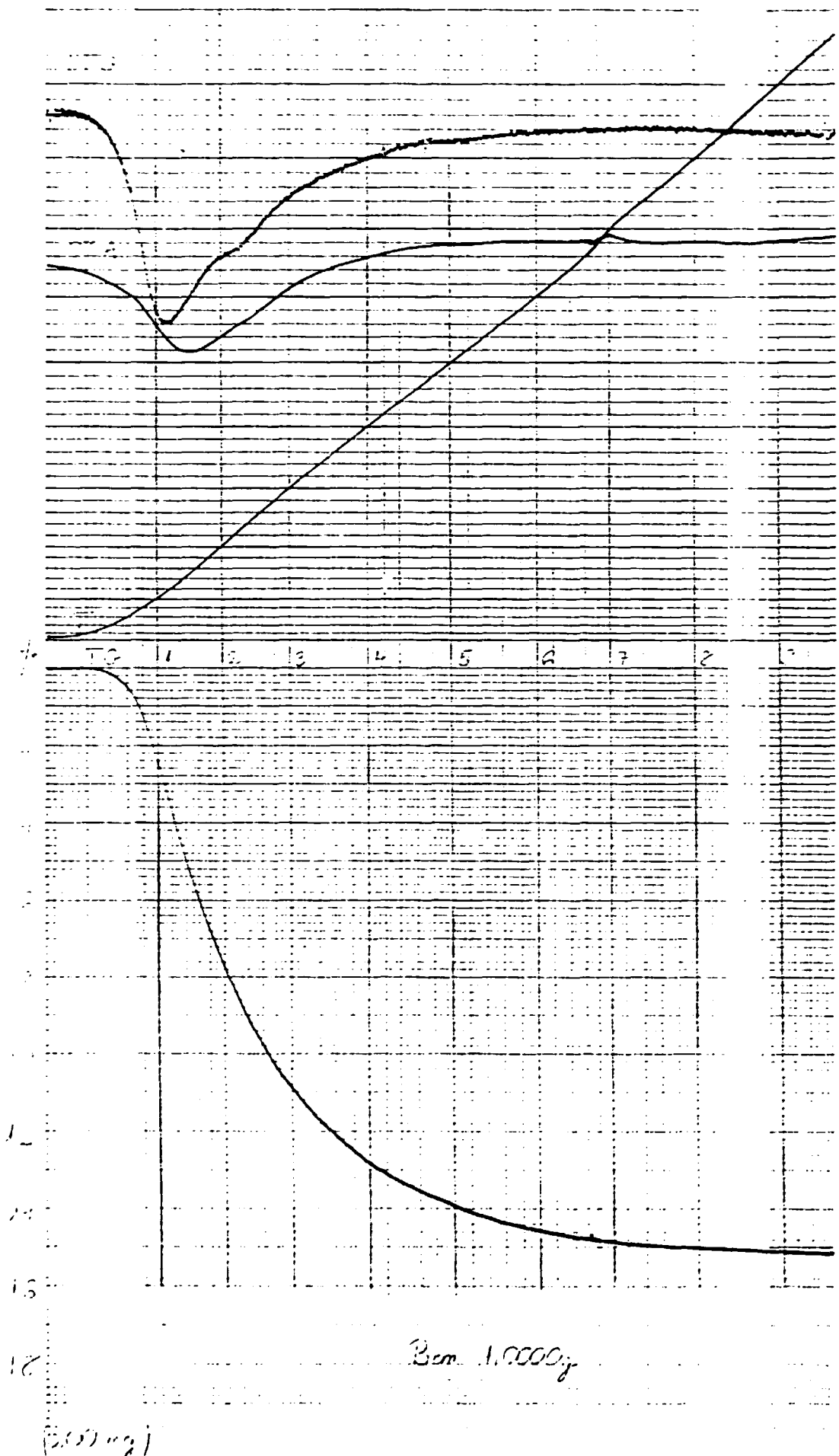
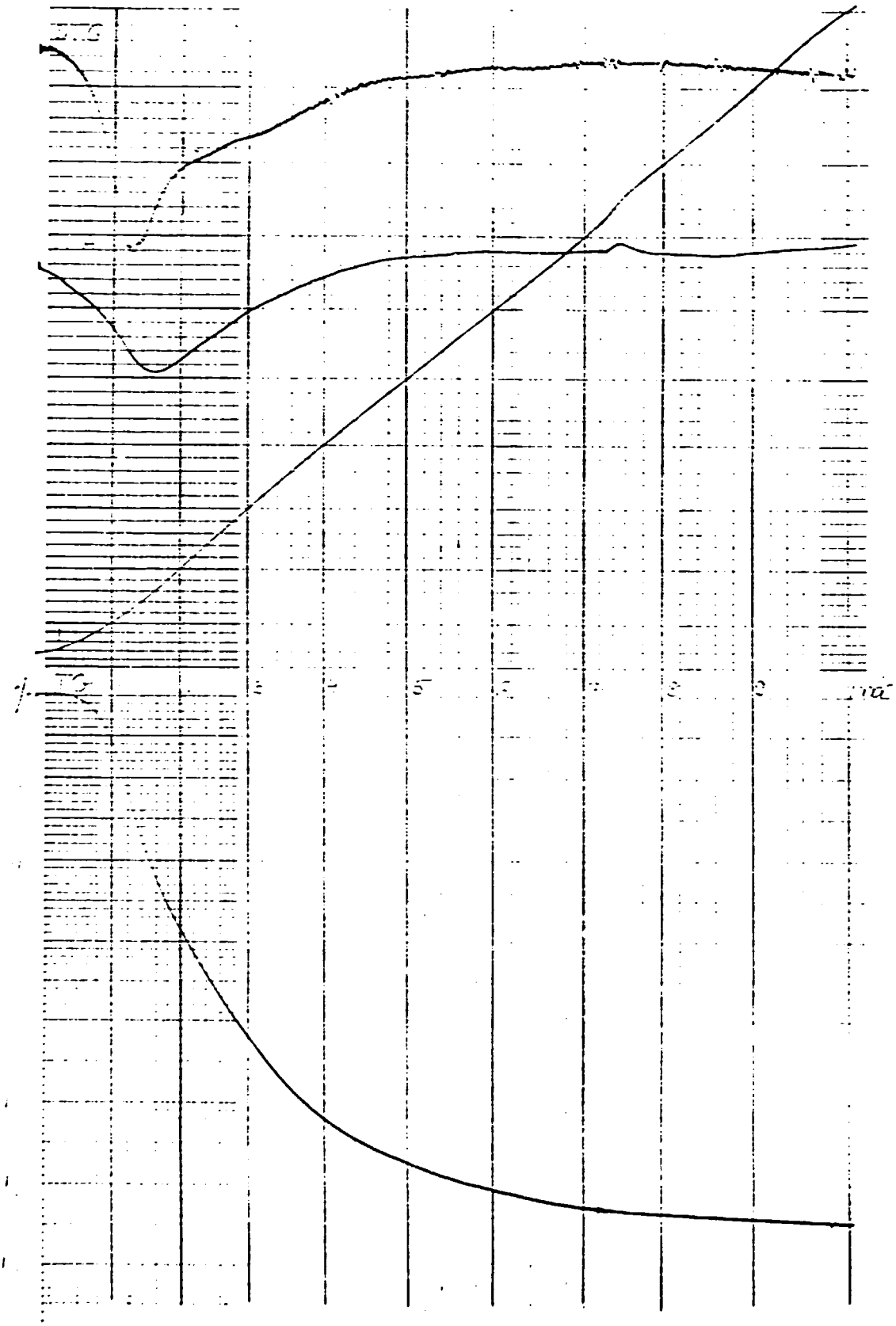




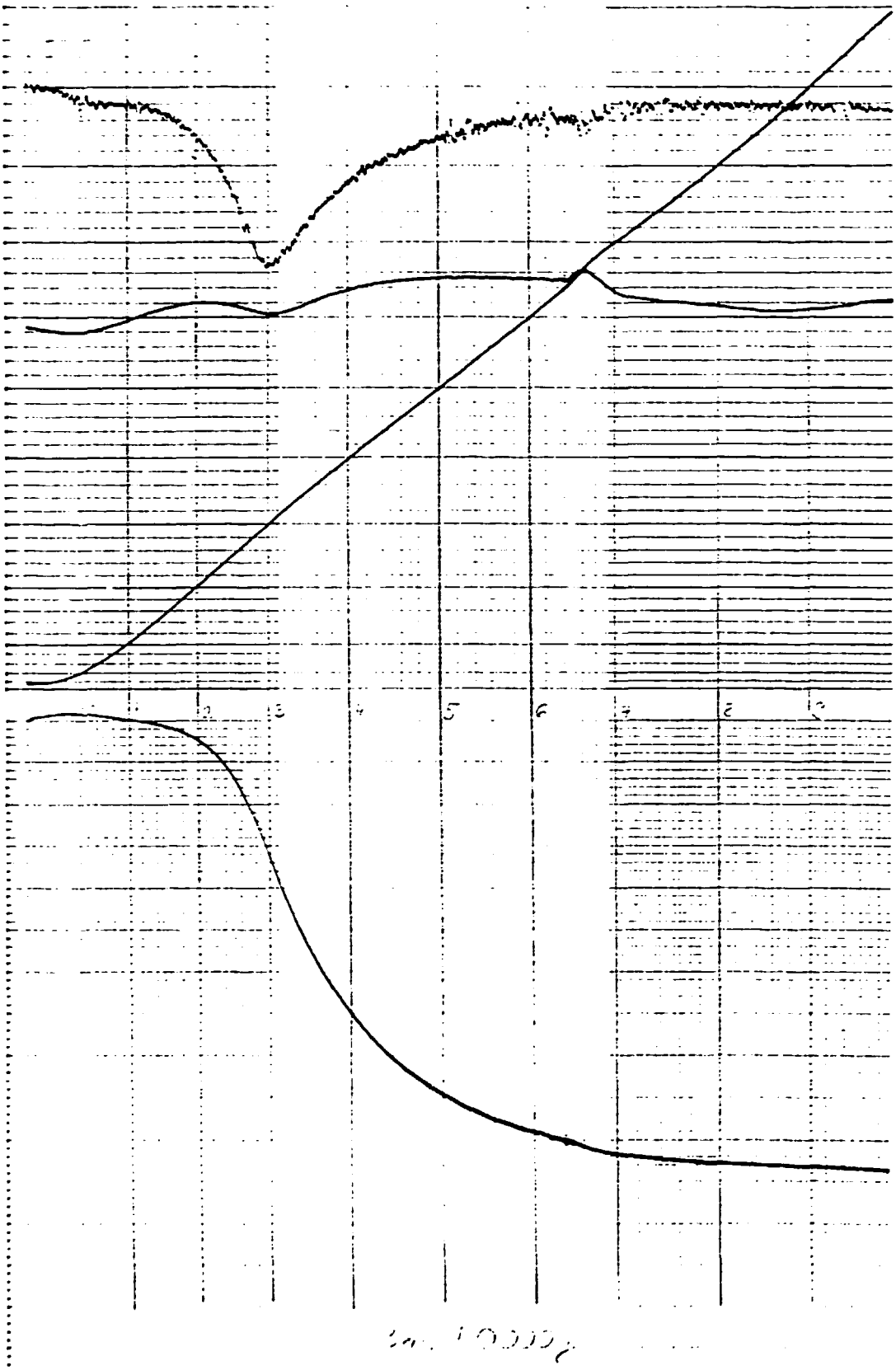
Bem. 1:0000

ZU-13





Bem: 1,0000 g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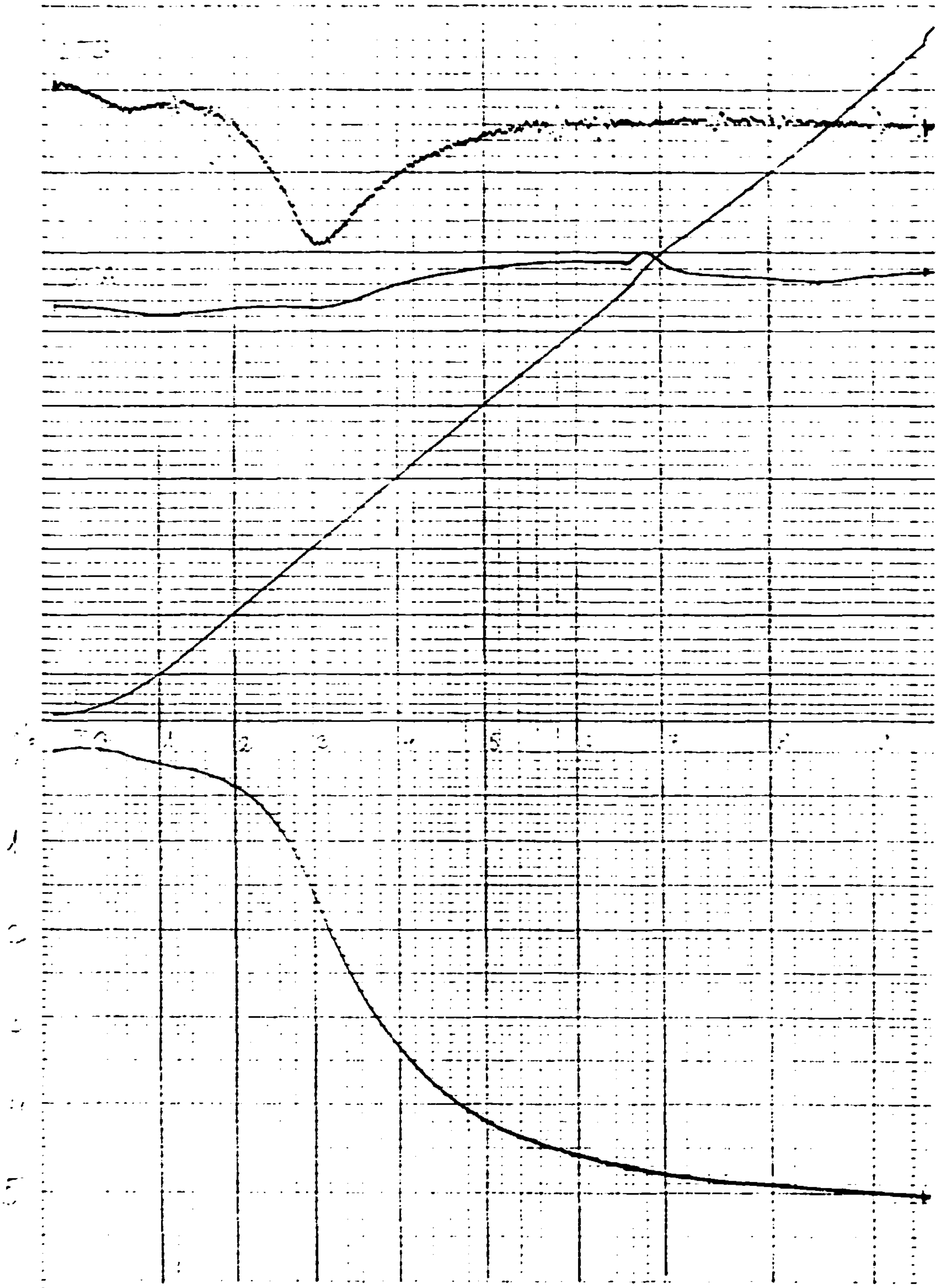
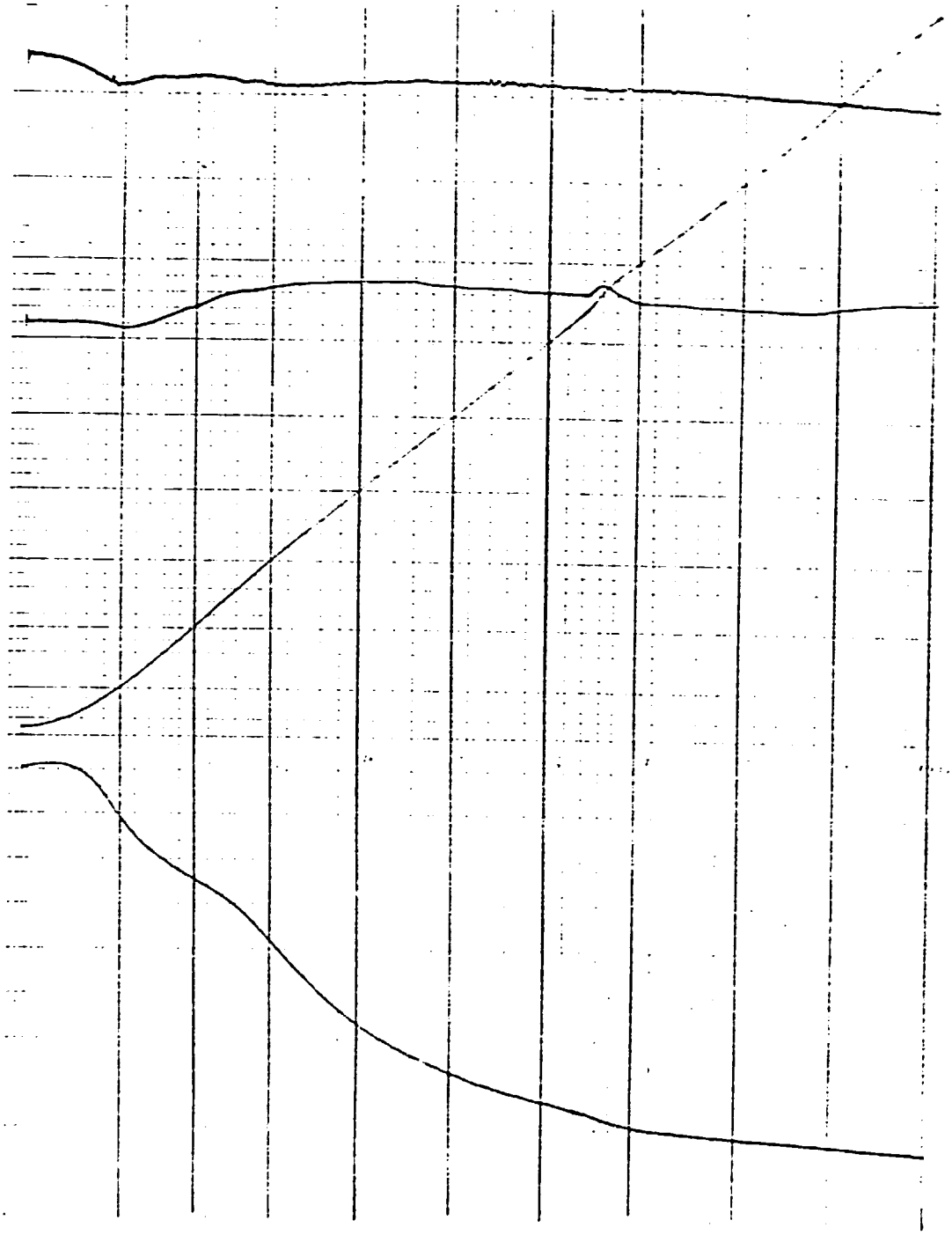
ZU-16

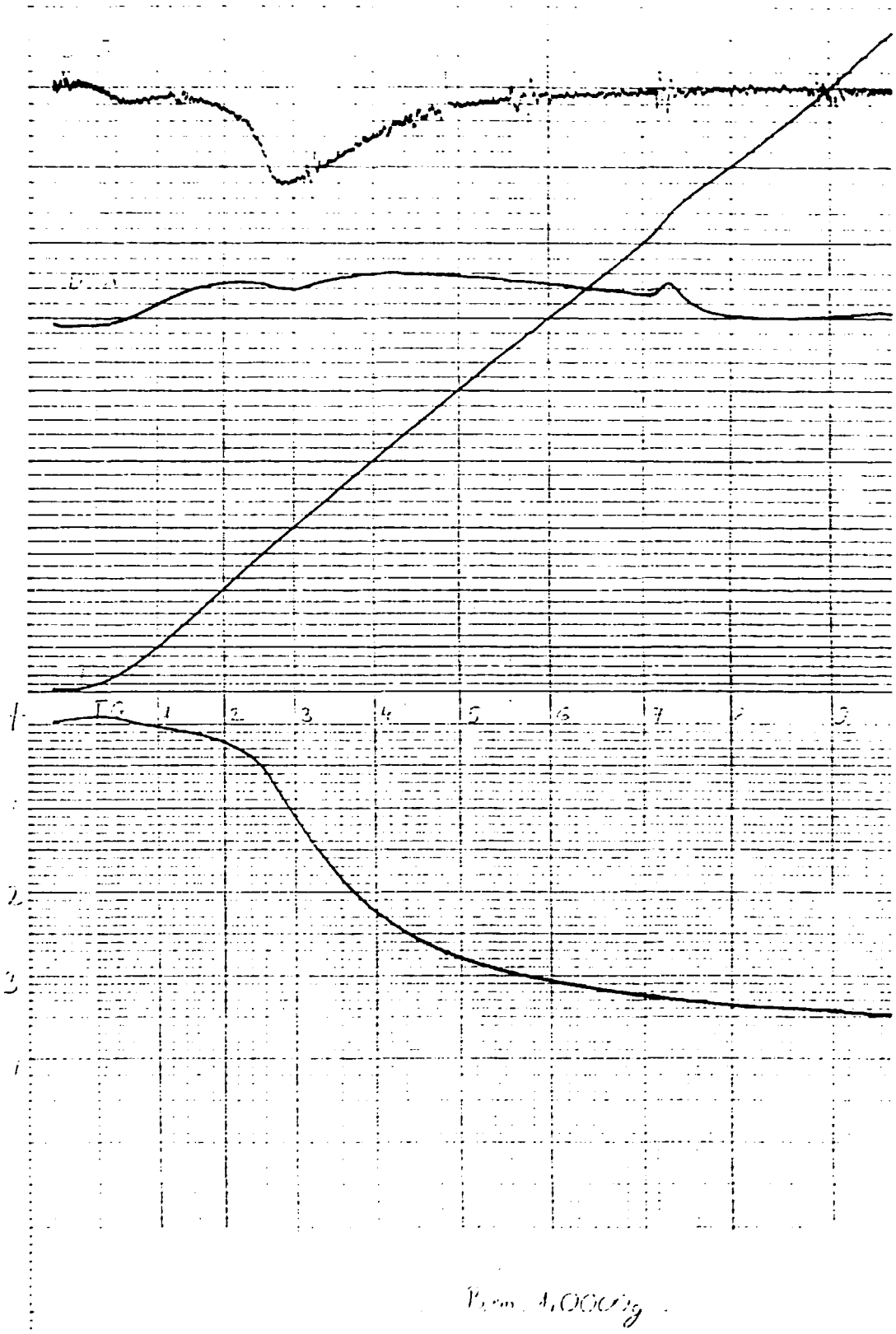


Ein. 1,0000g

(100 mg)

EB-1




1
2
3
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5
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8

ELECTRONMICROSCOPE TESTS

The following conclusion can be drawn from the electronmicroscope tests /see photos /:

a/ The presumption that expanded perlite-graines of large specific surface, middle aggregation density and high strength are developing during expansion have been proved again. On the pictures magnified thirty three times, the grain-sizes are of 1-3 mm. This is a characteristical size for the perlite for agricultural use.

b/ On pictures magnified three hundred and thirty times it is well noticable that the grains are well-expanded and unbroken, that is they have not been exploded and their round shape almost everywhere is noticable. On the surfaces those fractures, clefts can be seen where water vapour escaped.

c/ Thus it can be stated as well that a closed-cellular perlite can be produced by an adequate dehydration and expansion method for which expansion equipment of PERLITE GmbH of Austria is suitable,however, technological tests are required.

d/ On pictures magnified eleven thousand times the thickness of cells /walls/ can be seen, which is cc. 0.8-1,3 µm in every case. This also certifies the excellent possibility of agricultural utilization, as the material is high-resistant to direct mechanical effects.

