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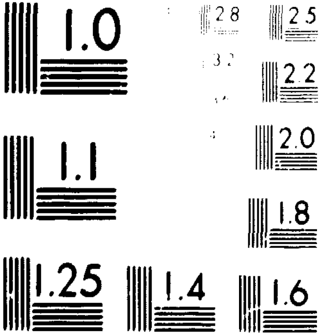

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TURKEY

Technical report: Examination of the Feasibility Study for blast furnaces and sintering plant of the 4-th Integrated Steel Works to be constructed at Sivas area in Turkey

Prepared for the Government of Turkey by the United Nations Industrial Development Organization executing agency for the United Nations Development Programme

Based on the work of Wladyslaw Sabela, expert in blast furnace and sintering plant

United Nations Industrial Development Organization
Vienna

This report has not been cleared with the United Nations Industrial Development Organization which does not, therefore, necessarily share the views presented.

ABSTRACT

The problem described in the report is the examination of the Feasibility Study for blast furnaces and sintering plants of the 4-th Integrated Steel Works to be constructed at Sivas area - post: DP/TUR/76/038/11-15

The duration of the mission was 1 month from 3.February.1981 to 2.March.1981 - the duty station: Sidemir Project Group in Ankara.

After examining the " Fourth Iron and Steel Works Feasibility Report " an estimation of some problems important for the further project stages was done (findings).

Recommendations: For the beginning of the preparation of detailed project study for the sintering plant and blast furnaces some problems as coal and ore quality, quantities and transport possibilities etc. must be known exactly. After having these settlements can start the technical and economical optimization and ultimate consolidation techniques and technologies.

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INTRODUCTION

According to the job description DP/TUR/76/038/11-15/31.8.C there are following duties:

1. Examine the Feasibility Study of Sivas Project which has been prepared and give advice on further improvement of this study in the part of blast furnace and sintering plant.

2. Give advice to Sivas Project Group on how to start and process a detailed project study for engineering to construct the blast furnace and sintering plant.

The additional request from Sidemir Project Management was " Generating and evaluating of different alternatives considering the conditions in Sivas, infrastructure of Turkey and present financial difficulties prevailing and reporting of the findings".

General situation of Sivas Iron and Steel Works

The basic material for examining the Feasibility Study of Sivas Project Group is the " Fourth Iron and Steel Works Feasibility Report " from June 1980.

The Sivas Iron and Steel Works - named " Sidemir " will be located about 15-20 km to Sivas, near Doğanca village. The capacity of Sidemir has been determined as 1.3 million tones per year for Stage I and 2.4 million tones per year for Stage II. The projected production of pig-iron will be 1 260 000 tpy and 2 520 000 tpy.

Plant will utilize local fine ores and concentrates for sintering and pellets, and imported coking coal.

Site properties

The site is close to highways and railroads. Fadlim stream is flowing at the east and Tecer river at the west of the site. Hills of different elevations are located at the north and south of it. The average elevation of the main installations area is about 1350 m above sea level. A general sloping in the northwest-southwest direction is observad towards the Fadlim stream. The present ground surface slope is between 1.5% and 4%.

The main wind direction,250-300 days in a year, is from northwest to southeast (from Sivas).

The result of the unconfined compressive strength tests varied within a wide band. The average value, constant with depth, may be taken as 1.0 kg/sq.cm. for the preliminary evaluations (IV.5).

The process water will be supplied from Kızılırmak. This water is salty.

In Sivas region winter lasts 5 months.

Iron ores and other raw materials

In the neighbourhood of Sivas area there are many iron ore deposits. Many of these iron ores are high in sulphur and arsenic and some in titania and alkali.

In some deposits beneficiation plants are under construction now (Divriği). For others, technological studies are not completed. Therefore it is not possible to calculate the real composition of sinter and the entire blast furnace charge -it is only estimated.

The limestone of good quality for the sintering plant is available at Felfan and dolomite at Tecer.

The quality of coke for Sidemir is at present not known -there are some assumptions.

The Feasibility Report contains also descriptions of stock yards for ores, pellets, limestone and coal of the sintering plant, blast furnaces, the market study etc.

