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BAUXITE MINING AND PROCESSING IN HUNGARY

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SECOND IRANIAN SYMPOSYUM ON EXPLORATION,
MINING AND MINERAL PROCESSING

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The First Consultation on Non-Ferrous Metals Industry organised by UNIDO last year in Budapest got to the conclusion, that it was essential to guarantee all the technical, economic and institutional conditions that might ensure the harmonious development of mining and processing industry projects. The governments of the developing countries were proposed to give priority to establishing closer links between mining operations and metallurgical processing.

The goal of our present meeting might be a step forward, which brings this important issue closer to realisation.

The Working Group on technological alternatives discussed the case of bauxite mining and processing in detail. First of all the importance of obtaining an overview of mining potential and to plan accordingly in any given country was emphasized. Regarding the optimization of processes it revealed, that mining - metallurgical activity should be taken into consideration as a whole, even on the expense of the individual processing steps. It was stressed, that new, already tested processes should be offered to the developing countries, taking into account the specific characteristics in the given country.

Governed by this important ideas, I am going to offer you a review on the Hungarian mining and processing technologies, experiences, problems, and on the trends of the further development of our industry. At the same time may I call your attention on my country's readyness to co-operate and participate in projects on mining and metallurgy.

Certainly, it is well known, for all of you that the aluminium consumption of the world, together with the price-level of this metal, is on the increase since 1986. The aluminium [illegible] in strengthening its position on the market of [illegible] as well as in the competition against [illegible].

The forecast annual growth rate of aluminium consumption may more or less proportionally to that of the industrial gross-production of the developed areas - North America, Europe, and Japan. However in some fields the demand may be slightly restrained by the tendency of technical development, that is, that new technologies use less and less raw materials. According to the most recent forecasts however, in the period between 1990-1995 the yearly net consumption of Europe will be slightly more then twice as much as in the period between 1981-1990 and five times as much as in the depressed years between 1979-1984.

A similar trend can be predicted for that part of the world which does not belong to the above-mentioned region. As here the decrease of consumption did not sink to level experienced in the developed countries, the annual growth rate could be less significant as well. In some areas, however, and as for as I know the Islamic Republic of Iran belongs to them - the demand for aluminium is high even to-day.

The effects of the depression which marked the years between 1979-1984 are obvious by the actual state of stagnation in the development of alumina and smelting capacities. The consequences of this situation are the base for the prognostization of the probable trends in supply and demand. From 1991 a considerable lack of equilibrium can be foreseen.

It is highly probable that within some years all these tendences will result in rapid development of productive capacities, first of all in those geographical regions, which by their natural conditions are suitable for mass-ore production by simple mining technology. Consequently the lowest price level will be determined by producers of cheap alumina, by processing cheap laterite-type bauxite - like those of Australia, India, Brasil, Venezuela or even Viet-Nam - but only after the above mentioned dis-equilibrium state has been diminished.

We have to take into consideration however, that even in this economic situation a broad field of activity will remain open for aluminium producers who have only smaller reserves of relatively low grade ore, but at the same time a geological setting - if they are "protected" by their geographical

situation, e.g. by great distances separating them from the "cheap" producers, by considerable investment costs needed for creating infrastructure for transport etc. Further on the high level of technology used in their mining and alumina production, the specific structure of the national consumption, and the local or regional possibilities of export of the aluminium semis and finished products can be of advantage. It should also be empnasized that the new developments in technology require a continuous reevaluation of the known reserves.

The Hungarian bauxite mining and alumina plants work and plan for the future just under these mentioned conditions.

The Hungarian bauxite mines produced 3.17 millions of metric tons of ore in 1987. With this level of production Hungary ranks as the 8th among the bauxite producers of the world, and is the second in Europe-preceded only by Yugoslavia.

This ore production represents the base of the Hungarian alumina industry, the 3 refineries of which turned out 869,000 metric tons of alumina in 1987. This output represents roughly 2.7 percent of world's total production, and more than 12 percent of that of the European countries.

The primary aluminium production of Hungary amounted to 75,500 metric tons in 1987.

The geological prospection for bauxite, the mining of the ore, the alumina production, aluminium smelting and casting, together with the fabrication of semis and finished goods represent the main branches of the organisation of the Hungarian Aluminium Corporation (HUNGALU), which has more than 21,000 employees on staff.