/Compared to perlite deposits in Europe where thickness of cell-walls is 0.1-0.5 /um./

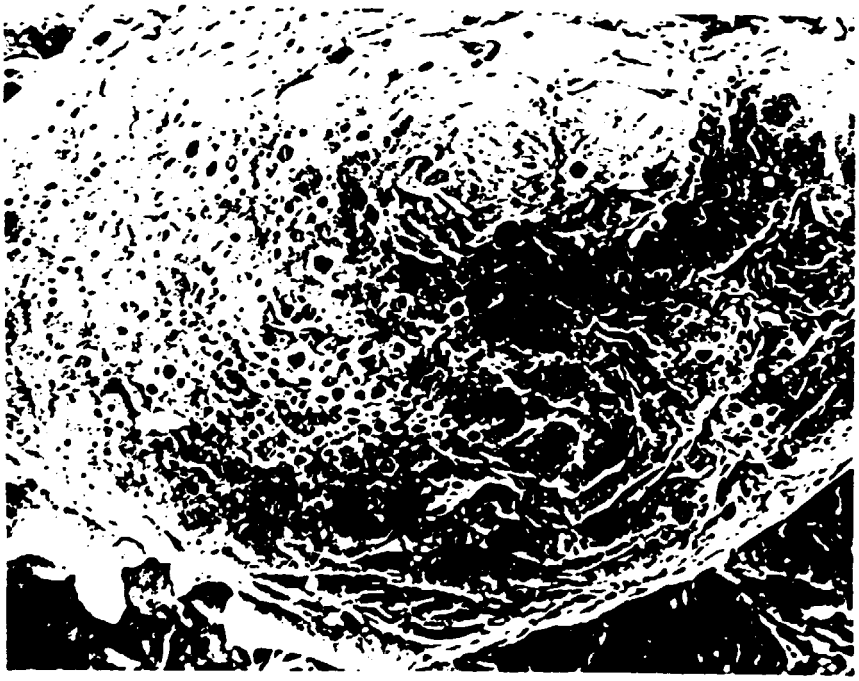
e/ By proper grinding perlite suitable for filtering can be produced, as cells will break in a way where cavernulous and spiky particles occur to ensure the required filtering effect.

ELECTRONMICROSCOPE

ZU 1

33x

1 cm = 303 /um



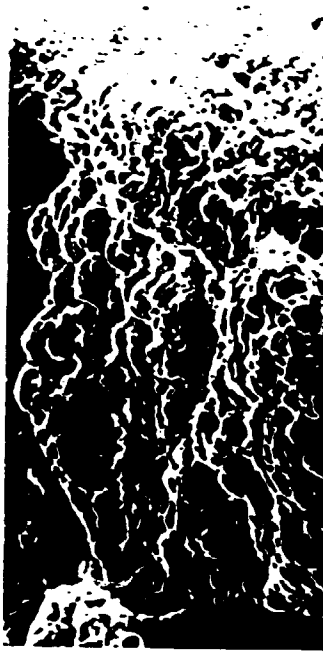
330 x

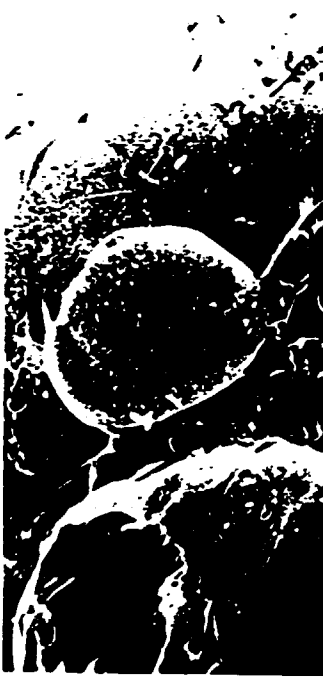
1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

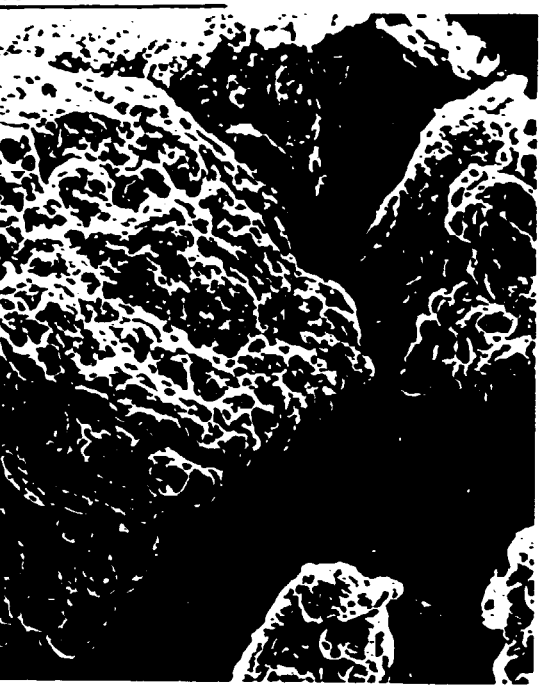
ELECTR





RONMICROSCOPE

ZU 2



33x

1 cm = 303 /um

330 x

1 cm = 30,3 /um

11.000 x

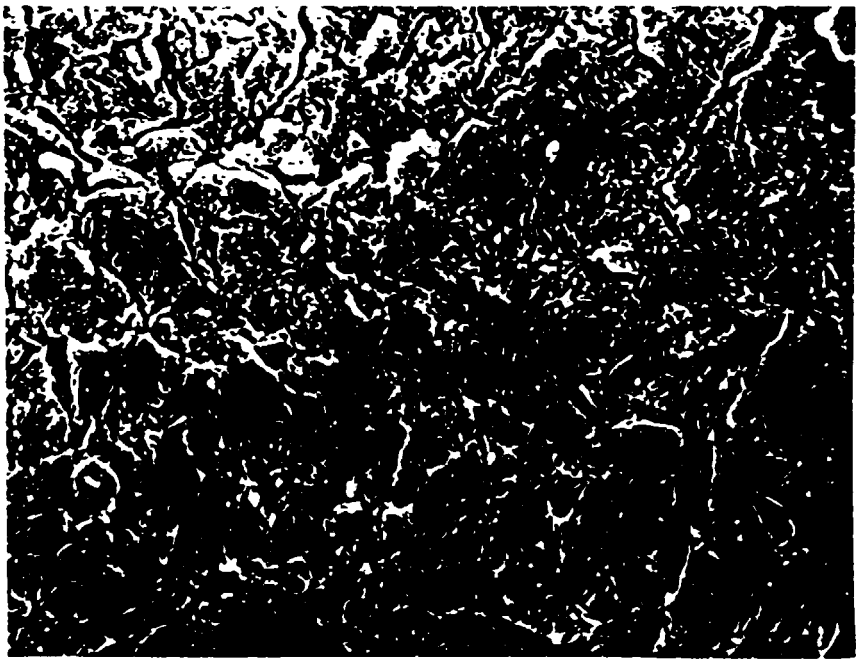
1 cm = 0,9 /um

ELECTRONMICROSCOPE

ZU 3

33x

1 cm = 303 /um



330 x

1 cm = 30,3 /um

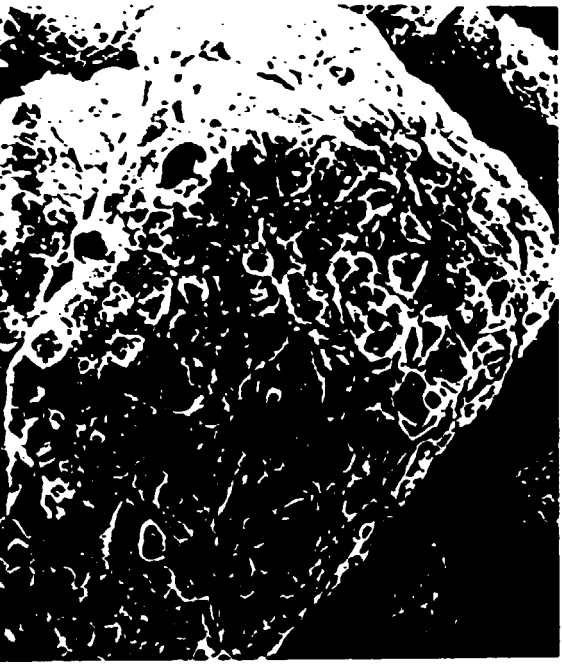
11.000 x

1 cm = 0,9 /um

ELEC

TRONMICROSCOPE

ZU 4



33x

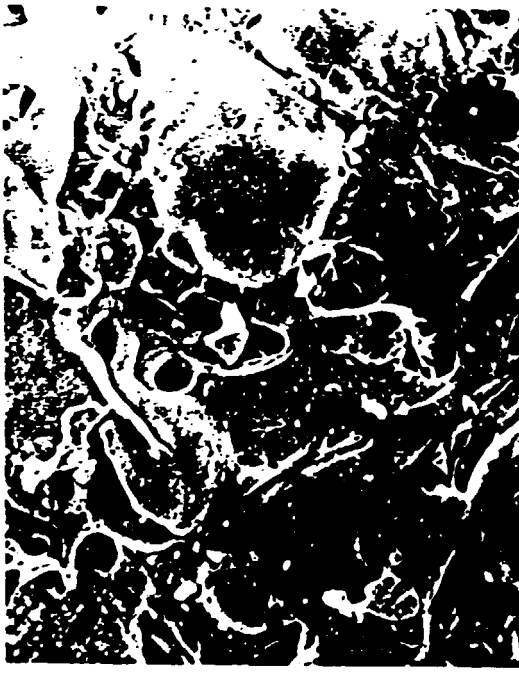
1 cm = 303 /um

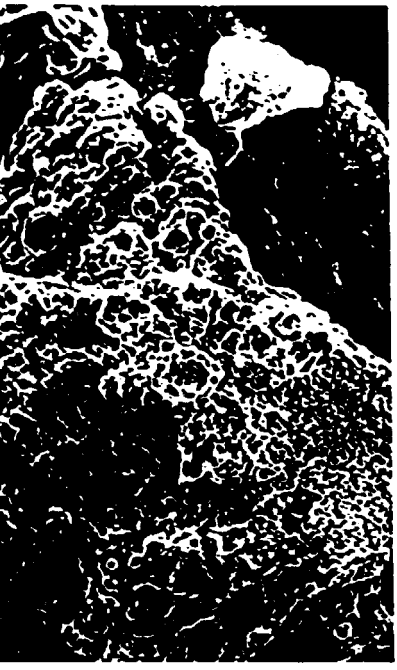
330 x

1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um





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330 x

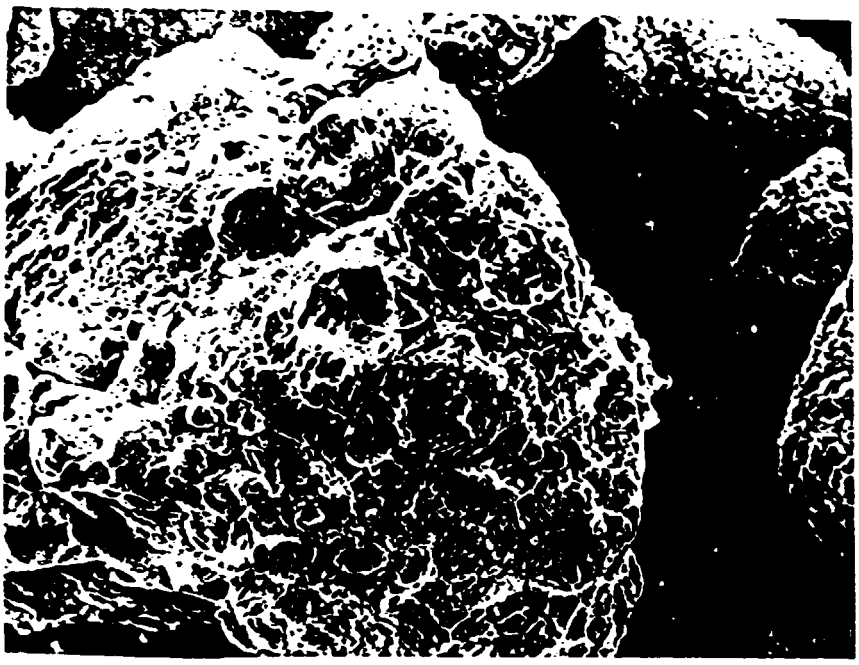
1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

ELECTRONMICROSCOPE

ZU 6



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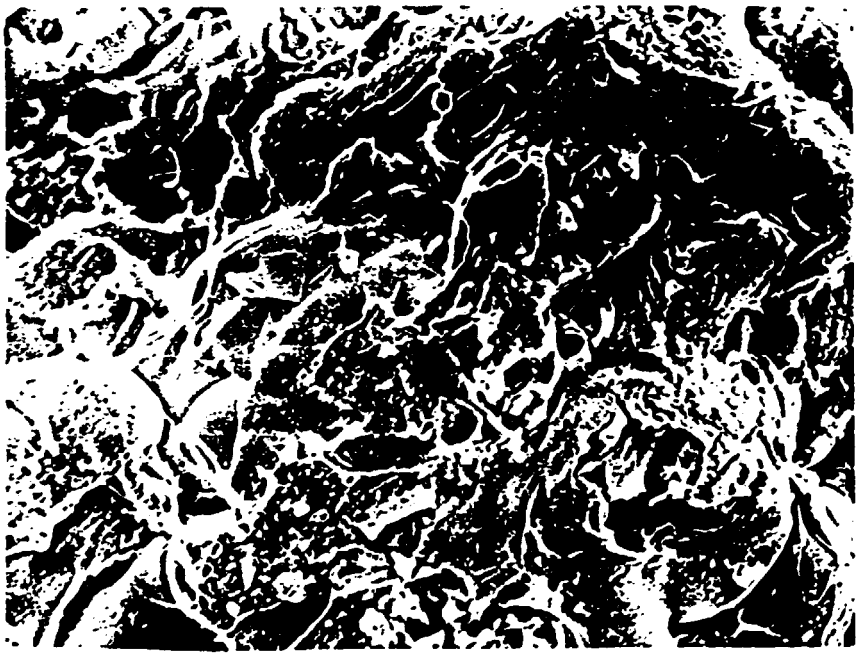

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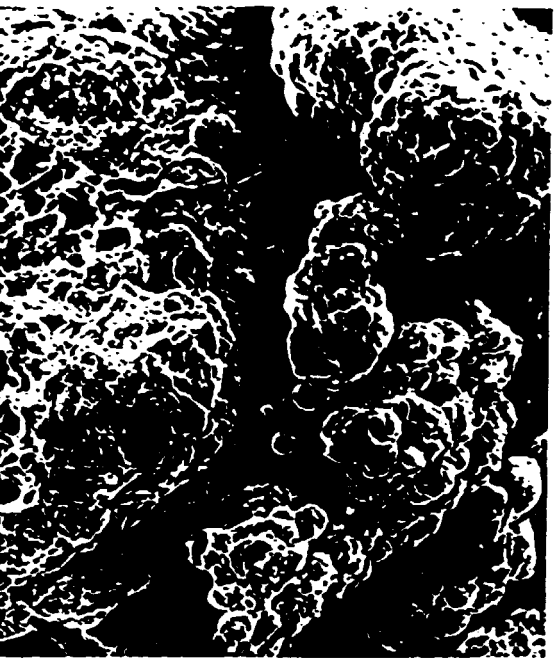
11.000 x

1 cm = 0,9 /um

ELEC

ZU 7



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1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

ELECTRONMICROSCOPE

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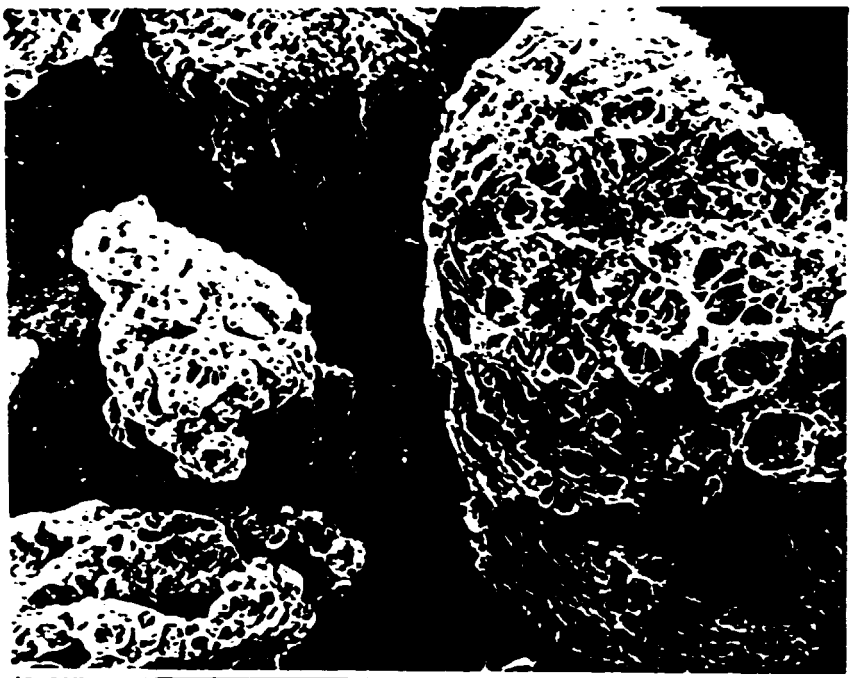

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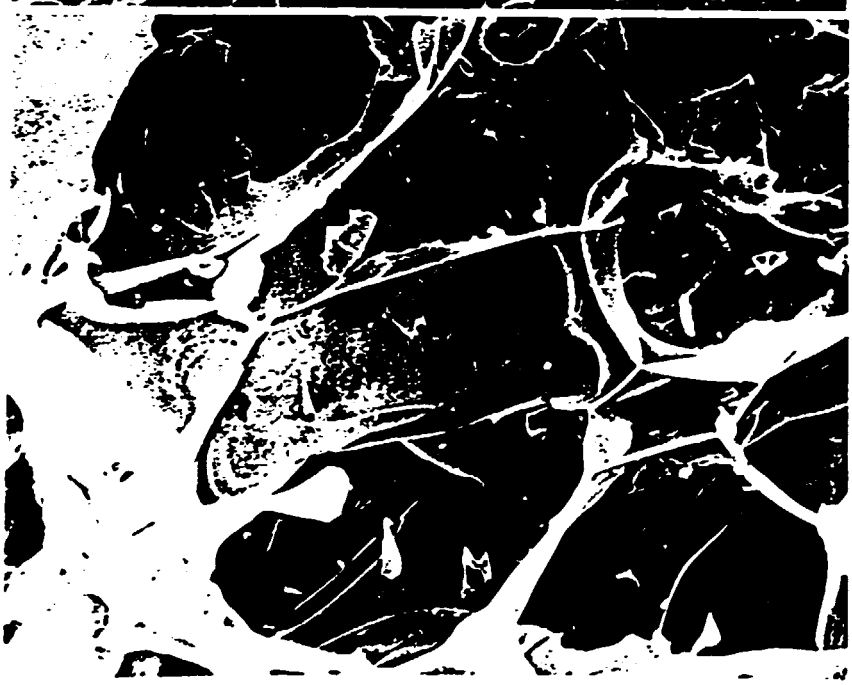