I. FINDINGS -ESTIMATION OF ORE PREPARATION AND BLAST FURNACE PROBLEMS IN THE FEASIBILITY STUDY OF SIVAS PROJECT

The Feasibility Study gives a good general view about the future technology and arrangements for the storing of raw materials and poducing sinter and pig iron.

In the proposed plant layout the sintering and blast furnaces are on the main wind direction which allows to get the waste gases to ore and coal stock yards and not to the other production arrangements -this is a correct solution.

Some of the described matters can be discussed.

Technological problems

Since the real chemical composition of ores, sinter, pellets and coke is not known, it is necessary to set requirements for the blast furnace charge:

Alkali from ores and coke can not exceed 4-5 kg/ton of hot metal. Greater quantities needs more acid slag in the blast furnace, such a slag does not allow good desulphurisation of pig iron in the blast furnace.

Titania in the charge has a good influence for the durability of the hearth of the blast furnace at 1-2 kg/ ton hot metal. Greater quantities need special working technology of the blast furnace.

Arsenium in the charge must be lower than 0.1 kg/thm and for some grades of steel this quantity is too great.

Zinc in the charge can not exceed 0.5 kg/thm.

Nothing is written about other undesirable ingredients like Cr,Cu.

The coke must be after the Micum test M40 no less than 75-78% and the minimum size 25 mm (or 20 mm) only after good stabilization -otherwise 35 to 40 mm.

The calcined lime added to the sinter raw mixture can be

0-10 mm if added to the sinter mixing bed. The raw mixture in the mixing bed must be moistened (to a total humidity up to 1% less than needed for sintering) and remain 10 days or more before sintering. This process allows better permeability of the mix on the grate and greater production rate of sinter. The addition of 5% calcined lime is necessary only if there is 200 kg/ton of sinter or more of fine (under 0.1 mm) concentrates. If the concentrates are coarser, 2% calcined lime can be sufficient.

The quantities of coke fines (0-10 mm) from the coke plant will be too small for the sintering plant (pages VIII.5 and VIII.4). The crushing of size 0-15 or 0-20 mm must be foreseen.

In calculations on page A IV.3 the iron content in pig iron will be rather 94% than 93%. To the consumption of iron for the production of 1 ton of pig iron addition must be made for the iron in slag (about 5 kg) and the iron in dust (about 15 kg) and about 10 kg for other losses (scraps) - together 970 kg/t pig iron or more. That means the sinter consumption will be greater than on page A IV.4. The capability of the planned sintering plant will be still sufficient.

On page AIV.3 the quantitiy of silica for reduction to silicon in pig iron must be deducted from the silica in slag. After the quantity of limestone must be reduced (without the correction the basicity Cao/SiO_2 would be 1.5 in-stead of 1.2).

The basicity of Hasançelebi pellets need not be high. It will be necessary to investigate in labaratory the mechanical properties of acid and basic pellets from Hasançelebi concentrates. Usually the acid pellets are stronger which is very important for the transport. In the blast furnace they can be used together with super-fluxed sinter.

The calculated coke consumption (450 kg/thm+ 60 kg oil/thm) and the daily production 3600 ton of pig iron gives an intensity of coke burning 0.8 t/cu.m.-24 hr and with oil 0.9 t/cu.m.-24 hr. Such intensity factor (1 t/ cu.m.-24 hr or less) allows the best coke consumptions.

The calculated requirement (pages AV4-5) for blast 2750 cu.m./min. and 275 cu.m.O_2/min. is possible.

It will be necessary to foresee how to produce pig iron without oil and oxygen. If the price of oil is higher than 130% of the price of coke, the using of oil will be too expensive: oxygen will not be necessary, the blast temperature will be 1000-1050°C and the coke rate 520-550 kg/ton.

Production units

Because of frosty winters in Sivas, defrosting of ores, limestone and coals in wagons before tipping must be foreseen.

There is a possibility to make sinter without hearth layer. When the coke is well crushed (under 3 mm) the sinter mix can segregate and on the top of the layer accumulates fines (also coke) and on the bottom largest pieces (more ore).