Hungalu incorporates one bauxite prospecting company, two bauxite mines, an engineering and development centre - the ALUTERV-FKI - three smelters, two semis production and two finished product manufacturing plants, moreover it owns a machine construction factory for the aluminium industry and a trading company - as well.

The advantages of this vertical organization lives not only in the broader co-ordination possibilities, but also in the fact, that it provides the most favourable conditions for the most efficient technical, technological development, and scientific research.

The bauxite deposits of Hungary are situated in the geographical region of the Transdanubian Central Range which occupies the central part of Western Hungary. The Hungarian bauxite - just like the bauxite deposits of Iran - are of the so-called karstic type developed on the more or less eroded surface of carbonatic rocks - i.e. on limestone or dolomite - under terrestrial conditions. In their hanging wall black clays rich in organic material and thin brown-coal seams are common. Analogous setting of bauxite is well known in Iran as well.

In the area of West-Hungary the formation of bauxite deposits have been repeated several times during its geological history. The shape and dimensions of the ore-bodies are extremely different, as well as their depth of setting under the present surface. As a consequence of their karstic-bauxite type the characteristics of the Iranian bauxites are very similar or even the same as those of the Hungarian ones. The most common morphological type of the orebodies is that of the "ore-lens", having horizontal extent of some 1000 sq meters and thickness values between 5-25 meters. The ore may be found outcropping on the surface, lying under a cover of several metres of tens of meters, or even in depths of 200-300 meters as well.

The mineralogical composition of the Hungarian bauxite is boehmitic, however, it contains also considerable quantities of gibbsite.

Although the mineralogical and chemical features of the ore are rather uniform, some types differing in details can be outlined. The industrial grade reserves comprises 50.3 percent of Al_2O_3 on the average, and about 7.0 percent of SiO_2. Locally in some deposits - or in parts of them - higher alumina contents and considerably lower values of silica content - down to 2 percent - can be found.

The participation of contaminations (e.g. calcium or/and magnesium oxides, iron sulphide, organic material etc.) in the composition of ore does not reach the limits of their technologically tolerable amount in general.

In the Transdanubian Central Range - the most important part of the Bakony region - great number of bauxite occurrences are known. Their dimensions are - often extremely - different. According to the computerized data recording system of their data some 50 of them are of importance. These are the "deposits" in the general use of this term. Each of them incorporates a number of more or less separated orebodies. The total number of the latter is over 200.

The main bauxite deposits can be outlined in 4 bauxite regions. These are:

1. *The bauxite region of South-West Bakony*
   Its most important deposits can be found West of Nyirád village, and north of Halimba village. The "geological" reserves of this region are about 55 million of metrics tons.
2. *The bauxite region of North- Bakony*
   The most important deposits are around the villages Iharkút-Fenyőfő and Bakonyoszlop. Geological reserves: some 40 millions of metrics tons.
3. *The bauxite region of Eastern-Bakony - West-Vértes hills*
   The main deposits can be found at Iszkaszentgyörgy and Gánt villages. They are partly depleted. Geological reserves of the region: 25 millions of metric tons.
4. *The bauxite region of East-Vértes Hills and Gerecse Hills*
   The deposits are grouped around Nagyegyháza village. Geological reserves are about 30 millions of metric tons.

Partly within, partly outside these regions some scattered bauxite bodies are known too; on some of them the geological prospection is in progress. Data given above does not contain their possible reserves.

The majority of the Hungarian bauxite is situated under the karstic-water table. This geological condition made it indispensable to set up an efficient protection against the karstic water hazard.

With the exploitation of the ore reserves the two mining enterprises of Hungarian Aluminium Corporation are entrusted. The Tatabánya Mines Company - which does not belong to HUNGALU - is co-operating.

To maintain the required level of productivity of mining - both in quantity and quality - and to supply refineries with the required bauxite quality the following tasks are to be solved by geological prospecting.

First of all I have to mention the necessity to increase the "proven" reserves to counter-balance the exploited ore (plus losses of various nature) in quantity and quality. Up to now, the prospection done by experts of Hungarian Aluminium Corporation has success in the realization of this aim, moreover some degree of over-compensation seems to be probable in future. However, the tendency towards less favourable geological conditions in future - e.g. the growing depth of the setting of deposits - is obvious.