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ELECTRONMICROSCOPE

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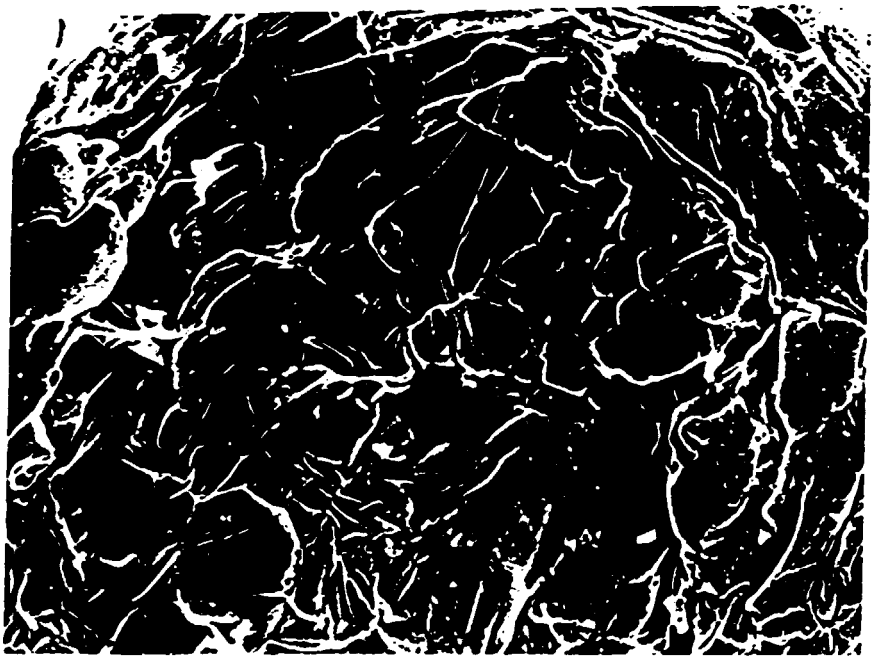

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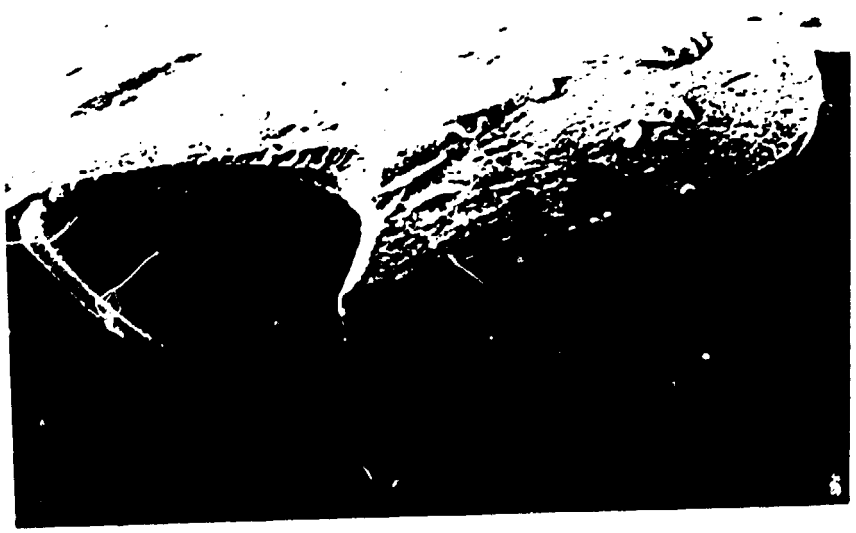

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ELECTRONMICROSCOPE

ZU 10

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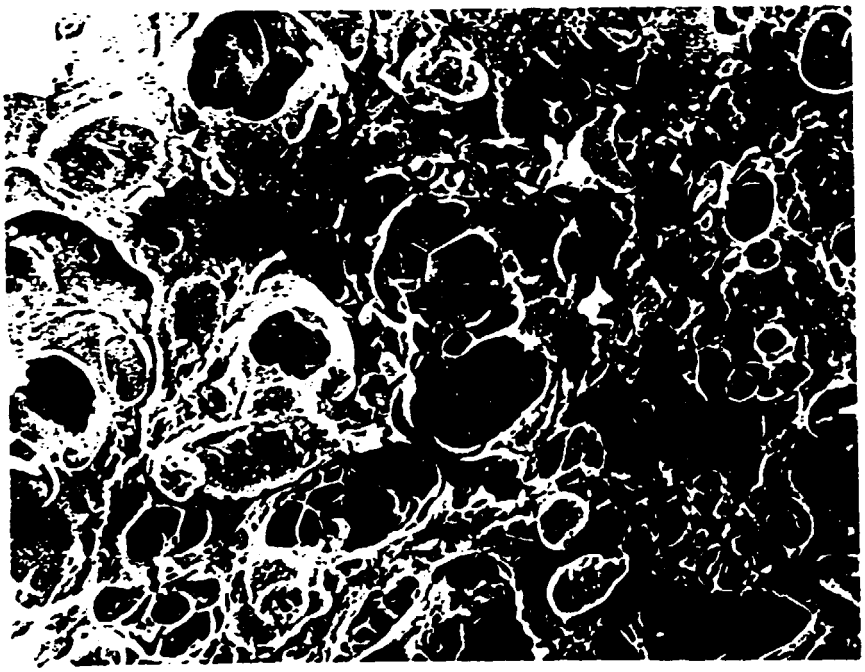

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11.000 x

1 cm = 0,9 /um

ELECTRO

ZU 11

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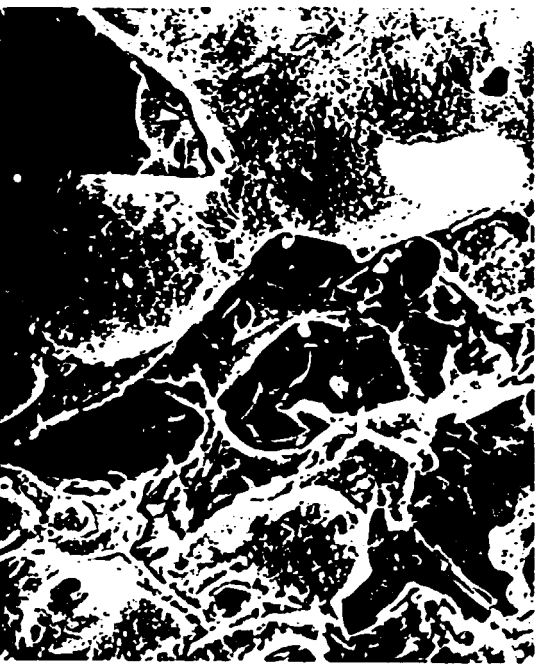

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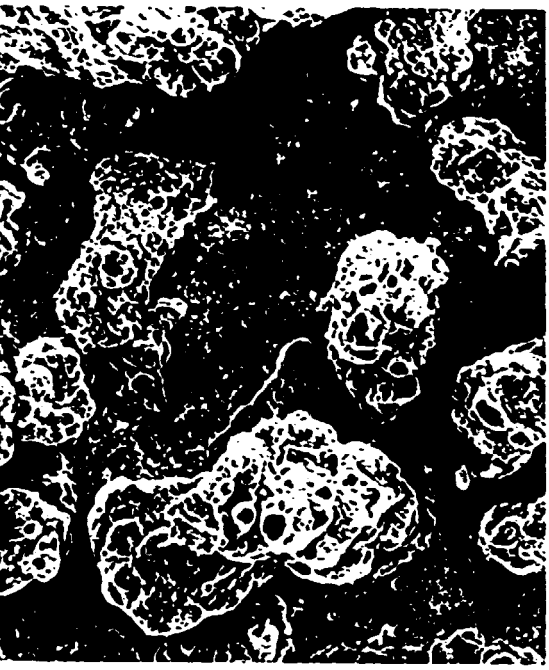
11.000 x

1 cm = 0,9 /um

ELECTR

CU 12



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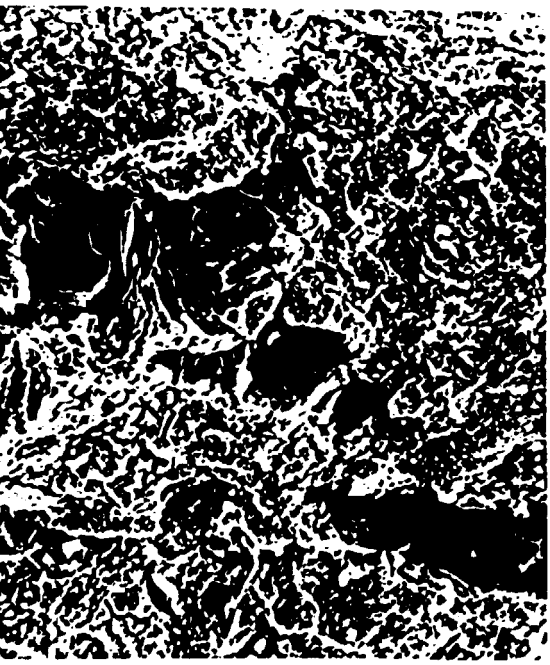
1 cm = 303 /um



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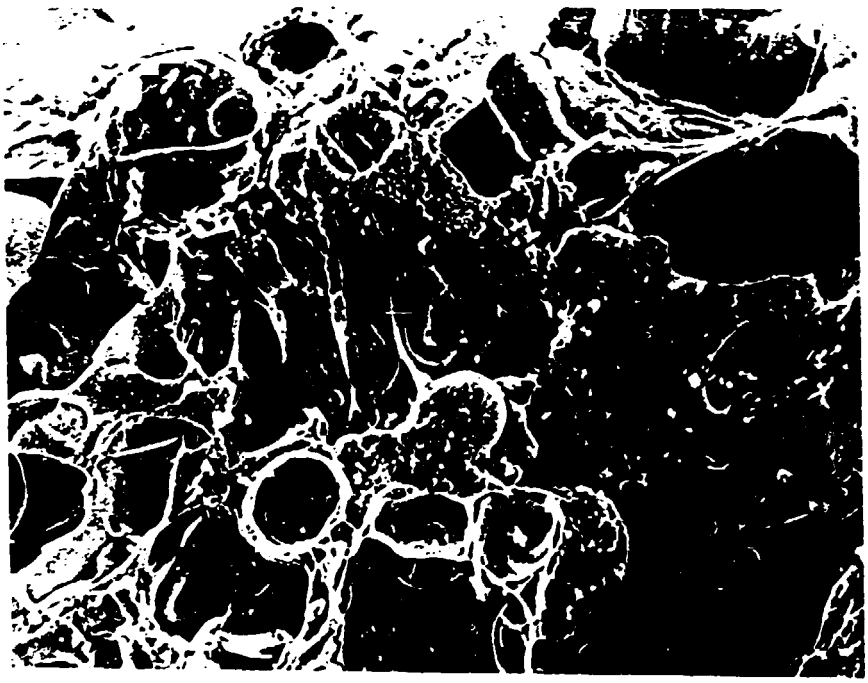
11.000 x

1 cm = 0,9 /um

ELECTRONMICROSCOPE

33x

1 cm = 303 /um



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11.000 x

1 cm = 0,9 /um

ELECTRONMICROSCOPE

ZU 14

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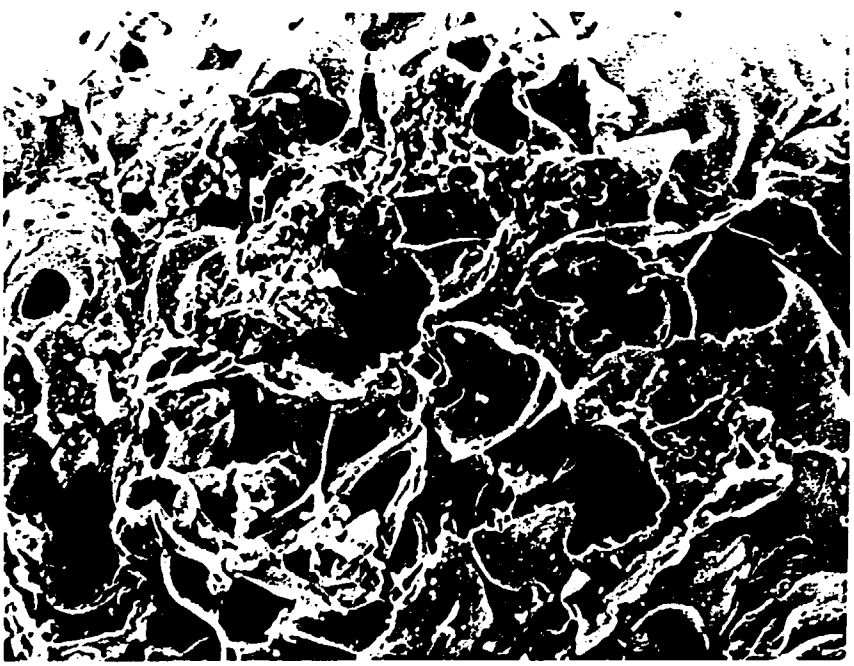
1 cm = 303 /um



330 x

1 cm = 30,3 /um

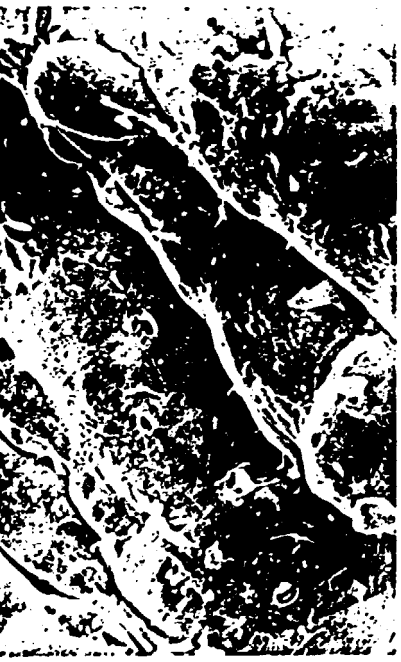
11.000 x

1 cm = 0,9 /um

ELE

33x

1 cm = 303 /um



330 x

1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

33x

1 cm = 303 /um

330 x

1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

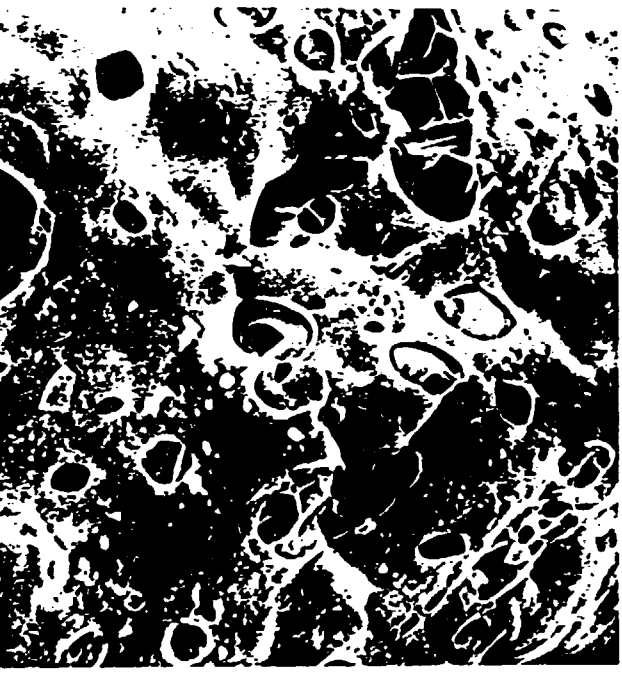
ELE

ELECTRONMICROSCOPE

ES 1

33x

1 cm = 303 /um



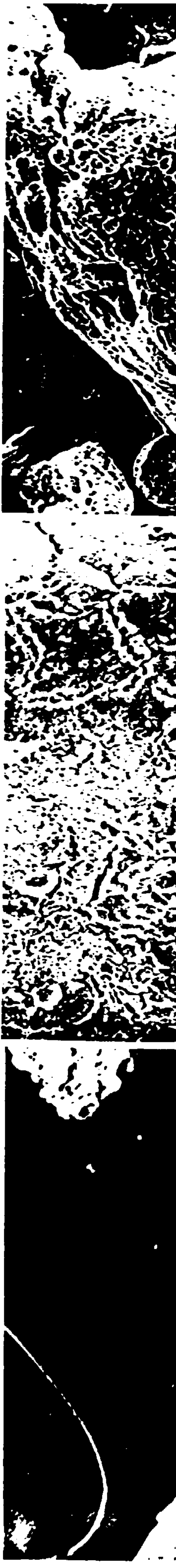
330 x

1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

E



BB 2

33x

1 cm = 303 /um

330 x

1 cm = 30,3 /um

11.000 x

1 cm = 0,9 /um

ECONOMIC ASSESSMENT

ECONOMIC EVALUATION

The COMFAR software was run with the available data provided by the Mongolian counter-part, However, as the attached data sheets show the programme run is not evaluable as the Mongolian economy - the taxation,investment, credit etc. system - is not a market-oriented one, thus COMFAR is based on market conditions. No firm terms and conditions prevale on amortization, value of land, taxation, inflation etc. Therefore the results of programme show unreal terms and conditions.

Due to the above reasons economic evaluation was prepared with the available data, estimates, international comparative prices. In some cases the Hungarian experience and practice of investment in the same field was taken into consideration.

The transportation costs were not calculated as the ones via the Sowjetunion are unpredictable due to some expected increase in prices and changes in rates of exchange.

When preparing the calculations the following rates of exchane were taken into consideration: 1 USD = 64,36 HUF
1 USD = 10,50 ATS
1 USD = 6,00 MNT

The capacity of the mine and the preparation plant is much higher than the on of the expanding plant. Should a second kiln be erected and operated, the capacity of the expanding plant could be doubled which would lead to a considerable decrease in specific investment costs. In case of installing one kiln only, the raw prepared raw perlite can be subject of export.

As a conclusion it may be drawn that the most important field of perlite utilization would be the agrilculture, first of all green-houses, producing vegetables and fruits.

When setting up a plan of implementation it is proposed to put the agrilutural field on the top of priority as perlite can be directly used without investment of further processing.

Further processing units are also not needed for the production of the most required perlites for the building industry.

The detailed economic calculations can be find in the following pages. As a final conclusion it is to be stated that expanded perlite can be manufactured under the world market price in Mongolia.