For the ignition of sinter mix a gas mix (blast furnace gas and coke oven gas) 1800-2000 kcal/cu.m. must be foreseen.

It is possible to lower the coke rate for sintering by rising the layer of sintering mix on the grate to 400mm or 500mm. Therefore the boards of the sintering machine must be sufficiently high.

Electrostatic filters for waste gas have very good dedusting efficiency but are sensitive for oil(from oiled mill scale used in the sinter mix), they explode. More safe are wet filters (they need water) or the less efficient, old, multi-cyclone dust catchers.

For efficient cooling, sinter must be screened before cooling, the second screening can be before charging into the blast furnace.

The facility for taking samples from sinter and preparation for physical and chemical analysis must be foreseen.

The blast furnace profile is well calculated, it is recommended to compare it with different good working blast furnaces at the last step of designing.

The Paul-Wurth (Hamborn) top is really the best now. It needs nitrogen from the oxygen plant for cooling. All modern blast furnaces have belt transport of the charge.

The hearth base can be cooled with air or water. For my opinion water is cheaper.

The shafts of many blast furnaces in Japan, Soviet Union, Poland and others have stave coolers in-stead of horizental cooling boxes. Well made stave coolers can work 7-8 years and allow a smooth descending of the charge.

On page VIII.8 is "one electric drill for tapping" must be added: "for each tap hole".

Tap hole drills and mud guns must be of small dimension.This allows to build above them a (continuous) tuyere platform. The higher heart (about 0.5 m) will enlarge the place under the tuyere platform.

The ventilation of the working spaces (also in the sintering plant) must be foreseen.

For the first step o[illegible]s cleaning a Venturi scrubber is not useful -there must be a dry dustcatcher.

Because of the small quantity of slag in the blast furnace (about 300 kg/ton pig iron) and the possible high sulphur content in ores (sinter) the desulphurization of pig iron outside the blast furnace will be desirable. The desulphurization can be done with soda ash, burned lime or calcium carbide. For desulphurization of pig iron the cheapest agent is powdered burned lime. Using of torpedo cars (1 for each tap), it will be suitable to desulphurize at the steel plant after pouring the pig iron into normal ladle. After the desulphurizing and removing the remaining slag or powder, the pig iron can be poured from this ladle into the converter.

If there is demand for granulated slag in the region of Sivas (e.g. for cement fabrication) the best way for utilization of blast furnace slag is the proposed (on page VIII.12) way for granulation directly at the blast furnace.This allows to reduce the cost of slag ladles -because they are not necessary. The demand for granulated slag must be confirmed for the next stage of the project (detailed project study).

For the injection of oil (if it will be applied) on automatically controlled installation for distribution of oil for each tuyere may be used.

In the project there must be a proposal where will be the maintanenence shop for ladies, the production shop of refractory masses for tap hole and runners (or will it be bought).

II. RECOMMENDATIONS

1. For the beginning of the preparation of detailed project study for the sintering plant and blast furnaces, the Sidemir Project Management must obtain some settlements:

- The charge for the sinter production for blast furnaces must be exactly known -e.g. quality and quantities of ores, concentrates, limestone, dolomite, coals- also their transport possibilities to Sidemir.

- From the future materials ought be made laboratory investigations producing sinter and coke- for the estimation of their quality and possible yields.

- The quality of water for industrial purposes in Sidemir throughout the year -specially the thermostability temperature. It will be necessary for the choice of the right method and calculations of cooling installations, dedusting systems etc.

- An exact soil quality (strengths etc.) for calculation of foundations. For the blast furnace foundation the strength must be (without special securing methods) higher than 2kg/cm^2.

- Assembling the regulations about acceptable pollution level of earth, air and water for designing suitable installations (for dedusting gases, cleaning waste water, slag utilization etc.)

- Confirmed possibilities for selling (transferring) by-products for limiting the area for stocking them (slag, dust, refractory, scrap etc.).