The systematic execution of geological prospecting together with the proper data-supply for the mine-design, needs a very complex and highly co-ordinated activity. These activities are performed by the Bauxite Prospecting Enterprise of HUNGALU - having its central offices at Balatonalmádi, in the geographic centre of the Transdanubian Bauxite Regions. This enterprise has almost one thousand employees, its technical staff is composed of 112 geologist, engineers, chemical engineers etc.

The general strategy of the geological prospecting is based on scientific models elaborated by experts of the Enterprise. These models take into consideration the conditions wich control the bauxite formation in a certain area, by evaluating the geological and geophysical data, which can prove the accumulation and preservation of deposits of industrial grade ore.

The drilling activity itself, together with its technical development, the introduction of new techniques, - like shaft sinking by great diameter drilling, - moreover the production of bits, tools and spare parts for drilling, are in the hand of Bauxite Prospecting Enterprise's workshop at Balatonalmádi.

The total drilling performance of the Enterprise amounted to 120.000 metres in 1987. As the average depth of the boreholes is about 100 m such the performance equals roughly the sinking of 1000 medium depth boreholes, with core recovering on the average of 98 percent in ore, and with complete hydrogeological, geophysical etc. observations.

As a result of this performance in 1987 new ore reserves amounting 5.7 millions of metric tons had been explored. The industrial grade part that of being about 4.5 millions of metric tons.

The efficiency of the exploration can be illustrated by the relation between the cost of exploration and the price of run-of-mine ore, being the first one about 10 percent of the latter in Hungary, varying slightly according to the quality and mining conditions of the ore.

In 1987 about 88 percent of the total of bauxite output of Hungary have been produced by two mining enterprises of the Hungarian Aluminium Corporation - i.e. by the Bakony Bauxite Mines Enterprise and by the Fejér County Bauxit Mines - while the remaining 12 percent was turned out by the Tatabánya Mines Company.

I give you a short introduction about these mining enterprises by some characteristic data.

The operations of Bakony Bauxite Mines cover the whole of the South-West Bakony bauxite region and the western part of the North Bakony region. The centre of the mining enterprise is located in the city of Tapolca. This mining enterprise has roghly 2100 employees. Its two mining centres are in Nyirád and in Halimba mining areas, co-ordinating the activity of 5 open-cast workings, and 7 shaft fields. The total length of enterprise's underground galleries runs up to 57,573 metres at the beginning of 1988.

The average productivity is 21.06 metric tons of ore/shift. The productive capacity of the Bakony Bauxite Mine runs to 2.0 millions of metric tons/year.

The activity of Fejér county Bauxite mines is based on the bauxite deposits of the eastern part of the North Bakony bauxite region, and on the deposits of the Iszkaszentgyörgy area on the margin of the eastern Bakony. Its centre is located in Kincsesbánya, in the distance of 15 kms from Székesfehérvár to the north-west. The number of employees is about 1030. The Fejér County Bauxite Mines Enterprise has 2 mining centres: co-ordinating the activity of one open cast exploitation and 3 shaft-fields. The total length of its underground galeries is 34,039 metres. The average productivity is 25.09 metric tons/shift. The productive capacity of the Fejer County Bauxite Mines is about 1 million tons of ore/year.

In total 3.17 million tons in 1987 the share of the Bakony Bauxite Mine Enterprise amounted to 1,398,000 metric tons, its module-value being 7.0 on the average. The Fejér County Bauxite Mines Enterprise put out 888,400 tons of bauxite with 6.1 module on the average. The production of Tatabánya Mines Company came to 382,500 metric tons of ore; its average quality reached the 9.6 modul-value.

Let us see the distribution of the total ore-output according to conditions of exploitation.

The Bakony Bauxite Mine Enterprise exploited 489,000 tons of ore from open pit workings - while 1,410,100 tons were given by its underground mine: this means a percentage distribution of the total output into 25.7 percent and 74.2 percent respectively.

The Fejér County Bauxite Mines Enterprise produced 714,000 tons of ore from its underground mines - it means the 80.4 percent of its total output - and 174,000 tons of ore from open cut mines: that is 19.6 percent of the total sum of the production.

Summarizing the performance of the Hungarian Aluminium Corporation's mining enterprises we find that 662,300 tons of ore - that is 20.9 percent of the total production - came from open cuts while 2,121,700 tons were exploited underground: amounting 66.9 percent of the total production. The whole output of the Tatabánya Mines came from open pits.