Summary of investment costs

1.) Mine and preparation plant	5.209.660	USD
2.) Perlite expanding plant	980.650	USD
3.) Partition wall prod. unit	687.542	USD
4.) Glue mat. unit	92.736	USD
5.) Mortar - plaster prod. unit	1.666.784	USD
Total:	8.637.372	USD

I. Prposed investment costs of the project

in US Dollar

Item	Denomination	Invest.costs	Amortization %/y	Amortization costs/year
1.)	Mine and preparation plant	5.209.660		399.681
1.1.	Mine equipment	1.245.900	8	99.672
1.2.	Transp. equip.	295.200	8	23.672
1.3.	Prep.plant equip.	2.205.000	8	176.400
1.4.	Energy suppl.	178.400	8	14.272
1.5.	Erection	771.600	8	61.728
1.6.	Building, road,	34.960	2	700
1.7.	Engineering	83.600	2	1.672
1.8.	Training	32.600	8	2.608
1.9.	Miscelanneous	27.900	8	2.232
1.10.	Reserve (12 %)	334.500	5	16.725
2.)	Perlite expanding plant	980.650		65.104
2.1.	Expanding equipm.	454.580	8	36.370
2.2.	Energy supply	80.000	8	6.400
2.3.	Erection	141.000	8	11.280
2.4.	Building, road	150.000	2	3.000
2.5.	Engineering	20.000	2	400
2.6.	Training	20.000	8	1.600
2.7.	Miscellaneous	10.000	8	800
2.8.	Reserve (12 %)	105.070	5	5.254

in US Dollar

Item	Denomination	Invest.cost	Amortization %/y	Amortization cost/year
3.)	Partition wall prod. unit	687.542		50.694
3.1.	Part. wall equipm.	432.930	8	34.634
3.2.	Energy supply	30.000	8	2.400
3.3.	Erection	42.000	8	3.360
3.4.	Building, road	10.000	2	200
3.5.	Engineering	25.000	2	500
3.6.	Training	14.800	8	1.120
3.7.	Miscelanneous (know-how)	60.000	8	4.800
3.8.	Reserve (12 %)	73.612	5	3.680
4.)	Glue mat. unit to partition wall	92.736		7.163
4.1.	Glue. mat. equipm.	61.770	8	4.980
4.2.	Erection	6.180	8	495
4 3.	Training	4.850	8	388
4.4.	Miscellaneous (know-how)	10.000	8	800
4.5.	Reserve (12%)	9.936	5	500
5.)	Mortar-plaster prod. unit	1.666.784		47.933
5.1.	Mortar-plaster equip.	650.000	8	5.200
5.2.	Energy supply	130.000	8	10.400
5.3.	Erection, training	90.000	8	7.200
5.4.	Building, road	497.200	2	9.944
5.5.	Engineering	66.000	2	1.320
5.6.	Miscellaneous (know-how)	55.000	8	4.400
5.7.	Reserve (12%)	178.584	5	8.929

II. Proposed operation costs of the project

in US Dollar

1. Labour costs

Item	Prod. unit	Shift	No. of empl.	Costs of salary/year per person	per year
1.)	Mine	1	11	1.200	13.200
2.)	Transport	1	5	1.200	6.000
3.)	Preparation	2	44	1.200	52.800
4.)	Expanding pl.	2	15	1.200	18.000
5.)	Partition wall	2	16	1.200	19.200
6.)	Glue mat. unit	1	4	1.200	4.800
7.)	Mortar & plaster	1	6	1.200	7.200
Total Labour costs:			101	1.200	121.200

2. Energy costs

Item	Plant	Oil unit	Oil costs	Petrol unit	Petrol costs	Electricity unit	Electricity costs
1.)	Mine, prep.	8,5kg/t	20.000	701/t	4.770	45kWh/t	30.000
2.)	Transport			801/t	5.450	1kWh/t	667
3.)	Expanding	12kg/m^3	144.000			80kWh/h	12.960
4.)	Partit.wall	0,5kg/h	3.840			120kWh/h	19.440
5.)	Glue mat.					12kWh/h	1.944
6.)	Mort.&plast.					400kWh/h	64.800
7.)	Internal trans.				1.000		
Total energy costs:			167.840		11.220		129.811

Prices: oil 0,80 MNT/kg
elec 0,20 MNT/kWh
petr.1,00 MNT/liter

3. Materials, additives and auxiliary materials

Raw material	:	cca. 100.000 USD per year (this figure may not be defined more precisely because the receipts were not provided by the owners of the know-hows)
Additives	:	cca. 70.000 USD per year
Spare parts	:	cca. 180.000 USD per year

III. Proposed production parameters

1.) Operational periods per year

Mine:	six months
Prepar. plant:	eight months
Expanding plant:	300 working days
Partition wall pl.:	300 - " -
Glue mat. plant :	300 - " -
Mortar & plaster plant :	300 - " -

2.) Production capacity:

Mine and prep. plant	:	20.000 t/y
Expanding plant	:	90.000 m^3/y
Partition wall plant	:	26.000 m^2/y
Glue mat. unit	:	3.000 t/y
Mortar and plaster plant	:	18.000 m^3/y

IV. Manufacturing costs of expanded perlite

(without taking into consideration the further processing costs related to mortar and plasters, partition wall etc.)

Amortization:	464.785 USD
Salaries and wages:	90.000 USD
Energy:	218.327 USD
Additives:	25.000 USD
Spare parts:	100.000 USD
Total:	898.112 USD per year

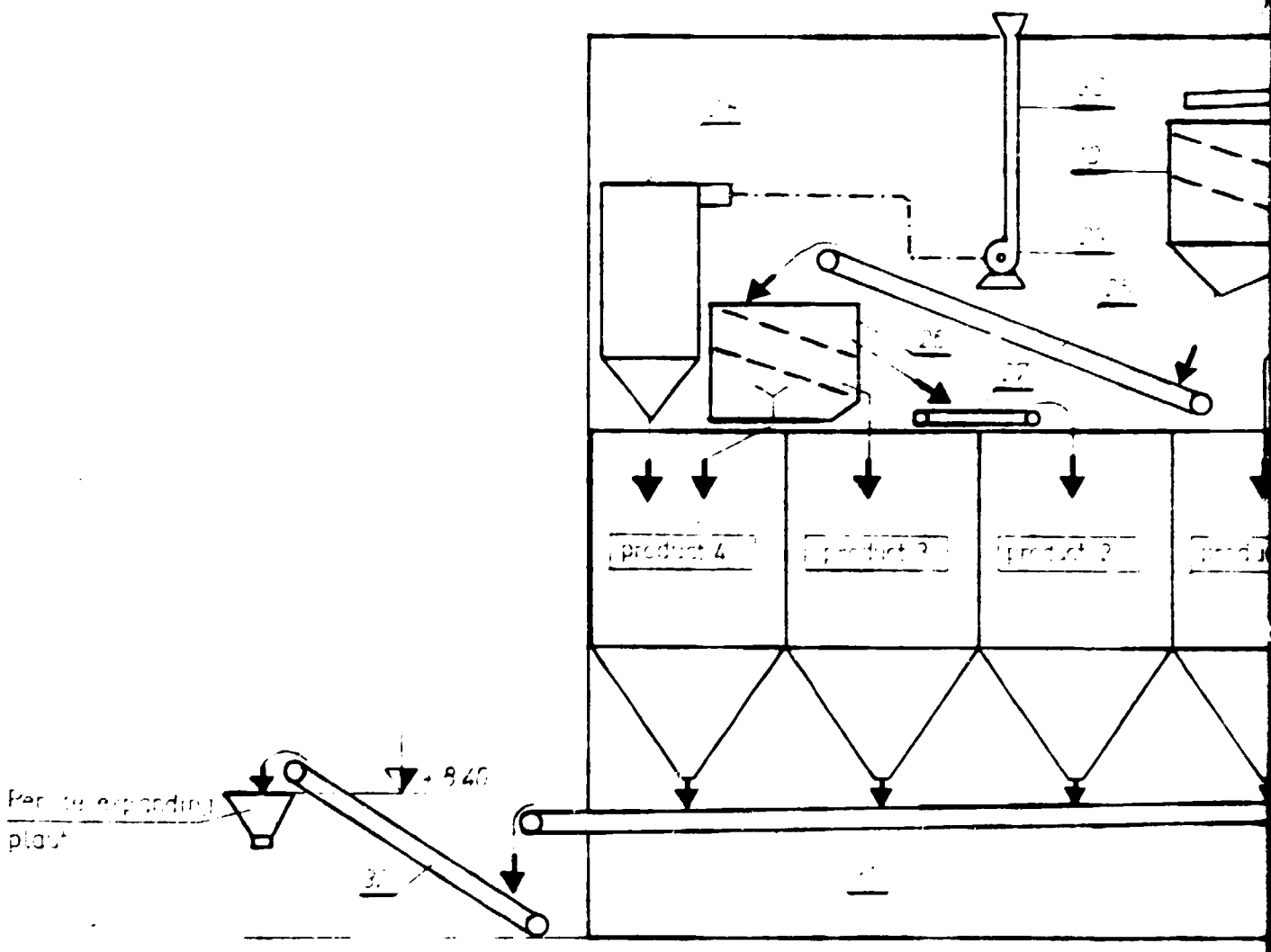
Production of expanded perlite: 90.000 m^3/year

Specific production costs:		$\frac{898.112 \text{ USD/year}}{90.000 \text{ m}^3\text{/year}}$ =	9,98 USD/m^3
Average taxation	:	30 %	3,00 USD/m^3
Profit	:	5 %	0,50 USD/m^3

Ex works price of expanded perlite: 13.48 USD/m^3

For comparison the expected price level of different kind of perlites in Hungary in 1991 are herebelow:

P 1 type expanded perlite	18,00 USD/m^3
P 2 type expanded perlite	11,70 USD/m^3
P 3 type expanded perlite	13,30 USD/m^3
Filter-aid perlite	46,00 USD/m^3
Agro - perlite	22,00 USD/m^3



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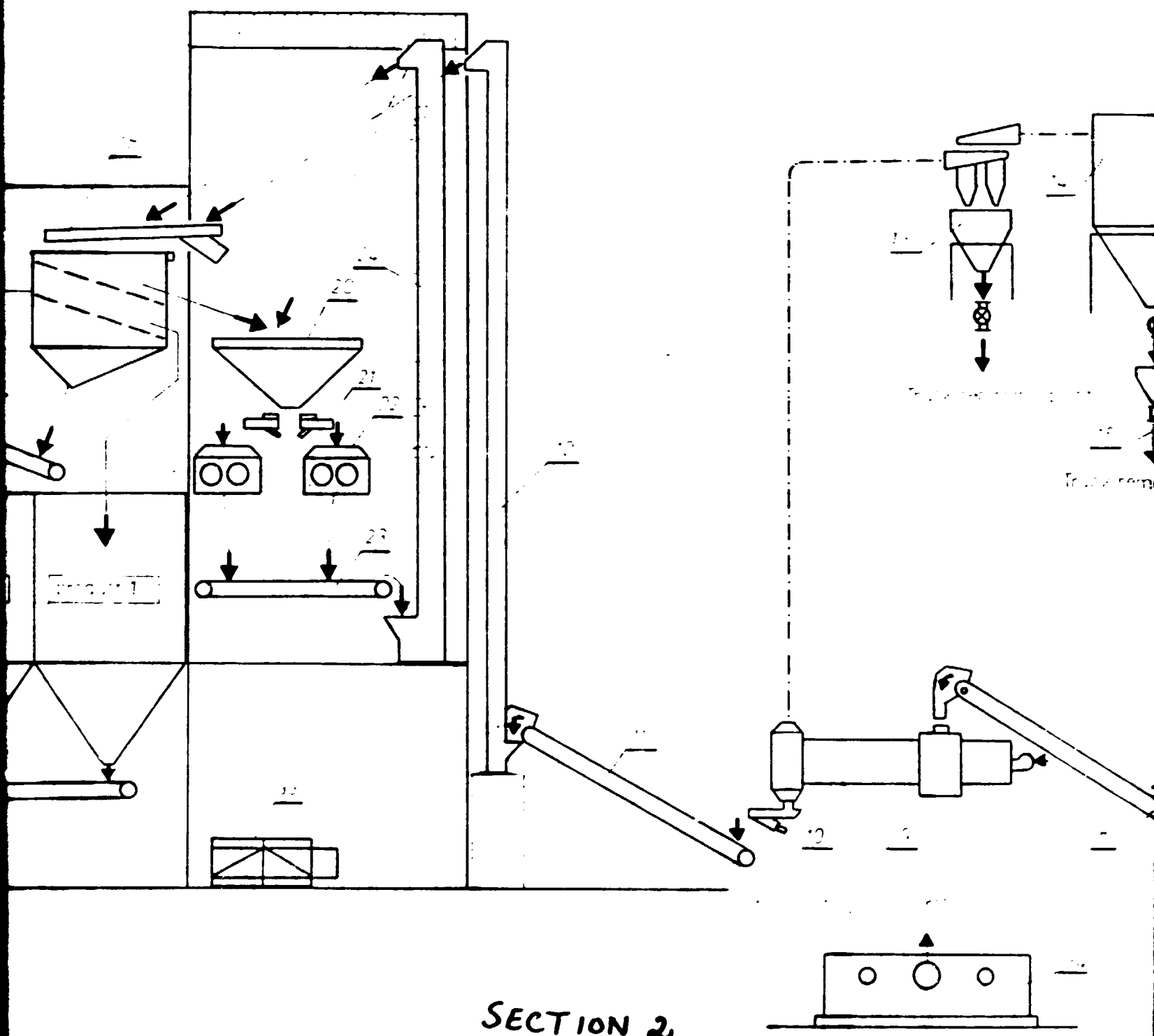

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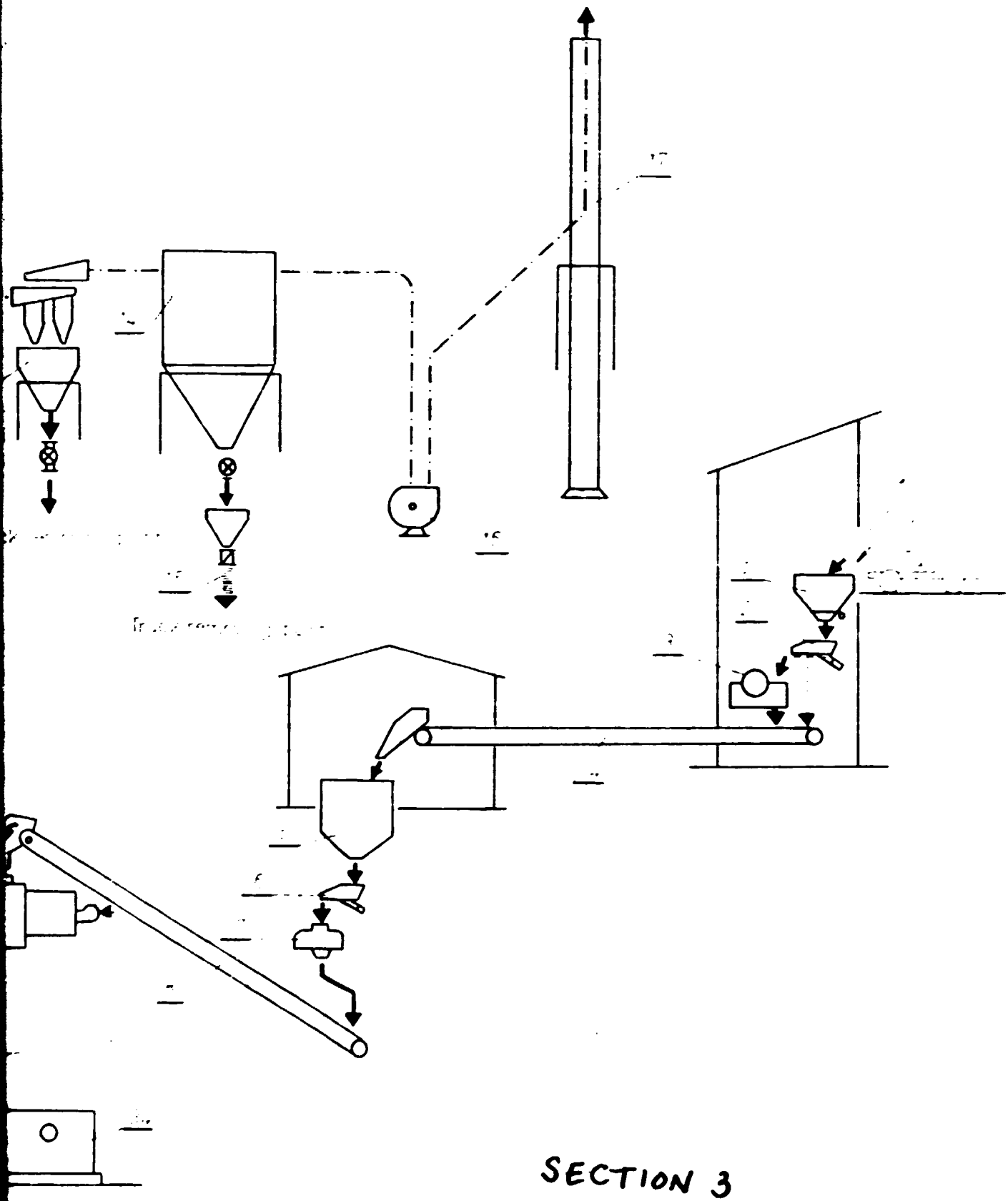

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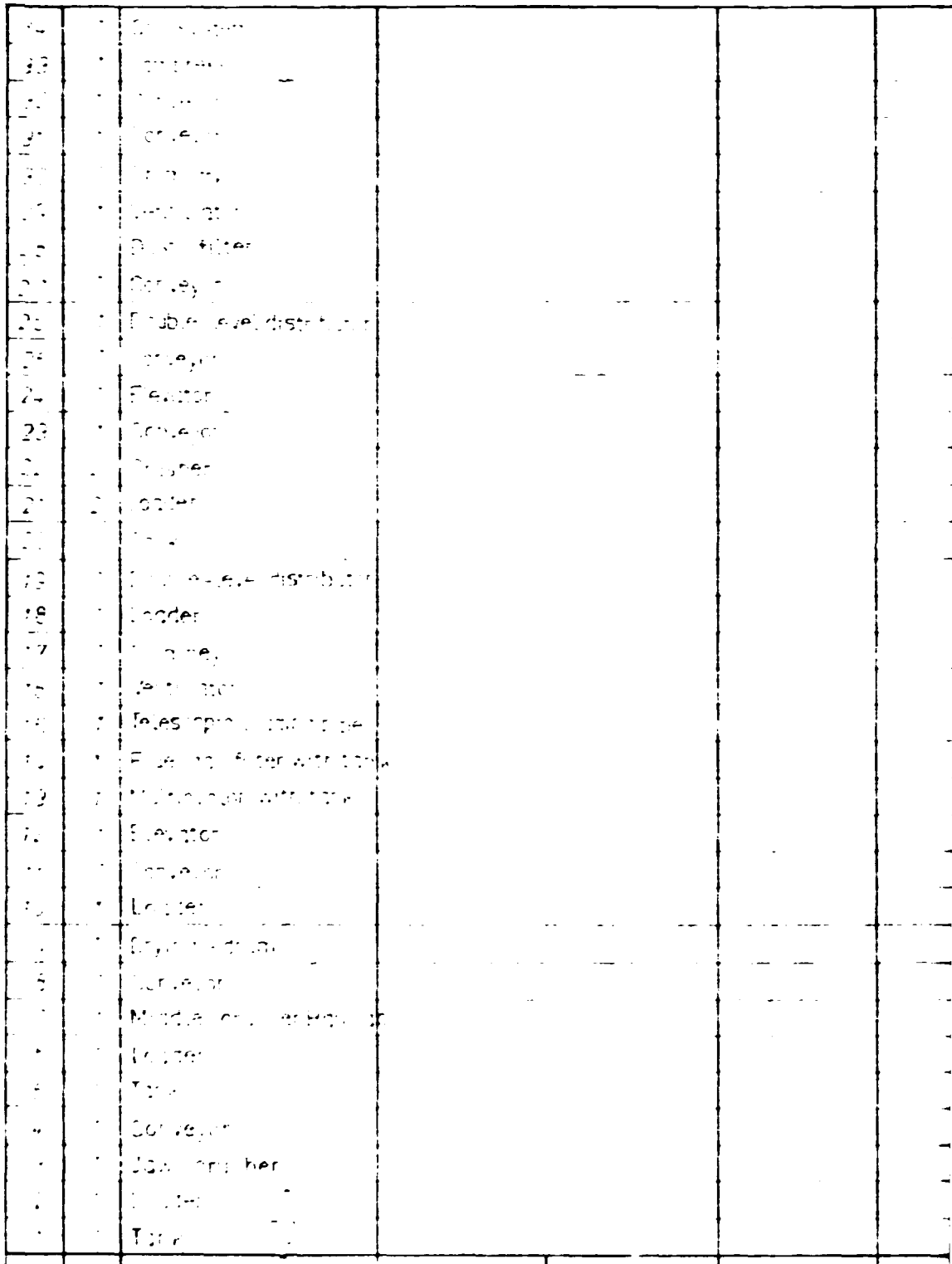
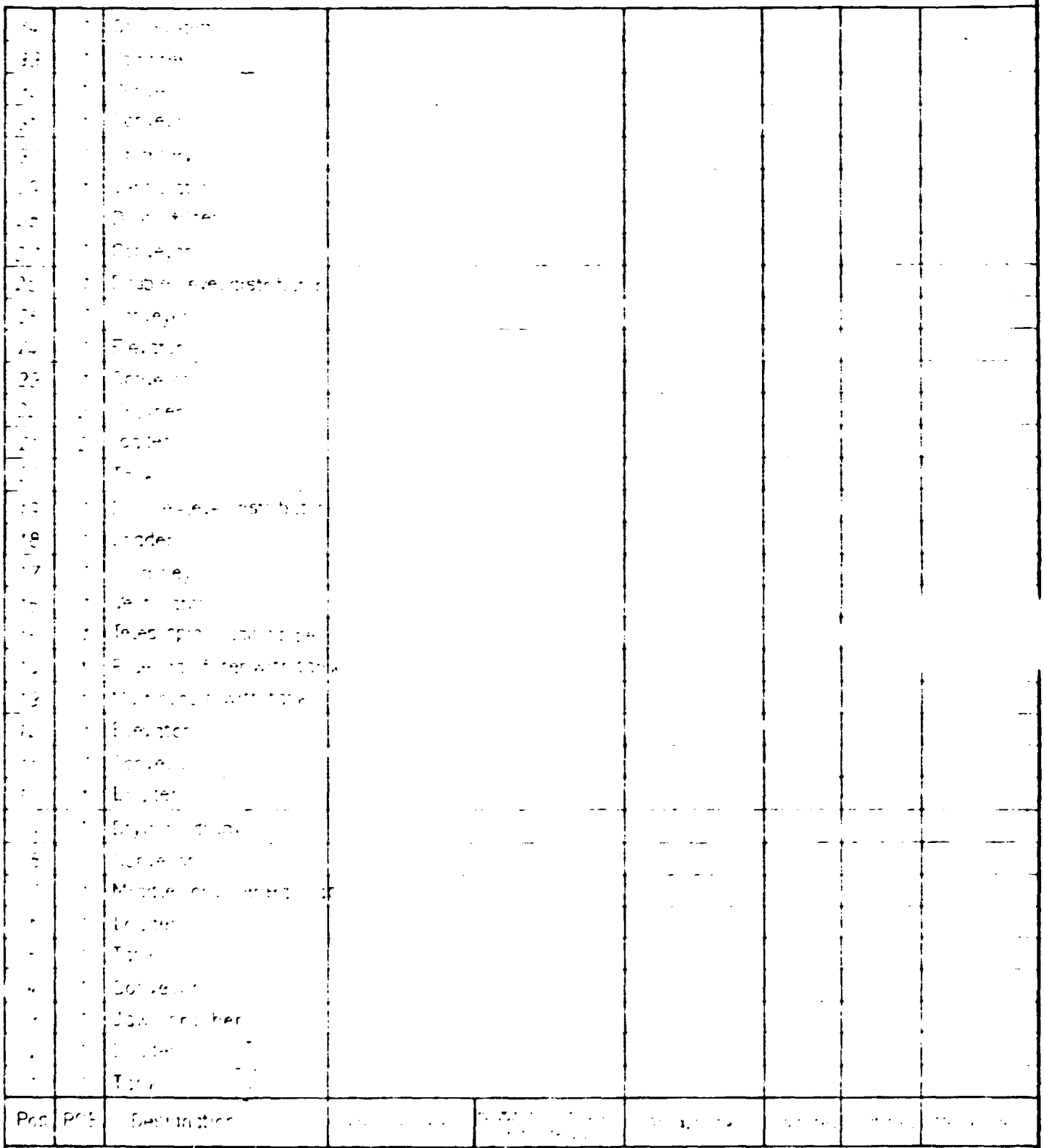

Pos
Designation
TECHNOLOGICAL
FLOW - CHART
MONGOLIA
1990. VII.