2. After having settlements (mentioned in point 1)the Sidemir Project Management can start the technical and economical optimization and ultimate consolidation of techniques, technologies. The quality of work(the effects of this work) must allow the collection of the offers and the calculation of the general cost of the Sivas plant. Problems which ought to be discussed are:

- exact calculation of necessary area of stock yards
- the largeness and type of the defrozening installation for ores and coal
- the type of ore handling unit making possible the work in

winter

- the method of utilization iron-containing dusts from blast furnaces and steel plant
- the method of dedusting gas from the sintering plant
- the type of cooling the blast furnaces
- the type of installation for granulating slag.
- the quality of oil and oxygen used in the blast furnace etc.

ANNEX I

POSSIBLE ORGANIZATION FOR THE PREPARATION OF THE DETAILED PROJECT STUDY

In some countries detailed engineering reports of new iron and steel works are conducted by special groups in planning designing offices. This coordinating group headed by e.g. deputy director of the office cooperates with sintering plant department, blast furnace department, steel plant department, rolling mill department, automation department, department for transportation facilities and organization etc. in the office. These collaborating departments perform general plans of each plant (e.g. blast furnace plant, steel plant etc.) and design some installations. These departments are also obliged to indicate designers and performers outside the office to make some work better (have better experience, know good solutions).

The people in the coordinating group must know the formal procedure of preparing new investment, its purposes, technical possibilities for solving this purposes. After discussing different technical possibilities the coordinating group proposes the best solution. The coordinating group "buys" plans and designs in their own office or outside. This group is also responsible for the adjustments of designs made by different performers. The group coordinates the execution of all arrangements.

Detailed project study

After my opinion it is possible to organize the coordinating group outside the planning and designing office.

In such case the group must be extended -in addition there must be engineers- metallurgists for ore preparation (sintering), blast furnaces, steel-making (e.g. continuous casting), different rolling mills, electrical engineer, specialist in energetics etc.

(also environmental pollution problems),in transport etc.

These engineers must be graduated, have no less than 5-10 years experience in designing and planning or in managing production in the steel-works.

They must be talented and willing. The knowledge of 2 foreign languages (English and a second) is necessary.

ANNEX II

PROPOSALS FOR DİFFERENT ALTERNATIVES -HOW TO GET MORE IRON AND STEEL

The cheapest way to produce more iron and steel, though probably not in great quantities, is the intensification of production and modernization of existing iron and steel works. Therefore an analysis of actual operational variables must be done. This will allow to find the bottlenecks. The following modernization of units and alteration of the organization of work must eliminate the bottlenecks. The renovation of installations is the best opportunity for changing the construction.

Eventual division of the construction of Sidemir in two or more stages

A. Rolling mills without production of steel:

The only construction of mills without steelmaking is possible if:
- in Turkey there are free blooms or billets -the import of blooms or billets is for a longer period uncertain,
- in the neighbourhood of Sivas exist market for the majority of the produced rods, sections etc.

This stage of constructing only mills at start requires majority of the site preparation work needed for the entire iron and steel plant(Water, electricity etc.).

Additional costs are:
- the supply of gas for reheating furnaces, and
- retransport of scrap from rolling mills to the steel plant (melting shop)

B. Coke-ovens, sintering plant, steel plant, continuous casting without rolling mills:

The only production of steel billets and blooms is suitable if there are rolling mills needing such semi-products in the neighbourhood of Sivas.

The information about the availability of such enterprice will give comparing the costs of transporting coal, ores, limestone (dolomite) needed for 1 ton of crude steel -to Sivas or alternatively to other chosen place (e.g. to enlarged Isdemir plant)

Not constructing of coke ovens in the plant will need an additional supply of gas or oil for the ignition of coke-ore mix in the sintering plant, and
- not the best utilization of blast furnace gas. The gas from the blast furnace can be used for the heating of coke ovens, making the coke oven gas free e.g. for the blast furnace instead of oil, or domestic purposes.

Not constructing of the sintering plant is possible only by having good lump ores (not sinter from a far sintering plant).

There is also a new possibility for producing steel billets and blooms for mills in the Sivas area. This is the production of sponge iron using lignites.

The new method developed by LURGI allows making sponge iron using lignites, instead of oil or natural gas, in a rotary kiln.

It is necessary to have near Sivas lignites [illegible] enough electricity for electric furnaces smelting steel from sponge iron.

It is necessary to make calculations about the economy of such production method in Sivas.