The operations of bauxite mining like stoping (including the processes of drilling, blasting and loading), supporting, underground haulage of the ore and auxiliary materials, are completely mechanized to-day. Bauxite is not touched by human hand.

Under the actual techno-economic conditions, the economic depth-limit for open-cuts is regarded as being the eightfold of the orebody's average thickness. In practice this relation does not surpass that of the fivefold. The thickness of banks, both in stripping and stoping is 7 metres. Stripping of overburden and excavation of the ore are done by blasting. The blasted material is loaded by diesel powered shovels into tracks of 20 tons capacity and hauled by them to the depots.

The bulk-density of the blasted ore is between 1.6-1.8 ton/cu.meters on the average.

As the open cuts are very close to the underground mines, or even almost on top of them the water protection of the underground mines solves the dewatering problem of the open ones, except for rain-water.

Bauxite bodies which lie in depths below 60 metres are exploited in underground workings. They are opened either by vertical shafts sinked to 300 metres below the surface - i.e. to some 180 m below sea-level - or by extracting inclines, which in some cases reach the - 320 m level under the surface. For ventilation only vertical shafts are sinked.

Comparing the performance of the inclines to that of the hoisting shafts some advantage of them, such as their simpler implementation, lower costs of maintenance, high level of performance etc. are obvious. Their main disadvantage can be found in their higher specific consumption of electric-power used for haulage.

The useful section of vertical shafts is between 3.0 -5.5 sq. meters while that of the inclines is about 13.0 sq. meters. The main roadways of extraction have useful sections between 12.0 and 13.0 sq. metres.

In the stage of opening of new mines, the galleries are excavated either by blasting - with a rate of advance from 50 to 80 metres monthly (in hard sedimentary rocks like dolomite or limestone), or by using Paurat-Eickhorn type gallery driving machine. The rate of advance ensured by this technology - the use of which is spreading rapidly - is between 150-200 metres in a month.

The drilling of blastholes is performed either by Boehler type jumbos, or by machines of local construction (or more correctly: adapted to local conditions).

As to the support systems used in the mines of Hungarian Aluminium Corporation it can be mentioned that timbering is almost completely ousted today, as only 15 percent of the total lenght of the drifts are supported by wood - while 85 percent of them have modern support like concrete masonry, shotcrete, steel ring support system (TH-ring, compressible steel-arches etc.) aluminium-props and roof-bolting.

The HBT type aluminium props used in support of short-live drifts - like working rooms for instance - had been developed by HUNGALU itself. The hydraulic expanded (swelled) roof-bolt is the licence of Swellex Co. Sweden, adopted by the technical staff of Bakony Bauxite Mine Enterprise. These *"swelled"* roof-bolt proved to be very suitable for roof-bolting in soft or even plastic rocks, like clayey marl, sandy marl and so on - accordingly for the use in very difficult hanging wall-sequences. Some technical characteristics of the aluminium props of HUNGALU: weight of one prop is between 9.2-44.0 kgs according to its type, their yield capacity is between 200-400 kN, that is roughly 20 to 40 tons.

The current technology of the underground exploitation is that of the *"room-and-pillar workings with caving"*. Recently a new mining technology was developed by the engineers of the technical staff in Bakony Bauxite Mine Enterprise in order to improve the productivity and security of the stoping under highly unfavourable hanging wall, called as *"roof-bolting protected block stoping"* system. The adaptation of the hydraulic expanded roof-bolt was one of the most important steps in realizing this scheme.

The amount of mining losses is between 21-23 percent of the reserve in exploitation.

For loading of the blasted ore and for its haulage to conveyor-belts (to the bins) Jow TLF-1 and GHH-TLF-1 type diesel powered transloaders are in use. The use of compressed air powered CAVO-210 type loaders is diminishing partly because of their difficult power supply, and because of their relatively low productivity.

The underground haulage of the ore is performed by rubber belt conveyors. In the Hungarian bauxite mining there is no loading by hand or use of mine cars. The transport of personnel and auxiliary materials is the underground roadways - which can be sometimes several kilometres long - is done by Multicar type, diesel powered cars.

Due to geological setting of the bauxite bodies, the karstic-water represents the sole, but very serious hazard for their mining. The first water-inrushes occured simultaneously to the beginning of the underground exploitation. The hydrology had been a determining factor in the past, and has the same role to-day too.