Section 4



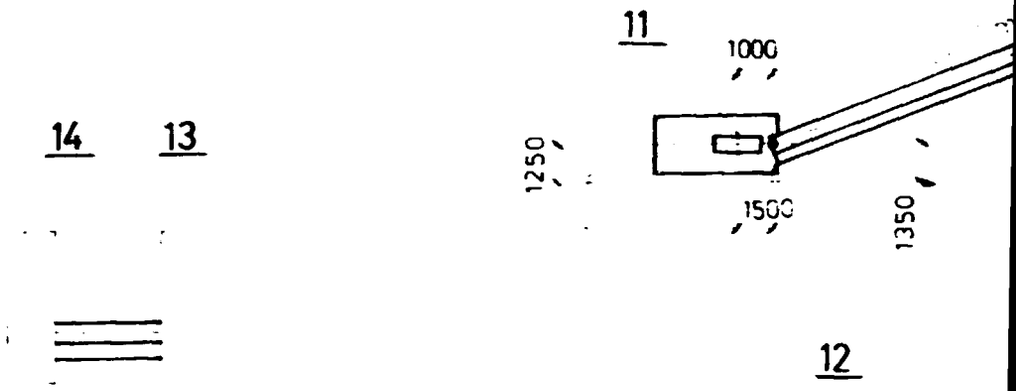
TECHNOLOGICAL FLOW - CHART

M.P.1.

MONGOLIA

1990. VII.

Section 5



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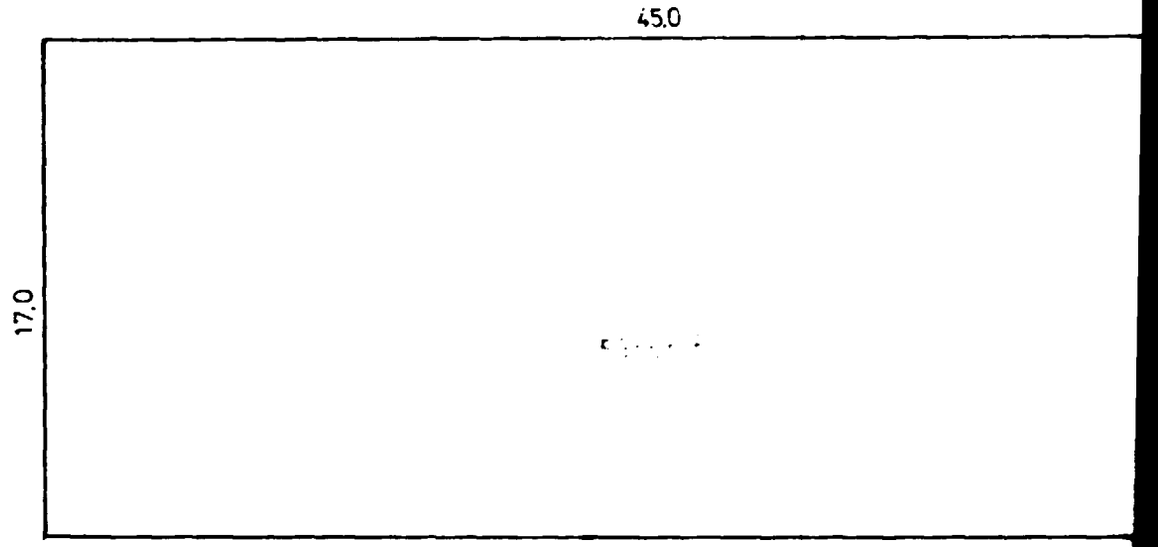

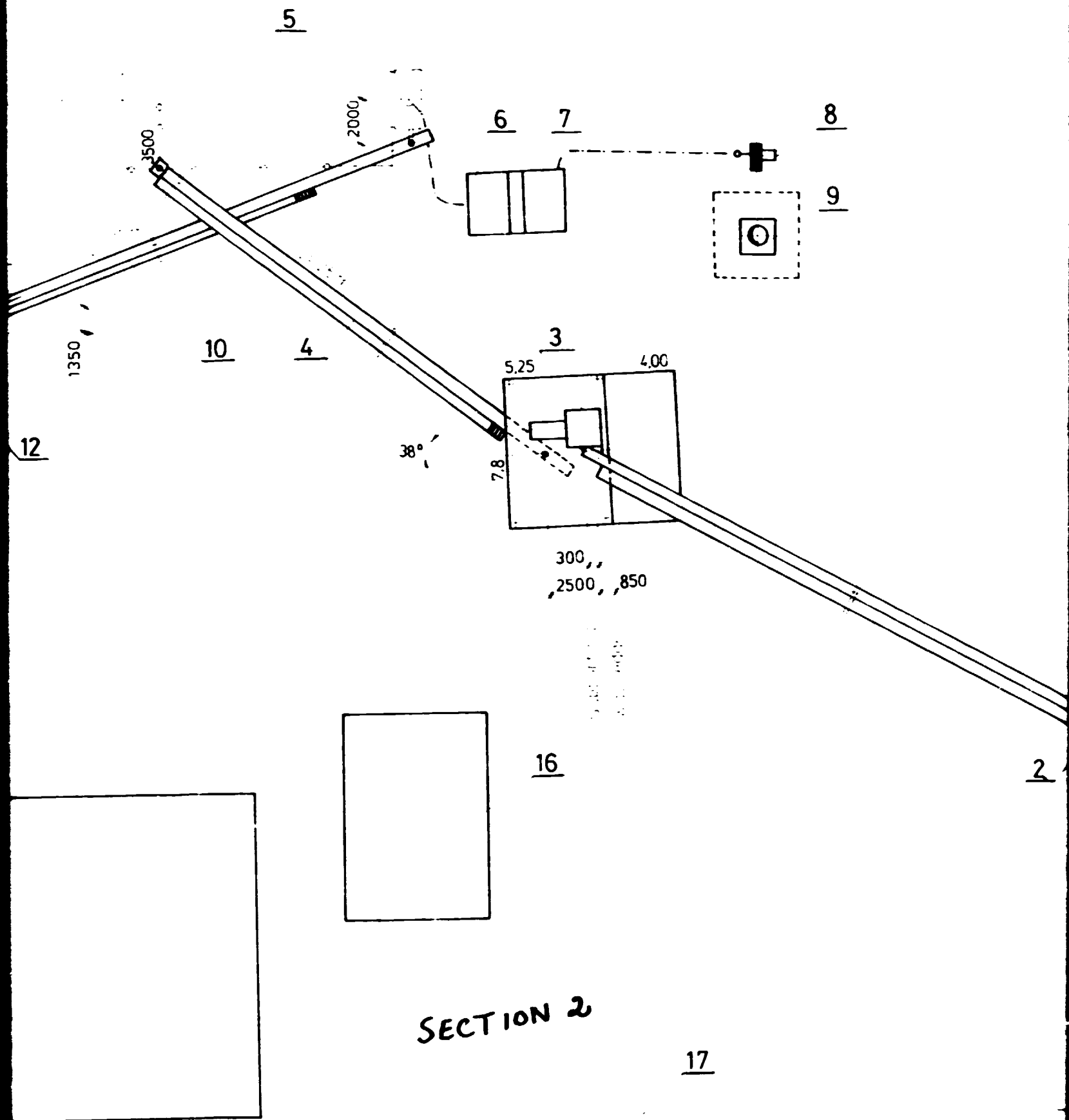
5
6
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3500
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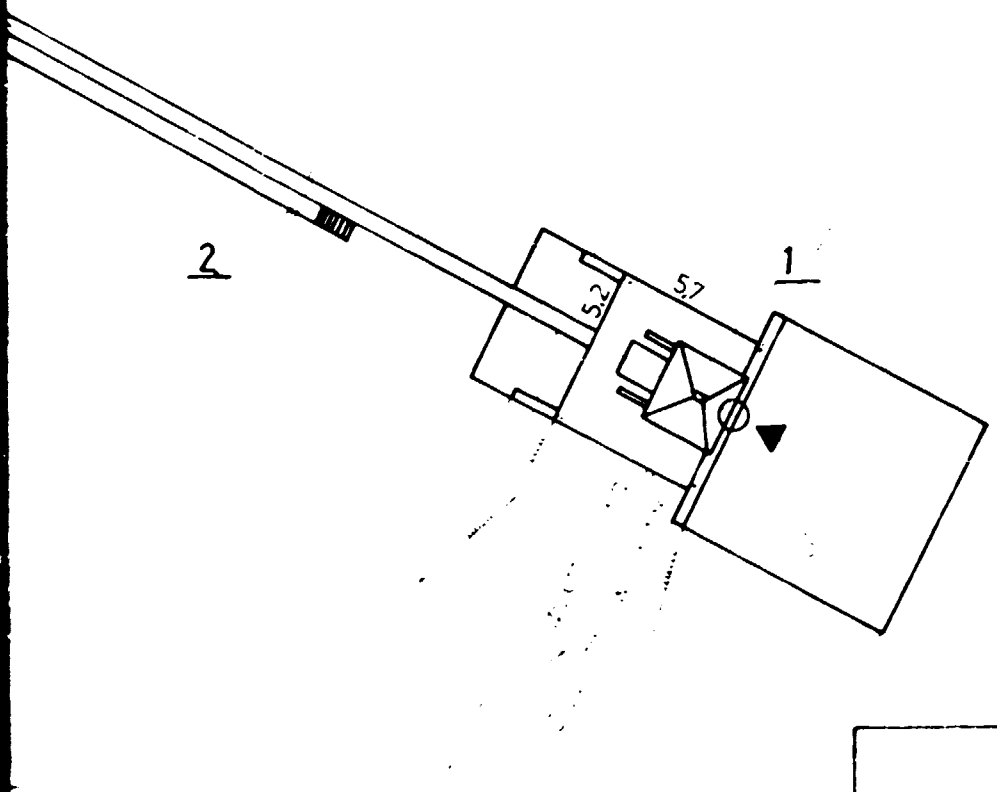
12
38°
7.8
300
2500
850
16
2
SECTION 2
17



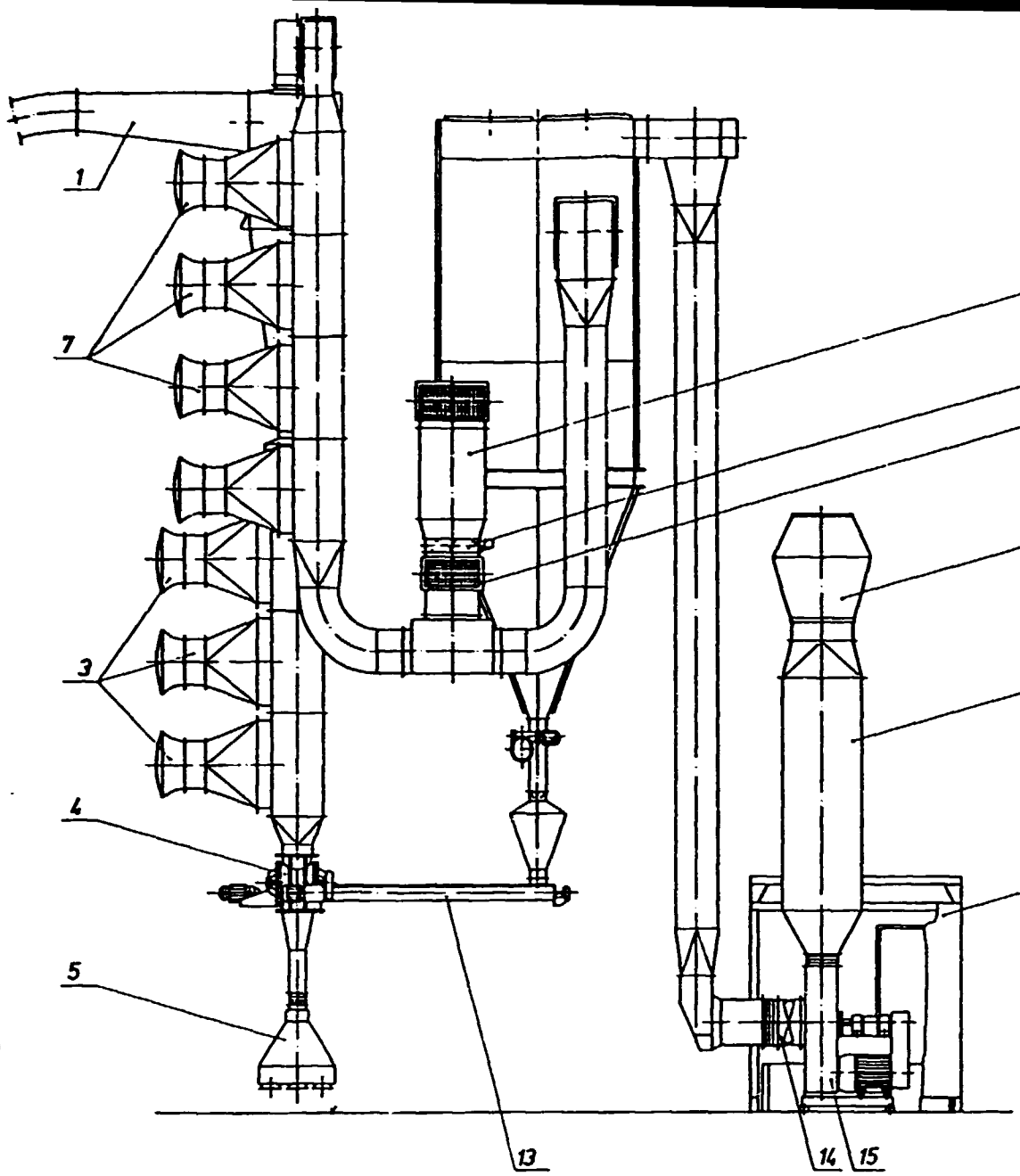
SECTION 3

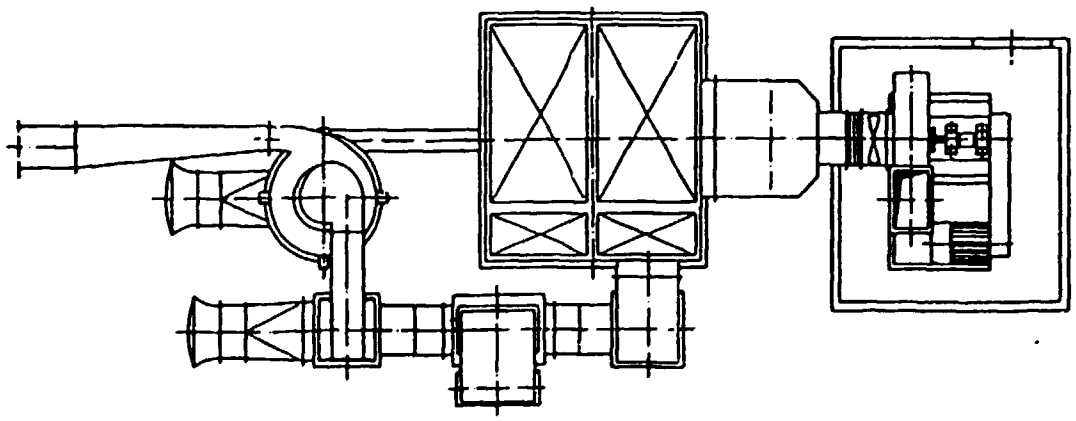
LAY – OUT

(with possible geographical location)

MONGOLIA

M 1:250



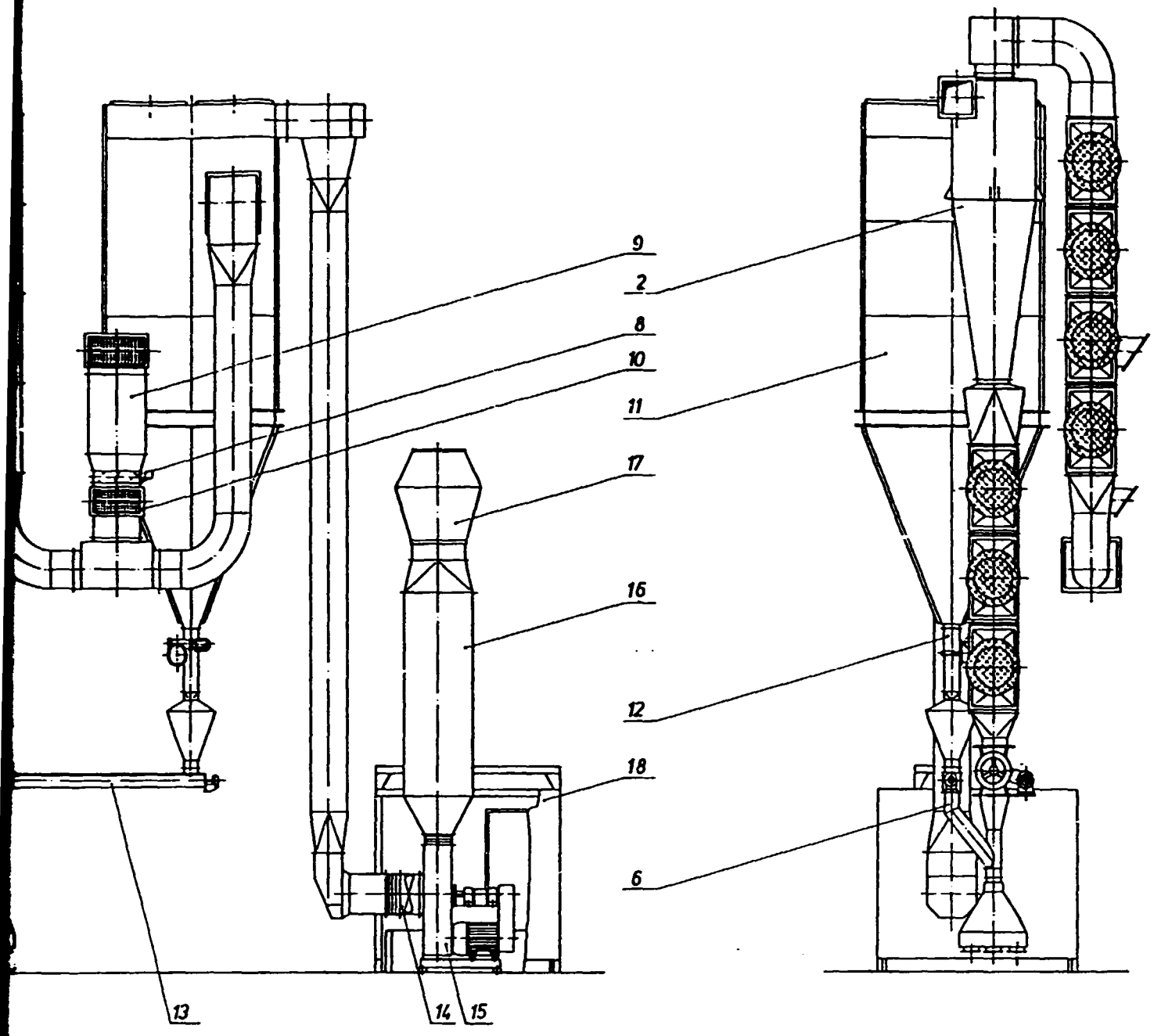


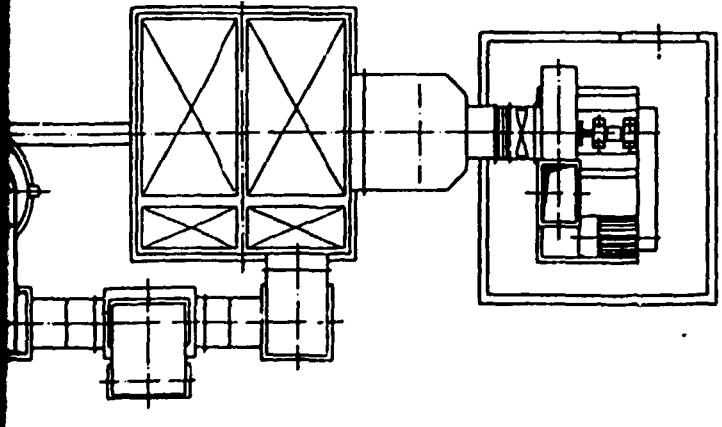
Pos	
18	Sound
17	Muffle
16	Silence
15	Suction
14	Centrif
13	Dust s
12	Double
11	Dust fi
10	Savety
9	Silence
8	Supple
7	Exaust
6	Ductin
5	Rotary
4	Rotary
3	Produk
2	Cyclon
1	Produ

PERLIT

P

SECTION 1





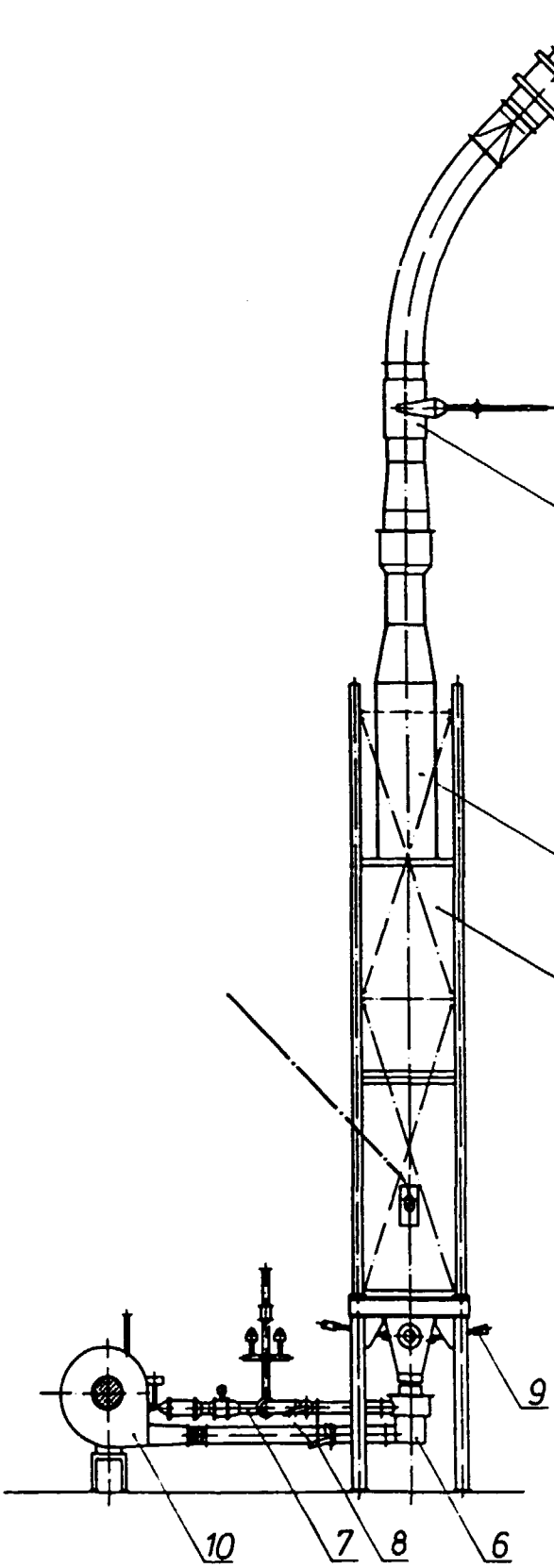
Pos	Designation
18	Sound absorbtion cover
17	Muffler
16	Silencer
15	Suction blower
14	Centrifugal regulator
13	Dust screw
12	Double door valve
11	Dust filter
10	Savety valve
9	Silencer
8	Supplement air valve
7	Exaust air cooler
6	Ducting
5	Rotary distributor
4	Rotary valve
3	Produkt cooler
2	Cyclon
1	Produkt line

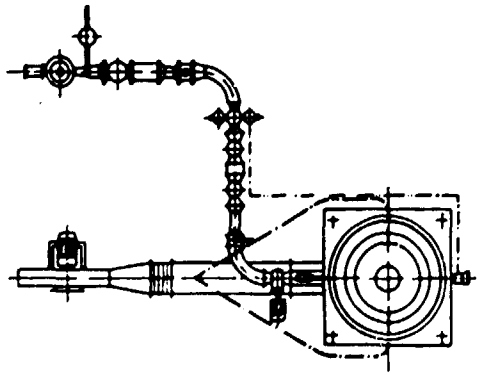
PERLITE EXPANDING UNIT

PEA 650

PERLITE GES.M.B.H. AUSTRIA

SECTION 2

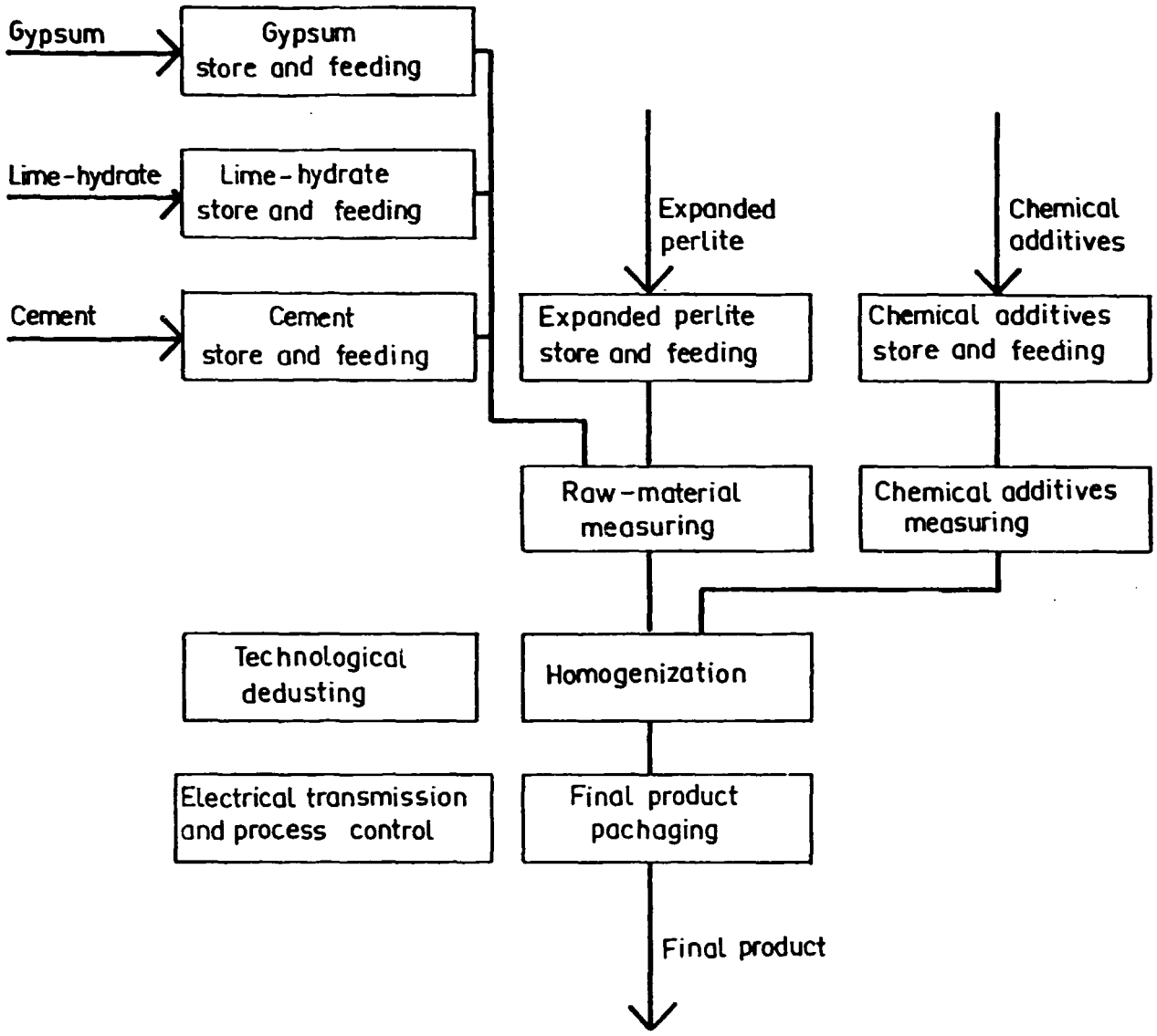




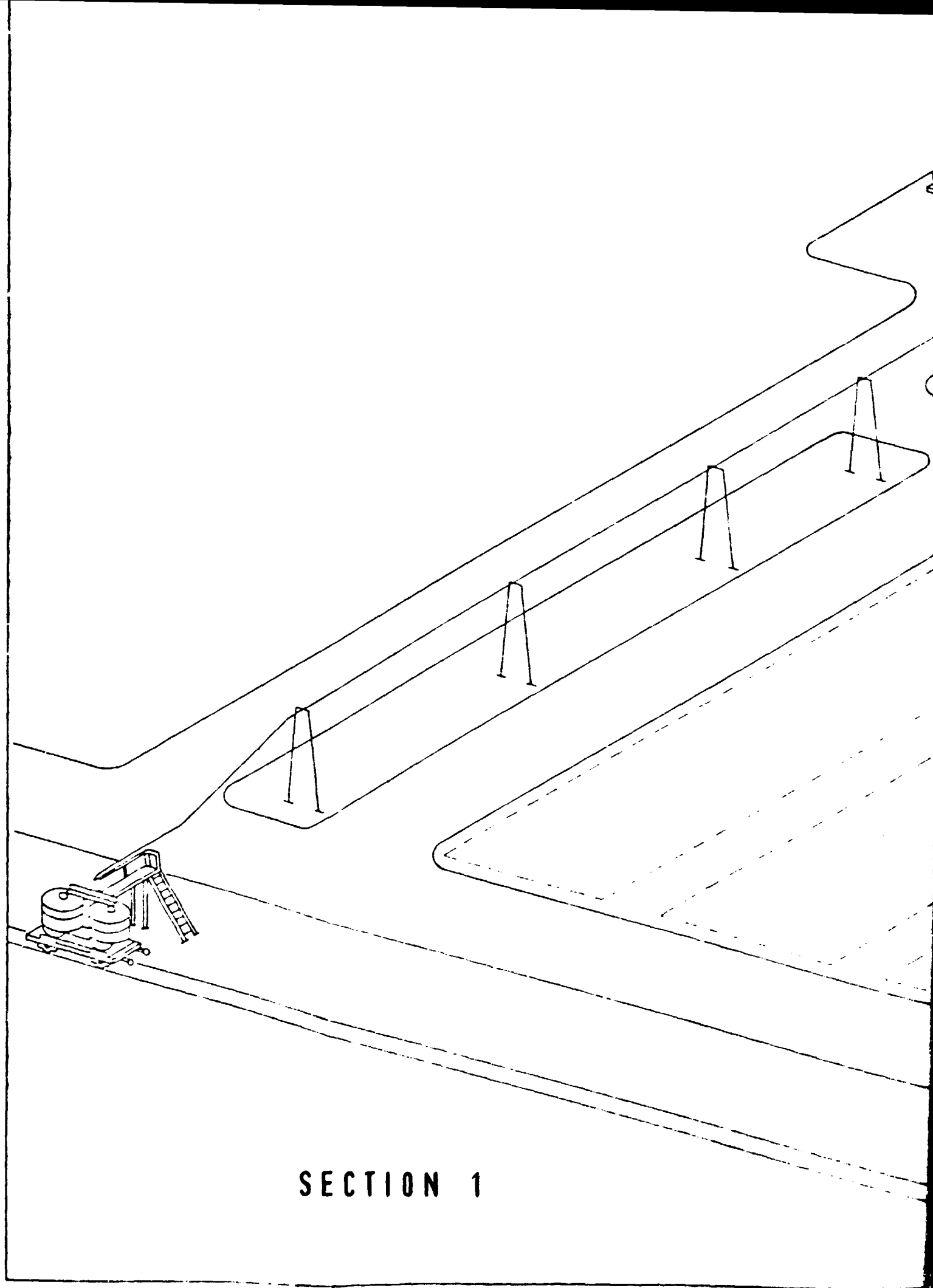
POS	DESIGNATION	PCE	
10	COMBUSTION AIR BLOWER	1	
9	IGNITION DEVICE	1	
8	COMBUSTION MIXING CONTROLL	1	
7	SAFETY CONTROLL INSTALLATION	1	
6	BURNER	1	
5	COOLING AIR TUBE	1	
4	EXPANDING FURNACE	1	
3	VERT. TUBING WITH AIR MIXING	1	
2	COMPENSATOR	1	
1	MATERIAL TUBING	1	

PERLITE EXPANDING UNIT
PEA 650

PERLITE GES.M.B.H. AUSTRIA



Tsz.	Db.	Megnevezés	Méret	Anyag	Szabvány	Db / Össz. Tömeg	Megjegyzés
Tervező		Tárgy: FLOW-CHART OF DRY-MORTAR MIXING TECHNOLOGY			[illegible] ÉRC- és ÁSVÁNYBÁNYÁK [illegible] MŰVEI Pilisvörösvár TERVEZÉSI és FEJLESZTÉSI O.		
Szerkesztő							
Rajzoló							
Osztályvez.					Rajzszám: 1020 - 00 - A		
Dátum	90.08.						



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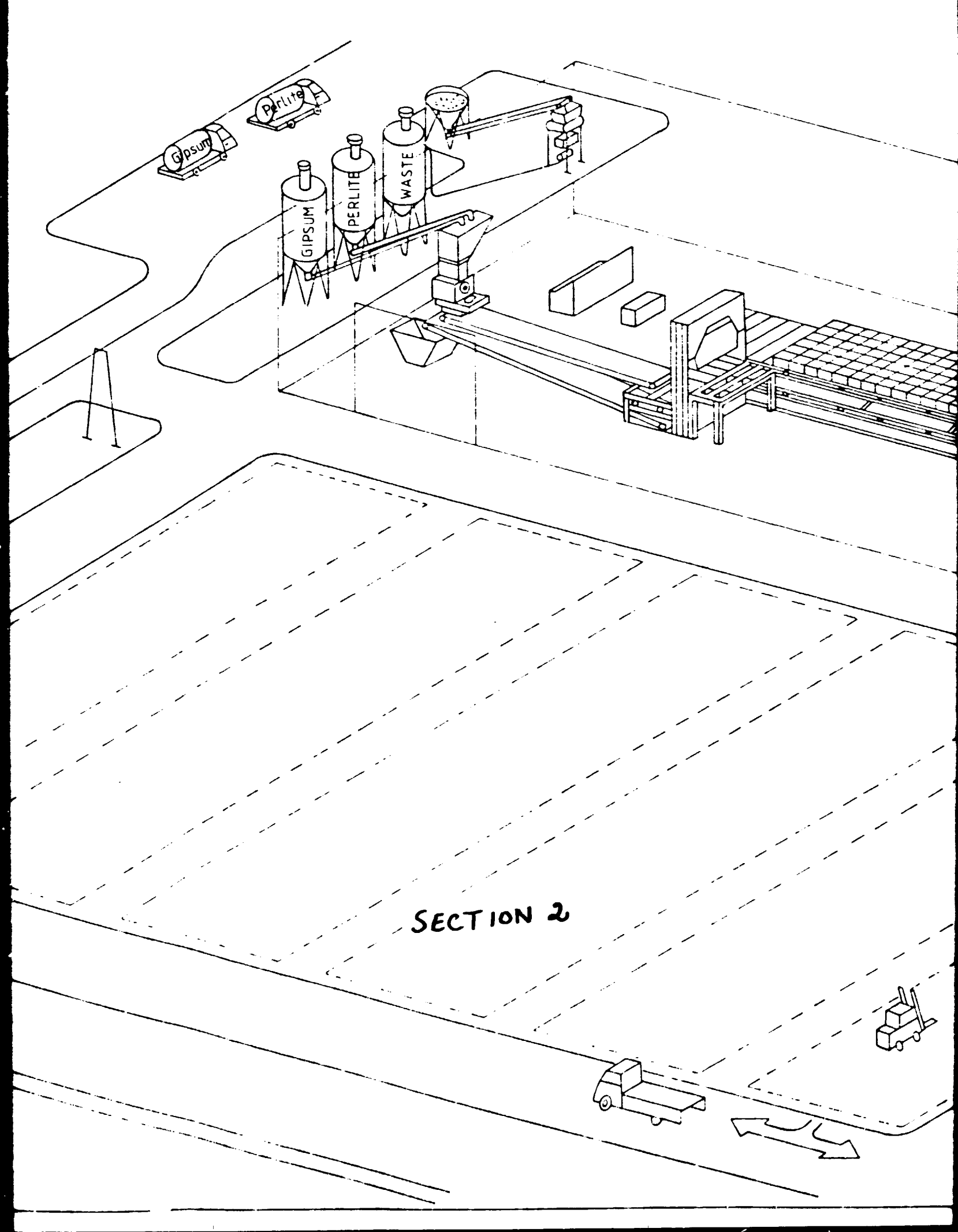
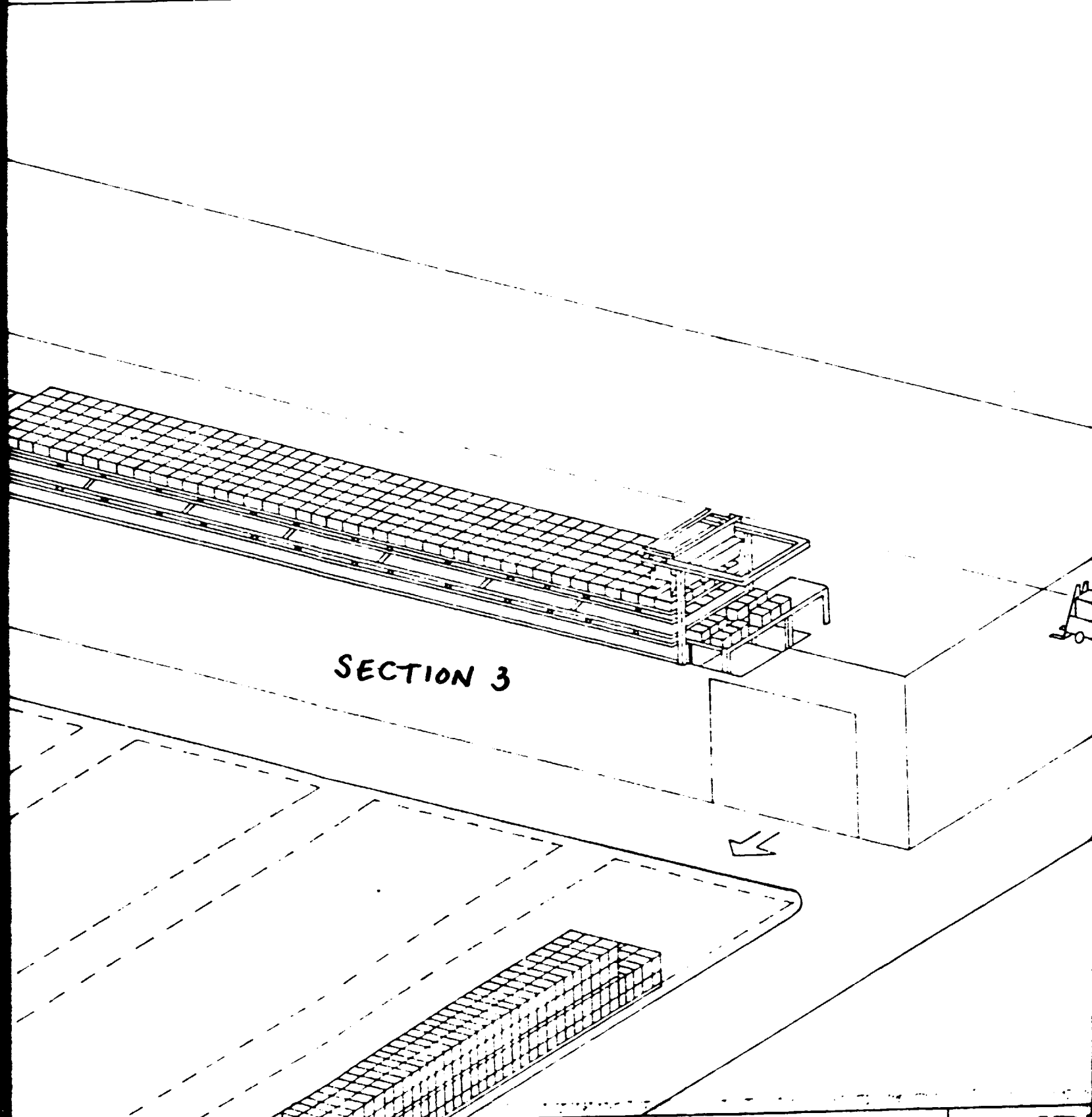

Gipsum
Perlite
GIPSUM
PERLITE
WASTE
SECTION 2



	Nev	Alairas
Vezo		
Szerk		
Iroda v		
Ugyv. ig		
Datum	1990. 06. 09.	