The protection of bauxite mines against the hazard caused by karstic-water had been "passive" until the first years of the fifties. It represents the excavation of sump systems and the installation of pumping capacities to raise the water from the mines. Since the watered dust and fine graines of bauxite tend to become plastic, and strongly adhesive in this passive period the loading of ore could be done only by and. Not till the first years of the sixties, when the first CAVO type loading machines came into use could this outdated situation be improved. This period was characterized by the 6.0-8.0 tons/shift level of productivity. Consequently to find an entirely new solution for the defence against karstic-water hazard became of utmost importance for the Hungarian bauxite mining. This tasks had been accomplished in the middle of the sixties by co-operation of geologists, hydrogeological experts, mining engineers, drilling experts working in various branches of Hungarian Aluminium Corporation. As a result of this activity the passive emptying methods could be raised from the 6 tons-level to the 21-23 tons-level.

Today the Hungarian bauxite mining is working under "active" water-defence. This means that by lowering the karstic-water table below the lowermost point of the bauxite bodies to be exploited, for the mining operations "dry" conditions can be established. By this way the re-forming of the whole technology could be realized by its entire mechanization. In underground workings of our days the water inrushes are unknown.

It is quite evident that the increase of productivity "has its price" as well. Today the "cones of depression": that is the area influenced by the water-level's drawdown cover several thousand of square kilometres. Enormous quantities of karstic-water is to be raised in order to stabilize the "sucked-down" level. The Hungarian bauxite mining raised in the year 1987 not less than 334.5 cu.m/min karstic-water. Some details concerning the dimensions of dewatering in the main mining regions: Nyirád 240,7 cu.m/min, Kincsesbánya 32,3 cu.m/min, Halimba 8,8 cu.m/min, and the Fenyőfő mine: 2,2 cu.m/min. To produce a ton of run-of-mine-ore needs the pumping of 55 cu.m water, consuming 15,47 kWh of electric energy.

However, the dewatering of the mining regions furnishes the possibility to supply a considerable part of West Hungary with high-quality drinking water. The selling of water ease the financial burden of dewatering coasts in bauxite production.

Some words about the technical realization of this dewatering system. To safeguard the required high purity of water exploited from its karstic reservoir it is pumped out from drilled shafts by submergible pumps. The large diameter drillings are carried out by the Bauxite Prospecting Enterprise, using Wirth L-10 machine. The drilling starts from shafts sinked to 60-70 m depth by traditional methods. The drilling starts with 2500 mm-diameter, ends with 800 mm to 1500 mm diameter; average length of the drilled shafts is between 120 and 150 metres. Up to now 42 drilled shafts had been sinked and implemented.

It is needless to say that this dewatering system, tested and well proved as a "water-mining" method in practice is suited

to solve the dewatering problems of mining in case of other minerals than bauxite as well - or can be used to establish regional water supply systems for communal purposes or irrigation.

Let us see the influence of actual, and continuously developing, state of mining technology on the assesment of bauxite reserves.

In order to ensure the required informations either for mine development and design or by long-range production strategies not less than 89 parameters of the ore-reserve are registered in the yearly balance of reserves and compiled by the Hungarian Aluminium Corporation for each areal unit of the assesment. Some of them are data as quality and quantity of reserves, amounts of impurities, depth of setting under the surface and below the karstic-water table, volume of the further prospection needed (by code numbers), economic evaluation, like costs of mine development and exploitation related to reserve in question, cost limit "at the mine-gate", and so on.

The operations of reserve estimation and evaluation are computerized. Computing centres are organized (and implemented) in the Bauxite Prospecting Enterprise in Balatonalmádi and in the headquarters of the Hungarian Aluminium Corporation. The data of hydrogeological observations are processed by specific software programmes in the Mining-Development Department of the ALUTERV-FKI.

The production of alumina can be regarded as processing of bauxite. The three alumina plants of the Hungarian Aluminium Corporation are located in North-West part of the country: in Magyaróvár, Almásfüzitő and Ajka. The productive capacity of these plants is 880,000 tons of alumina per year. (Magyaróvár 75,000 tons, Almásfüzitő 475,000 tons and Ajka 330,000 tons/year).

The Hungarian alumina plants run on Bayer technology using continuous digesting cycle with hydrogarnet addition - as a special Hungarian technique. The main steps of this process are [illegible] digestion, precipitation, filtration and calcination.