Targy

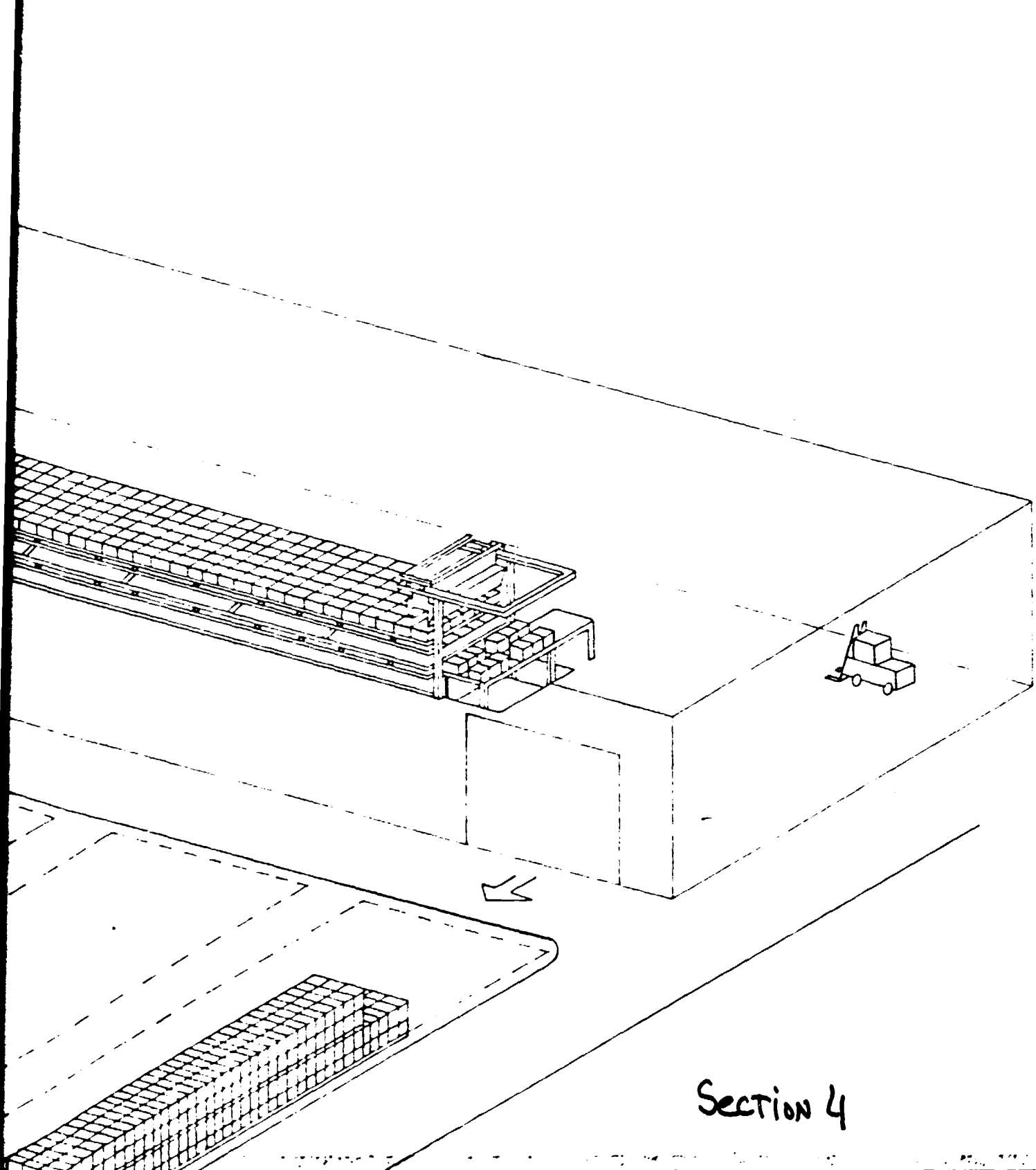
FLOW-CHART OF PARTITION WALL PRODUCTION TECHNOLOGY

Rajzfajta	Tomeg
Alak szabv.	Anyag

KUTATASI, FEJLES
SZEKESFE

Rajzszam

Lapok szama



Section 4

	Nev	Alairas
vezo		
Szerk		
Iroda v		
Ugyv ig		
Datum	1990. 08. 09.	

Targy

FLOW-CHART OF PARTITION WALL PRODUCTION TECHNOLOGY

Rajzfajta	Tomeg
Alak szabv.	Anyag

AR INNOV (EX)

KUTATASI, FEJLESZTESI ES KERESKEDELMI KFT

SZEKESFEHERVAR, ADY E U 9-15.

Rajzszam	Tetel szam
	Meretarany
Lapok szama	sz lap

PRELIMINARY SURVEYS

PREFEASIBILITY STUDIES

FEASIBILITY STUDIES

TENDER DOCUMENTATION

TENDER APPRAISAL

BID NEGOTIATIONS

PLANNING AND DESIGN

SURVEYING

LANDSCAPING

PLANNING

TECHNICAL DESIGNS

REALIZATION OF PROJECTS

INVESTIGATION OF BUILDING SITES

ARCHITECTURE

INFRASTRUCTURAL WORKS

ERECTION OF BUILDINGS

MECHANICAL AND ELECTRICAL INSTALLATIONS

SPECIAL ISOLATION

CORROSION CONTROL

SUPERVISION OF WORKS

COMMISSIONING

MANAGEMENT

ASSIGNEMENT OF QUALIFIED STAFF FOR PROJECT PERFORMANCE

CONSULTING SERVICES

SUPERVISING OF PRODUCTION PROCESSES

TESTING

RESEARCH AND DEVELOPMENT

MODERNIZATION & RECONSTRUCTION OF PLANTS

ANALYSIS OF PROCESSES

OPTIMALIZATION OF PRODUCTION ECONOMIES

COST CONTROL

SKILLED LABOUR IMPROVEMENT

ENGLISH
February, 1991.

Economic assesment by

C O M F A R - S O F T W A R E

(part of the Final Report)

UNIDO PROJECT No.: DP/MON/88/004
DUTY STATION: ULAN-BATOR, MONGOLIA

Prepared by TESCO - SZIKKTI
Budapest - Hungary

ECONOMIC EVALUATION

The COMFAR software was run with the available data provided by the Mongolian counter-part, However, as the attached data sheets show the programme run is not evaluable as the Mongolian economy - the taxation,investment, credit etc. system - is not a market-oriented one, thus COMFAR is based on market conditions. No firm terms and conditions prevale on amortization, value of land, taxation, inflation etc. Therefore the results of programme show unreal terms and conditions.

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUCHAREST -----

Production costs for productgrading giant, foreign

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	0.000	0.000	0.000	0.000	0.000	0.000
energy	0.000	0.000	0.000	0.000	0.000	0.000
labour	0.000	0.000	0.000	0.000	0.000	0.000
maintenance	0.000	0.000	0.000	0.000	0.000	0.000
spares	0.000	0.000	0.000	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
administration	0.000	0.000	0.000	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000	0.000	0.000	0.000
total before interests	102.600	102.600	89.400	76.200	76.200	15.360
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	102.600	102.600	89.400	76.200	76.200	15.360
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	0.000	0.000	0.000	0.000	0.000	0.000
depreciation borne by product	102.600	102.600	89.400	76.200	76.200	15.360

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	0.000	0.000	0.000	0.000	0.000	0.000
energy	0.000	0.000	0.000	0.000	0.000	0.000
labour	0.000	0.000	0.000	0.000	0.000	0.000
maintenance	0.000	0.000	0.000	0.000	0.000	0.000
spares	0.000	0.000	0.000	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
administration	0.000	0.000	0.000	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000	0.000	0.000	0.000
total before interests	15.360	7.680	0.000	0.000	0.000	0.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	15.360	7.680	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	0.000	0.000	0.000	0.000	0.000	0.000
depreciation borne by product	15.360	7.680	0.000	0.000	0.000	0.000

Production costs for product grading plant, foreign

	Year:13	Year:14	Year:15
raw material (first)	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000
utilities	0.000	0.000	0.000
energy	0.000	0.000	0.000
labour	0.000	0.000	0.000
maintenance	0.000	0.000	0.000
spares	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
administration	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000
total before interests	0.000	0.000	0.000
interests	0.000	0.000	0.000
total production cost	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
total labour (of tot. prod. cost)	0.000	0.000	0.000
depreciation borne by product	0.000	0.000	0.000

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Production costs for product grading plant, local

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.300	0.500	0.700	0.900	1.000	1.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	84.000	140.000	196.000	252.000	280.000	280.000
energy	75.000	125.000	175.000	225.000	250.000	250.000
labour	105.000	175.000	245.000	315.000	350.000	350.000
maintenance	350.000	350.000	350.000	350.000	350.000	350.000
spares	200.000	200.000	200.000	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000	250.000	250.000	250.000
subtotal factory costs	1064.300	1240.500	1416.700	1592.900	1681.000	1681.000
thereof variable	264.300	440.500	616.700	792.900	881.000	881.000
administration	330.000	330.000	330.000	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	1794.300	1970.500	2146.700	2322.900	2411.000	2411.000
total before interests	1969.900	2146.100	2322.300	2498.500	2586.600	2586.600
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	1969.900	2146.100	2322.300	2498.500	2586.600	2586.600
thereof variable	264.300	440.500	616.700	792.900	881.000	881.000
total labour (of tot. prod. cost)	355.000	425.000	495.000	565.000	600.000	600.000
depreciation borne by product	175.600	175.600	175.600	175.600	175.600	175.600

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	1.000	1.000	1.000	1.000	1.000	1.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	280.000	280.000	280.000	280.000	280.000	280.000
energy	250.000	250.000	250.000	250.000	250.000	250.000
labour	350.000	350.000	350.000	350.000	350.000	350.000
maintenance	350.000	350.000	350.000	350.000	350.000	350.000
spares	200.000	200.000	200.000	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000	250.000	250.000	250.000
subtotal factory costs	1681.000	1681.000	1681.000	1681.000	1681.000	1681.000
thereof variable	881.000	881.000	881.000	881.000	881.000	881.000
administration	330.000	330.000	330.000	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	2411.000	2411.000	2411.000	2411.000	2411.000	2411.000
total before interests	2586.600	2530.800	2475.000	2475.000	2475.000	2427.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	2586.600	2530.800	2475.000	2475.000	2475.000	2427.000
thereof variable	881.000	881.000	881.000	881.000	881.000	881.000
total labour (of tot. prod. cost)	600.000	600.000	600.000	600.000	600.000	600.000
depreciation borne by product	175.600	119.800	64.000	64.000	64.000	16.000

Production costs for product grading plant, local

	Year:13	Year:14	Year:15
raw material (first)	1.000	1.000	1.000
raw material (other)	0.000	0.000	0.000
utilities	280.000	280.000	280.000
energy	250.000	250.000	250.000
labour	350.000	350.000	350.000
maintenance	350.000	350.000	350.000
spares	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000
subtotal factory costs	1681.000	1681.000	1681.000
thereof variable	881.000	881.000	881.000
administration	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	2411.000	2411.000	2411.000
total before interests	2411.000	2411.000	2411.000
interests	0.000	0.000	0.000
total production cost	2411.000	2411.000	2411.000
thereof variable	881.000	881.000	881.000
total labour (of tot. prod. cost)	600.000	600.000	600.000
depreciation borne by product	0.000	0.000	0.000

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Production costs for product: expander, local

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	90.000	240.000	30.000	0.000	0.000	0.000
energy	105.000	280.000	35.000	0.000	0.000	0.000
labour	153.000	408.000	51.000	0.000	0.000	0.000
maintenance	380.000	380.000	380.000	380.000	380.000	380.000
spares	300.000	300.000	300.000	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000	340.000	340.000	340.000
subtotal factory costs	1368.000	1948.000	1136.000	1020.000	1020.000	1020.000
thereof variable	348.000	928.000	116.000	0.000	0.000	0.000
administration	430.000	430.000	430.000	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	2548.000	3129.000	2316.000	2200.000	2200.000	2200.000
total before interests	2548.000	3129.000	2316.000	2200.000	2200.000	2200.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	2548.000	3128.000	2316.000	2200.000	2200.000	2200.000
thereof variable	348.000	928.000	116.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	743.000	993.000	641.000	590.000	590.000	590.000
depreciation borne by product	0.000	0.000	0.000	0.000	0.000	0.000

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	0.000	0.000	0.000	0.000	0.000	0.000
energy	0.000	0.000	0.000	0.000	0.000	0.000
labour	0.000	0.000	0.000	0.000	0.000	0.000
maintenance	380.000	380.000	380.000	380.000	380.000	380.000
spares	300.000	300.000	300.000	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000	340.000	340.000	340.000
subtotal factory costs	1020.000	1020.000	1020.000	1020.000	1020.000	1020.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
administration	430.000	430.000	430.000	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	2200.000	2200.000	2200.000	2200.000	2200.000	2200.000
total before interests	2200.000	2200.000	2200.000	2200.000	2200.000	2200.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	2200.000	2200.000	2200.000	2200.000	2200.000	2200.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	590.000	590.000	590.000	590.000	590.000	590.000
depreciation borne by product	0.000	0.000	0.000	0.000	0.000	0.000

Production costs for product expander, local

	Year:13	Year:14	Year:15
raw material (first)	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000
utilities	0.000	0.000	0.000
energy	0.000	0.000	0.000
labour	0.000	0.000	0.000
maintenance	380.000	380.000	380.000
spares	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000
subtotal factory costs	1020.000	1020.000	1020.000
thereof variable	0.000	0.000	0.000
administration	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	2200.000	2200.000	2200.000
total before interests	2200.000	2200.000	2200.000
interests	0.000	0.000	0.000
total production cost	2200.000	2200.000	2200.000
thereof variable	0.000	0.000	0.000
total labour (of tot. prod. cost)	590.000	590.000	590.000
depreciation borne by product	0.000	0.000	0.000

Production costs for product grading plant, foreign

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	0.000	0.000	0.000	0.000	0.000	0.000
energy	0.000	0.000	0.000	0.000	0.000	0.000
labour	0.000	0.000	0.000	0.000	0.000	0.000
maintenance	0.000	0.000	0.000	0.000	0.000	0.000
spares	0.000	0.000	0.000	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
administration	0.000	0.000	0.000	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000	0.000	0.000	0.000
total before interests	102.600	102.600	89.400	76.200	76.200	15.360
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	102.600	102.600	89.400	76.200	76.200	15.360
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	0.000	0.000	0.000	0.000	0.000	0.000
depreciation borne by product	102.600	102.600	89.400	76.200	76.200	15.360

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	0.000	0.000	0.000	0.000	0.000	0.000
energy	0.000	0.000	0.000	0.000	0.000	0.000
labour	0.000	0.000	0.000	0.000	0.000	0.000
maintenance	0.000	0.000	0.000	0.000	0.000	0.000
spares	0.000	0.000	0.000	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
administration	0.000	0.000	0.000	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000	0.000	0.000	0.000
total before interests	15.360	7.680	0.000	0.000	0.000	0.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	15.360	7.680	0.000	0.000		
thereof variable	0.000	0.000	0.000	0.000	0.	
total labour (of tot. prod. cost)	0.000	0.000	0.000	0.000	0.	0.000
depreciation borne by product	15.360	7.680	0.000	0.000	0.000	0.000

COMFAR 21 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Production costs for product grading plant, foreign

	Year:13	Year:14	Year:15
raw material (first)	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000
utilities	0.000	0.000	0.000
energy	0.000	0.000	0.000
labour	0.000	0.000	0.000
maintenance	0.000	0.000	0.000
spares	0.000	0.000	0.000
factory overheads	0.000	0.000	0.000
subtotal factory costs	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
administration	0.000	0.000	0.000
marketing, distribution indirect	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	0.000	0.000	0.000
total before interests	0.000	0.000	0.000
interests	0.000	0.000	0.000
total production cost	0.000	0.000	0.000
thereof variable	0.000	0.000	0.000
total labour (of tot. prod. cost)	0.000	0.000	0.000
depreciation borne by product	0.000	0.000	0.000

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST -----

Production costs for product grading plant, local

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.300	0.500	0.700	0.900	1.000	1.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	84.000	140.000	196.000	252.000	280.000	280.000
energy	75.000	125.000	175.000	225.000	250.000	250.000
labour	105.000	175.000	245.000	315.000	350.000	350.000
maintenance	350.000	350.000	350.000	350.000	350.000	350.000
spares	200.000	200.000	200.000	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000	250.000	250.000	250.000
subtotal factory costs	1064.300	1240.500	1416.700	1592.900	1681.000	1681.000
thereof variable	264.300	440.500	616.700	792.900	881.000	881.000
administration	330.000	330.000	330.000	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	1794.300	1970.500	2146.700	2322.900	2411.000	2411.000
total before interests	1969.900	2146.100	2322.300	2498.500	2586.600	2586.600
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	1969.900	2146.100	2322.300	2498.500	2586.600	2586.600
thereof variable	264.300	440.500	616.700	792.900	881.000	881.000
total labour (of tot. prod. cost)	355.000	425.000	495.000	565.000	600.000	600.000
depreciation borne by product	175.600	175.600	175.600	175.600	175.600	175.600

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	1.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	280.000	0.000	0.000	0.000	0.000	0.000
energy	250.000	0.000	0.000	0.000	0.000	0.000
labour	350.000	0.000	0.000	0.000	0.000	0.000
maintenance	350.000	350.000	350.000	350.000	350.000	350.000
spares	200.000	200.000	200.000	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000	250.000	250.000	250.000
subtotal factory costs	1681.000	800.000	800.000	800.000	800.000	800.000
thereof variable	881.000	0.000	0.000	0.000	0.000	0.000
administration	330.000	330.000	330.000	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	2411.000	1530.000	1530.000	1530.000	1530.000	1530.000
total before interests	2586.600	1649.800	1594.000	1594.000	1594.000	1546.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	2586.600	1649.800	1594.000	1594.000	1594.00	1546.000
thereof variable	881.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	600.000	250.000	250.000	250.000	250.000	250.000
depreciation borne by product	175.600	119.800	64.000	64.000	64.000	16.000

COMFAR 21 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Production costs for product grading plant, local

	Year:13	Year:14	Year:15
raw material (first)	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000
utilities	0.000	0.000	0.000
energy	0.000	0.000	0.000
labour	0.000	0.000	0.000
maintenance	350.000	350.000	350.000
spares	200.000	200.000	200.000
factory overheads	250.000	250.000	250.000
subtotal factory costs	800.000	800.000	800.000
thereof variable	0.000	0.000	0.000
administration	330.000	330.000	330.000
marketing, distribution indirect	400.000	400.000	400.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	1530.000	1530.000	1530.000
total before interests	1530.000	1530.000	1530.000
interests	0.000	0.000	0.000
total production cost	1530.000	1530.000	1530.000
thereof variable	0.000	0.000	0.000
total labour (of tot. prod. cost)	250.000	250.000	250.000
depreciation borne by product	0.000	0.000	0.000

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Production costs for product expander, local

	Year: 1	Year: 2	Year: 3	Year: 4	Year: 5	Year: 6
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	150.000	240.000	300.000	300.000	300.000	300.000
energy	175.000	280.000	350.000	350.000	350.000	350.000
labour	255.000	408.000	510.000	510.000	510.000	510.000
maintenance	380.000	380.000	380.000	380.000	380.000	380.000
spares	300.000	300.000	300.000	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000	340.000	340.000	340.000
subtotal factory costs	1600.000	1948.000	2180.000	2190.000	2180.000	2180.000
thereof variable	580.000	928.000	1160.000	1160.000	1160.000	1160.000
administration	430.000	430.000	430.000	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	2780.000	3128.000	3360.000	3360.000	3360.000	3360.000
total before interests	2780.000	3128.000	3360.000	3360.000	3360.000	3360.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	2780.000	3128.000	3360.000	3360.000	3360.000	3360.000
thereof variable	580.000	928.000	1160.000	1160.000	1160.000	1160.000
total labour (of tot. prod. cost)	845.000	958.000	1100.000	1100.000	1100.000	1100.000
depreciation borne by product	0.000	0.000	0.000	0.000	0.000	0.000

	Year: 7	Year: 8	Year: 9	Year:10	Year:11	Year:12
raw material (first)	0.000	0.000	0.000	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000	0.000	0.000	0.000
utilities	300.000	0.000	0.000	0.000	0.000	0.000
energy	350.000	0.000	0.000	0.000	0.000	0.000
labour	510.000	0.000	0.000	0.000	0.000	0.000
maintenance	380.000	380.000	380.000	380.000	380.000	380.000
spares	300.000	300.000	300.000	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000	340.000	340.000	340.000
subtotal factory costs	2180.000	1020.000	1020.000	1020.000	1020.000	1020.000
thereof variable	1160.000	0.000	0.000	0.000	0.000	0.000
administration	430.000	430.000	430.000	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000	0.000	0.000	0.000
total before depr. and interests	3360.000	2200.000	2200.000	2200.000	2200.000	2200.000
total before interests	3360.000	2200.000	2200.000	2200.000	2200.000	2200.000
interests	0.000	0.000	0.000	0.000	0.000	0.000
total production cost	3360.000	2200.000	2200.000	2200.000	2200.000	2200.000
thereof variable	1160.000	0.000	0.000	0.000	0.000	0.000
total labour (of tot. prod. cost)	1100.000	590.000	590.000	590.000	590.000	590.000
depreciation borne by product	0.000	0.000	0.000	0.000	0.000	0.000

Production costs for product expander, local

	Year:13	Year:14	Year:15
raw material (first)	0.000	0.000	0.000
raw material (other)	0.000	0.000	0.000
utilities	0.000	0.000	0.000
energy	0.000	0.000	0.000
labour	0.000	0.000	0.000
maintenance	380.000	380.000	380.000
spares	300.000	300.000	300.000
factory overheads	340.000	340.000	340.000
subtotal factory costs	1020.000	1020.000	1020.000
thereof variable	0.000	0.000	0.000
administration	430.000	430.000	430.000
marketing, distribution indirect	750.000	750.000	750.000
thereof variable	0.000	0.000	0.000
total before depr. and interests	2200.000	2200.000	2200.000
total before interests	2200.000	2200.000	2200.000
interests	0.000	0.000	0.000
total production cost	2200.000	2200.000	2200.000
thereof variable	0.000	0.000	0.000
total labour (of tot. prod. cost)	590.000	590.000	590.000
depreciation borne by product	0.000	0.000	0.000

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Total Initial Investment in thousand US dollars

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	47.000	0.000
Buildings and civil works	500.000	508.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	430.000	12.000
Plant machinery and equipment	550.000	338.000
Total fixed investment costs	1827.000	858.000
Pre-production capital expenditures	240.000	176.000
Net working capital	0.000	0.000
Total initial investment costs	2067.000	1034.000
Of it foreign, in %	16.447	19.729

Mongolian perlite --- 25 June 1990

COMFAR 2.1 UNIDO

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST -----

Total Current Investment in thousand US dollars

Year	1992	1993	1994	1995	1996
Fixed investment costs					
Land, site preparation, development	0.000	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000	0.000
Preproduction capitals expenditures	0.000	0.000	0.000	0.000	0.000
Working capital	617.181	50.397	39.339	17.222	8.611
Total current investment costs	617.181	50.397	39.339	17.222	8.611
Of it foreign, %	0.000	0.000	0.000	0.000	0.000

Mongolian perlite --- 25 June 1990

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST -----

Total Current Investment in thousand US dollars

Year	1997-98	1999
Fixed investment costs		
Land, site preparation, development	0.000	0.000
Buildings and civil works	0.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant, machinery and equipment	0.000	0.000
Total fixed investment costs	0.000	0.000
Preproduction capitals expenditures	0.000	0.000
Working capital	0.000	-196.694
Total current investment costs	0.000	-196.694
Of it foreign, %	0.000	0.000

Mongolian perlite --- 25 June 1990

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Total Production Costs in thousand US dollars

Year	1992	1993	1994	1995	1996
% of nom. capacity (single producti.	0.000	0.000	0.000	0.000	0.000
Raw material I	0.500	0.500	0.700	0.900	1.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	234.000	380.000	496.000	552.000	580.000
Energy	250.000	405.000	525.000	575.000	600.000
Labour, direct	360.000	583.000	755.000	825.000	860.000
Repair, maintenance	730.000	730.000	730.000	730.000	730.000
Spares	500.000	500.000	500.000	500.000	500.000
Factory overheads	590.000	590.000	590.000	590.000	590.000
Factory costs	2664.300	3188.500	3596.700	3772.900	3861.000
Administrative overheads	760.000	760.000	760.000	760.000	760.000
Indir. costs, sales and distribution	1150.000	1150.000	1150.000	1150.000	1150.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	279.200	278.200	265.000	251.900	251.800
Financial costs	0.000	0.000	0.000	0.000	0.000
Total production costs	4652.500	5376.700	5771.700	5934.700	6022.800
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, I	2.114	1.908	1.549	1.284	1.265
Of it variable,I	17.399	25.452	30.783	32.906	33.888
Total labour	1200.000	1423.000	1595.000	1665.000	1700.000

Total Production Costs in thousand US dollars

Year	1997-98	1999	2000- 2	2003	2004- 6
% of max. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material I	1.000	0.000	0.000	0.000	0.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	580.000	0.000	0.000	0.000	0.000
Energy	600.000	0.000	0.000	0.000	0.000
Labour, direct	850.000	0.000	0.000	0.000	0.000
Repair, maintenance	730.000	730.000	730.000	730.000	730.000
Spares	500.000	500.000	500.000	500.000	500.000
Factory overheads	590.000	590.000	590.000	590.000	590.000
Factory costs	3851.000	1820.000	1820.000	1820.000	1820.000
Administrative overheads	760.000	760.000	760.000	760.000	760.000
Indir. costs, sales and distribution	1150.000	1150.000	1150.000	1150.000	1150.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	190.960	127.480	64.000	16.000	0.000
Financial costs	0.000	0.000	0.000	0.000	0.000
Total production costs	5961.960	3857.480	3794.000	3746.000	3730.000
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	0.258	0.199	0.000	0.000	0.000
Of it variable,%	34.234	0.000	0.000	0.000	0.000
Total labour	1700.000	840.000	840.000	840.000	840.000

COMFAR 2.1 UNIDO

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST -----

Net Working Capital in thousand US dollars

Year	adc	coto	1992	1993	1994	1995	1996
Coverage							
Current assets &							
Accounts receivable	20	18.0	254.128	283.250	305.928	315.717	320.611
Inventory and materials	15	24.0	9.767	15.861	20.706	23.050	24.222
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	250.000	250.000	250.000	250.000	250.000
Work in progress	30	12.0	222.025	265.708	299.725	314.408	321.750
Finished products	10	36.0	95.119	109.681	121.019	125.914	128.361
Cash in hand	1	360.0	8.167	8.786	9.264	9.458	9.556
Total current assets			839.206	933.286	1006.642	1038.547	1054.500
Current liabilities and							
Accounts payable	30	12.0	222.025	265.708	299.725	314.408	321.750
Net working capital			617.181	667.578	706.917	724.139	732.750
Increase in working capital			617.181	50.397	39.339	17.222	8.611
Net working capital, local			617.181	667.578	706.917	724.139	732.750
Net working capital, foreign			0.000	0.000	0.000	0.000	0.000

Note: adc = minimum days of coverage ; coto = coefficient of turnover .

Mongolian perlite --- 25 June 1990

---------- COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST -----

Net Working Capital in thousand US dollars

Year	adc	coto	1997-98	1999	2000- 6
Coverage					
Current assets &					
Accounts receivable	20	18.0	320.611	207.222	207.222
Inventory and materials	15	24.0	24.222	0.000	0.000
Energy	0	---	0.000	0.000	0.000
Spares	180	2.0	250.000	250.000	250.000
Work in progress	30	12.0	321.750	151.667	151.667
Finished products	10	36.0	128.361	71.667	71.667
Cash in hand	1	360.0	9.556	7.167	7.167
Total current assets			1054.500	687.722	687.722
Current liabilities and					
Accounts payable	30	12.0	321.750	151.667	151.667
Net working capital			732.750	536.056	536.056
Increase in working capital			0.000	-196.694	0.000
Net working capital, local			732.750	536.056	536.056
Net working capital, foreign			0.000	0.000	0.000

Note: adc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in thousand US dollars

Year	1990	1991
Equity, ordinary ..	2067.000	1034.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	0.000	0.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	0.000	0.000
Current liabilities	0.000	0.000
Bank overdraft	0.000	0.000
Total funds	2067.000	1034.000

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Source of Finance, production in thousand US dollars

Year	1992	1993	1994	1995	1996	1997-92
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0 000	0.000	0.000
Loan A, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	0.000	0.000	0.000	0.000	0.000	0.000
Current liabilities	222.025	43.683	34.017	14.683	7.342	0.000
Bank overdraft	0.000	0.000	0.000	0.000	0.000	0.000
Total funds	222.025	43.683	34.017	14.683	7.342	0.000

Mongolian perlite --- 25 June 1990

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Source of Finance, production in thousand US dollars

Year	1999
Equity, ordinary ..	0.000
Equity, preference.	0.000
Subsidies, grants .	0.000
Loan A, foreign .	0.000
Loan B, foreign..	0.000
Loan C, foreign .	0.000
Loan A, local....	0.000
Loan B, local....	0.000
Loan C, local....	0.000
Total loan	0.000
Current liabilities	-170.083
Bank overdraft	0.000
Total funds	-170.083

Mongolian perlite --- 25 June 1990

Cashflow Tables, construction in thousand US dollars

Year	1990	1991
Total cash inflow	2067.000	1034.000
Financial resources	2067.000	1034.000
Sales, net of tax	0.000	0.000
Total cash outflow	2067.000	1034.000
Total assets	2067.000	1034.000
Operating costs	0.000	0.000
Cost of finance	0.000	0.000
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	0.000	0.000
Cumulated cash balance	0.000	0.000
Inflow, local	1727.000	830.000
Outflow, local	1727.000	830.000
Surplus (deficit)	0.000	0.000
Inflow, foreign	340.000	204.000
Outflow, foreign	340.000	204.000
Surplus (deficit)	0.000	0.000
Net cashflow	-2067.000	-1034.000
Cumulated net cashflow	-2067.000	-3101.000

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Cashflow tables, production in thousand US dollars

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	580222.000	930043.700	1170034.000	1190015.000	1200007.000	1200000.000
Financial resources	222.025	43.682	34.917	14.695	7.342	0.000
Sales, net of tax	580000.000	930000.000	1170000.000	1190000.000	1200000.000	1200000.000
Total cash outflow	5413.518	5192.581	5580.105	5714.781	5786.953	5771.000
Total assets	839.206	94.681	73.356	31.906	15.953	0.000
Operating costs	4574.313	5098.500	5506.750	5682.875	5771.000	5771.000
Cost of finance	0.000	0.000	0.000	0.000	0.000	0.000
Repayment	0.000	0.000	0.000	0.000	0.000	0.000
Corporate tax	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	574808.500	924851.100	1164454.000	1184300.000	1194220.000	1194229.000
Cumulated cash balance	574808.500	1499660.000	2664114.000	3848414.000	5042634.000	6236863.000
Inflow, local	580222.000	930043.700	1170034.000	1190015.000	1200007.000	1200000.000
Outflow, local	5413.518	5192.581	5580.105	5714.781	5786.953	5771.000
Surplus (deficit)	574808.500	924851.100	1164454.000	1184300.000	1194220.000	1194229.000
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	0.000	0.000	0.000	0.000	0.000	0.000
Net cashflow	574808.500	924851.100	1164454.000	1184300.000	1194220.000	1194229.000
Cumulated net cashflow	574807.500	1498659.000	2663113.000	3845313.000	5039533.000	6233762.000

Mangalias perlite --- 25 June 1990

Cashflow: tables, production in thousand US dollars

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	1200000.000	0.000	0.000	0.000	0.000	0.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	1200000.000	0.000	0.000	0.000	0.000	0.000
Total cash outflow	5771.000	3533.306	3730.000	3730.000	3730.000	3730.000
Total assets	0.000	-366.773	0.000	0.000	0.000	0.000
Operating costs	5771.000	3730.000	3730.000	3730.000	3730.000	3730.000
Cost of finance	0.000	0.000	0.000	0.000	0.000	0.000
Repayment	0.000	170.083	0.000	0.000	0.000	0.000
Corporate tax	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1194229.000	-3533.305	-3730.000	-3730.000	-3730.000	-3730.000
Cumulated cash balance	7431092.000	7427559.000	7423829.000	7420099.000	7416369.000	7412639.000
Inflow, local	1200000.000	0.000	0.000	0.000	0.000	0.000
Outflow, local	5771.000	3533.306	3730.000	3730.000	3730.000	3730.000
Surplus (deficit)	1194229.000	-3533.306	-3730.000	-3730.000	-3730.000	-3730.000
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	0.000	0.000	0.000	0.000	0.000	0.000
Net cashflow	1194229.000	-3533.305	-3730.000	-3730.000	-3730.000	-3730.000
Cumulated net cashflow	7427991.000	7424458.000	7420728.000	7416998.000	7413268.000	7409538.000

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Cashflow tables, production in thousand US dollars

Year	2004	2005	2006
Total cash inflow	0.000	0.000	0.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	0.000	0.000	0.000
Total cash outflow	3730.000	3730.000	3730.000
Total assets	0.000	0.000	0.000
Operating costs	3730.000	3730.000	3730.000
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	0.000	0.000	0.000
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	-3730.000	-3730.000	-3730.000
Cumulated cash balance	7409969.000	7405179.000	7401449.000
Inflow, local	0.000	0.000	0.000
Outflow, local	3730.000	3730.000	3730.000
Surplus (deficit)	-3730.000	-3730.000	-3730.000
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	0.000	0.000	0.000
Surplus (deficit)	0.000	0.000	0.000
Net cashflow	-3730.000	-3730.000	-3730.000
Cumulated net cashflow	7405808.000	7402078.000	7398348.000

Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value .....4332637.00 at 11.00 %
Internal Rate of Return (IRRE1) .. 1625.02 %
b) Net Worth versus Net cash return:
Net present value .....4333574.00 at 11.00 %
Internal Rate of Return (IRRE2) .. 1624.59 %
c) Internal Rate of Return on total investment:
Net present value .....4333574.00 at 11.00 %
Internal Rate of Return (IRR) .. 1624.59 %
Net Worth = Equity paid plus reserves

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Net Income Statement in thousand US dollars

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	580000.000	930000.000	1170000.000	1190000.000	1200000.000
Less: variable costs, incl. sales tax.	844.000	1368.500	1776.700	1952.900	2041.000
Variable margin	579155.700	928631.500	1168223.000	1188047.000	1197959.000
As % of total sales	99.854	99.853	99.848	99.836	99.830
Non-variable costs, incl. depreciation	4008.200	4009.200	3995.000	3981.800	3981.900
Operational margin	575147.500	924623.300	1164228.000	1184065.000	1193977.000
As % of total sales	99.163	99.422	99.507	99.501	99.498
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	575147.500	924623.300	1164228.000	1184065.000	1193977.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	575147.500	924623.300	1164228.000	1184065.000	1193977.000
Tax	0.000	0.000	0.000	0.000	0.000
Net profit	575147.500	924623.300	1164229.000	1184065.000	1193977.000
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	575147.500	924623.300	1164228.000	1184065.000	1193977.000
Accumulated undistributed profit	575147.500	1499771.000	2663999.000	3848064.000	5042042.000
Gross profit, % of total sales	99.163	99.422	99.507	99.501	99.498
Net profit, % of total sales	99.163	99.422	99.507	99.501	99.498
ROE, Net profit, % of equity	18547.1o9	29816.940	37543.640	38187.340	38502.930
ROI, Net profit+interest, % of invest.	15468.520	24535.070	30573.890	30954.670	31143.850

Net Income Statement in thousand US dollars

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1200000.000	1200000.000	0.000	0.000	0.000
Less: variable costs, incl. sales tax.	2041.000	2041.000	0.000	0.000	0.000
Variable margin	1197959.000	1197959.000	0.000	0.000	0.000
As % of total sales	99.830	99.830	0.000	0.000	0.000
Non-variable costs, incl. depreciation	3920.960	3920.960	3857.480	3794.000	3794.000
Operational margin	1194038.000	1194038.000	-3857.480	-3794.000	-3794.000
As % of total sales	99.503	99.503	0.000	0.000	0.000
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1194038.000	1194038.000	-3857.480	-3794.000	-3794.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1194038.000	1194038.000	-3857.480	-3794.000	-3794.000
Tax	0.000	0.000	0.000	0.000	0.000
Net profit	1194038.000	1194039.000	-3857.480	-3794.000	-3794.000
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1194038.000	1194039.000	-3857.480	-3794.000	-3794.000
Accumulated undistributed profit	6236080.000	7430118.000	7426260.000	7422466.000	7418672.000
Gross profit, % of total sales	99.503	99.503	0.000	0.000	0.000
Net profit, % of total sales	99.503	99.503	0.000	0.000	0.000
ROE, Net profit, % of equity	38504.930	38504.930	-124.395	-122.348	-122.348
ROI, Net profit+interest, % of invest.	31145.430	31145.430	-106.061	-104.315	-104.315

COMFAR 2.1 UNIDO

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Net Income Statement in thousand US dollars

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	0.000	0.000	0.000	0.000	0.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	0.000	0.000	0.000	0.000	0.000
As % of total sales	0.000	0.000	0.000	0.000	0.000
Non-variable costs, incl. depreciation	3794.000	3746.000	3730.000	3730.000	3730.000
Operational margin	-3794.000	-3746.000	-3730.000	-3730.000	-3730.000
As % of total sales	0.000	0.000	0.000	0.000	0.000
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	-3794.000	-3746.000	-3730.000	-3730.000	-3730.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-3794.000	-3746.000	-3730.000	-3730.000	-3730.000
Tax	0.000	0.000	0.000	0.000	0.000
Net profit	-3794.000	-3746.000	-3730.000	-3730.000	-3730.000
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-3794.000	-3746.000	-3730.000	-3730.000	-3730.000
Accumulated undistributed profit	7414879.000	7411132.000	7407402.000	7403672.000	7399942.000
Gross profit, % of total sales	0.000	0.000	0.000	0.000	0.000
Net profit, % of equity	0.000	0.000	0.000	0.000	0.000
ROE, Net profit, % of equity	-122.349	-120.809	-120.284	-120.284	-120.284
ROI, Net profit+interest, % of invest.	-104.315	-102.995	-102.555	-102.555	-102.555

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Projected Balance Sheets, construction in thousand US dollars

Year	1990	1991
Total assets	2067.000	3101.000
Fixed assets, net of depreciation	0.000	2067.000
Construction in progress	2067.000	1034.000
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2067.000	3101.000
Equity capital	2067.000	3101.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	0.000	0.000
Current liabilities	0.000	0.000
Bank overdraft, finance required	0.000	0.000
Total debt	0.000	0.000
Equity, % of liabilities	100.000	100.000

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Projected Balance Sheets, Production in thousand US dollars

Year	1992	1993	1994	1995	1996
Total assets	575470.500	1503138.000	2667400.000	3851480.000	5045484.000
Fixed assets, net of depreciation	2822.000	2544.600	2279.600	2027.800	1775.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	831.037	924.500	997.375	1059.089	1044.944
Cash, bank	8.167	8.786	9.264	9.458	9.556
Cash surplus, finance available	574638.500	1499660.000	2664114.000	3848414.000	5042634.000
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	575470.500	1503138.000	2667400.000	3851480.000	5045484.000
Equity capital	3101.000	3101.000	3101.000	3101.000	3101.000
Reserves, retained profit	0.000	575147.500	1499771.000	2663999.000	3848064.000
Profit	575147.500	924623.300	1164228.000	1184065.000	1193977.000
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	222.025	265.708	299.725	314.408	321.750
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	222.025	265.708	299.725	314.408	321.750
Equity, % of liabilities	0.539	0.206	0.116	0.081	0.061

Mongolian perlite --- 25 June 1990

COMFAR 2.1 - TESCO CONSULTING ENGINEERING CO., BUDAPEST

Projected Balance Sheets, Production in thousand US dollars

Year	1997	1998	1999	2000	2001
Total assets	6239502.000	7433540.000	7433370.000	7429513.000	7425719.000
Fixed assets, net of depreciation	1595.040	1394.080	1266.680	1202.480	1138.280
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1044.944	1044.944	680.556	680.556	680.556
Cash, bank	9.556	9.556	7.167	7.167	7.167
Cash surplus, finance available	6236857.000	7431070.000	7427553.000	7425778.000	7423982.000
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	3857.430	3794.000	3794.000
Total liabilities	6239502.000	7433540.000	7433370.000	7429513.000	7425719.000
Equity capital	3101.000	3101.000	3101.000	3101.000	3101.000
Reserves, retained profit	5042042.000	6238080.000	7430118.000	7426260.000	7422464.000
Profit	1194038.000	1194038.000	0.000	0.000	0.000
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	321.750	321.750	151.667	151.667	151.667
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	321.750	321.750	151.667	151.667	151.667
Equity, % of liabilities	0.050	0.042	0.042	0.042	0.042

Projected Balance Sheets, Production in thousand US dollars

Year	2002	2003	2004	2005	2006
Total assets	7421925.000	7418131.000	7414335.000	7410655.000	7406925.000
Fixed assets, net of depreciation	1074.600	1058.600	1058.600	1058.600	1058.600
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	680.556	680.556	680.556	680.556	680.556
Cash, bank	7.167	7.167	7.167	7.167	7.167
Cash surplus, finance available	7418768.000	7416078.000	7412908.000	7409173.000	7404443.000
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	3794.000	3746.000	3730.000	3730.000	3730.000
Total liabilities	7421925.000	7418131.000	7414335.000	7410655.000	7406925.000
Equity capital	3101.000	3101.000	3101.000	3101.000	3101.000
Reserves, retained profit	7413672.000	7411378.000	7411132.000	7407402.000	7403672.000
Profit	0.000	0.000	0.000	0.000	0.000
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	151.667	151.667	151.667	151.667	151.667
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	151.667	151.667	151.667	151.667	151.667
Equity, % of liabilities	0.042	0.042	0.042	0.042	0.042

PRELIMINARY SURVEYS

PREFEASIBILITY STUDIES

FEASIBILITY STUDIES

TENDER DOCUMENTATION

TENDER APPRAISAL

BID NEGOTIATIONS

NAGEMENT

SIGNEMENT OF QUALIFIED STAFF FOR PROJECT
RFORMANCE

NSULTING SERVICES

PERVISING OF PRODUCTION PROCESSES

STING

TION OF PROJECTS

ATION OF BUILDING SITES

CTURE

RUCTURAL WORKS

N OF BUILDINGS

CAL AND ELECTRICAL INSTALLATIONS

ISOLATION

ON CONTROL

SION OF WORKS

IONING