The ore-supply of the plants is based entirely on the output of Hungarian mines. This ore has an average composition of about 50 percent Al_2O_3 and 7.0-7.5 percent SiO_2 on average - so that the plants are processing bauxite of 6.8-6.9 module in average. The bauxite is a mixed, - boehmitic, gibbsitic type, comprising some adhesive water, too.

Homogenization and grinding of the run-of-mine ore are carried out in the alumina plants. These processes are wholly mechanized. The typical diameter of the ground ore's grains fed into the pre-desilication circuit is between 150-200 microns. The digestion is preceded by pre-desilication at 95 centigrades temperature during 8 hours.

The digestion process is of one-stream type in the Ajka and Almásfüzitő plants this process takes place in indirectly heated autoclaves on 240 centigrades. Some technical parameters of it: digestion-stream pressure is 70 bars in the Ajka-plant, and 40 bars in the Almásfüzitő plant, concentration of the caustic soda is 180-200 grams/dm^3 of the caustic liquor, mol-relation at the beginning of the process is between 3,3 and 3,5 values, autoclave pressure is 35-40 bars - i.e. 3,5-4,0 MPa. Retention time is about 40 minutes.

In spite of unfavorable changes in the quality of the raw materials available, our alumina plants - relaying on ALUTERV-FKI's development results in manufacturing processes and production facilities - *were capable to decrease the specific steam consumption approx. to one-third, the electric energy consumption also decreased, while considerable increase is attained in efficiency and economy of production.*

The experiments carried out between 1974-1978, provided reasonable and sufficient data for ALUTERV-FKI to design an industrial-scale tube digestion system and realized it later during the updating of the MOTIM WORKS' (Alumina Plants of Magyaróvár) digesting unit. The equipment has been in continuous operation since May of 1982 with capacity utilization of 95-97 percent.

Capacity of the unit is 10 t Al_2O_3/hour which - at the same time - represents the full capacity of the plant. Heat energy

supply of the tube digestion is assured by the existing boiler-house allowing digestion temperature of 260 centigrades. During the 6-year operation, we have gained reasonable experience considering the plant operation and the technological and mechanical maintenance.

As tube-digestion process of the Hungarian Aluminium Corporation proved to be highly effective on plant scale in the Magyaróvár plant, technical arrangement were done for its establishment in the Almásfüzitő and Ajka plants as well.

I will not exaggerate facts by saying, that this process yields quite new possibilities for countries having reserves of only medium or low-grade karstic bauxites to process their own ore.

As it is well known, a very problematic side-product of alumina fabrication is the so called "red-mud". The specific "production" of red mud is 1.3 ton (in dry form) for one ton of alumina. The red mud, produced by Ajka and Almásfüzitő plants is deposed as a dense slurry after washing it by 6 or 7 stage counter-current process. Even the "dried" red mud has some 55 percent water content and a little amount of residual soda. The water content may be decreased considerably by filtering it after the outwash-process. Actually this is done in Magyaróvár plant. The water demand of alumina production is about 8-10 cu.m/ton in Hungary but according to local conditions it may be lowered to 6 cu.m/ton.

A different side-product of alumina, - a very valuable one - is won by the recovery of gallium. In the Ajka plant, 3.5-4.0 tons of gallium-metal in a year are produced. Presently a second plant is being built with a capacity of 3.0 tons/year.

It would lead too far if I should go into details concerning special products like high purity, special ceramic grade Al_2O_3, artificial corundum, and so on. The presence of the Hungarian Aluminium Corporation on the world market, its post-graduate training courses, the participation of its experts in [illegible] organisation should be mentioned, too.

I should like to mention that the technical staff of the Hungarian Aluminium Corporation is fairly familiar with the

possibilities of mining and processing possibilities in Iran. Our people took part in the first stage of the field reconnaissances outlining the Iranian bauxite resources, and in the realization of their use by elaborating a technical process adapted to Iranian bauxites.

Coming to end of this lecture, allowe we to emphasize once more some ideas.

First of all it is a very important fact that the natural conditions of the bauxite-geology and bauxite mining in Iran are obviously analogous with those of Hungary. Some economic conditions are similar as well.

If you intend to develop an alumina industry and smelting based on your domestic ore you will find yourselves confronted with a lot of problems which were ours as well, and which are solved partly or entirely at the present.

I think, that our prospecting experiences, our technologies in mining, and in alumina production, first of all the tube digestion technology, are suited to solve problems in Iran with success, as they were developed for ores similar in characteristics.

Thank your for your kind attention.