PELLETIZATION OF BAHARIA IRON ORE FINES

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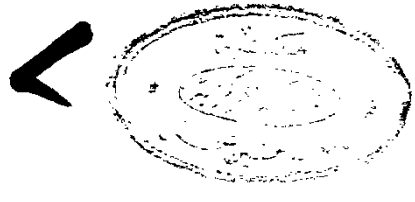

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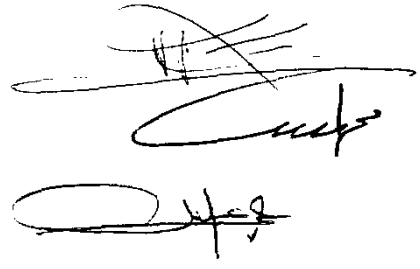

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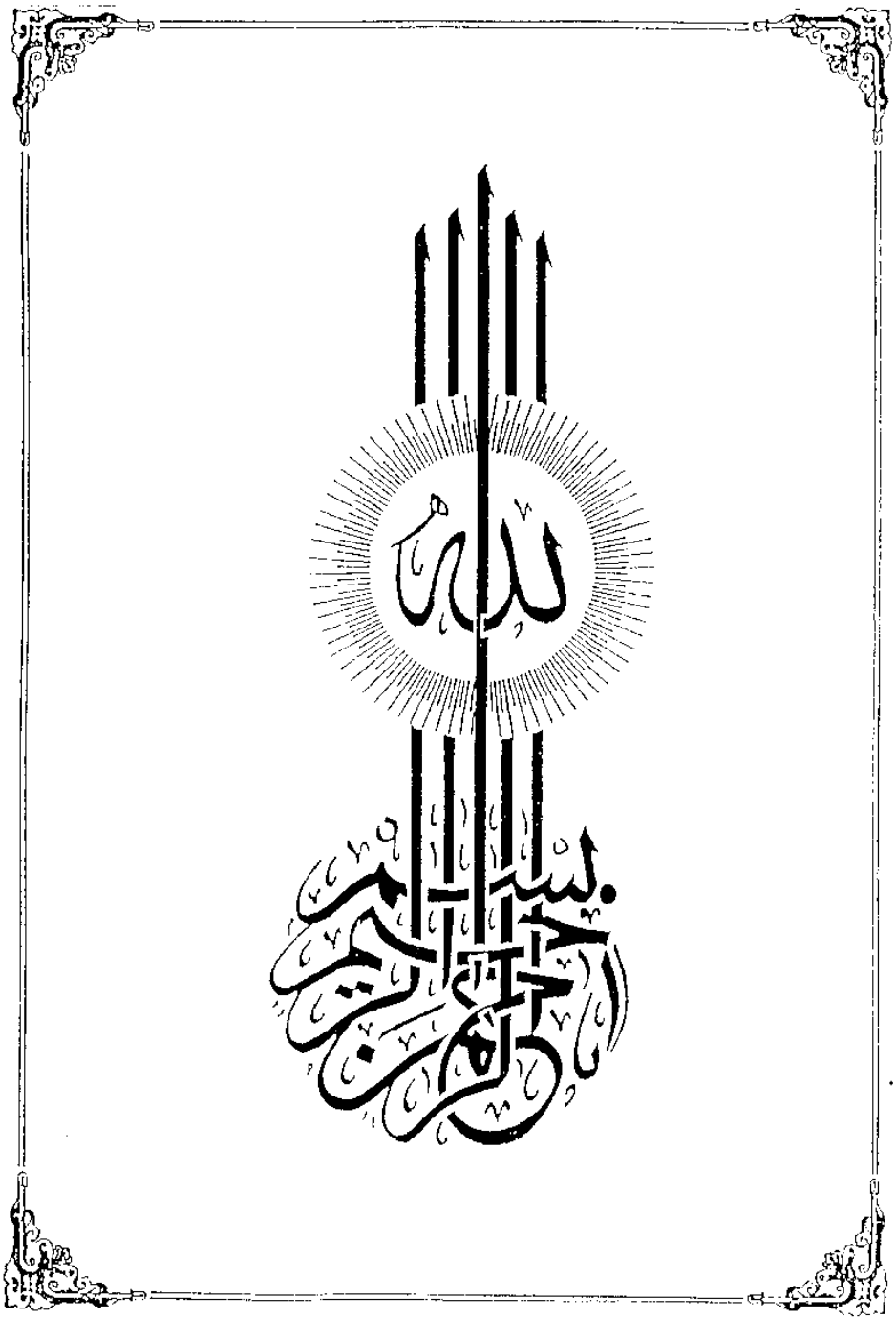

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CHAPTER I

INTRODUCTION AND THEORETICAL CONSIDERATION

1.1. Introduction

The modern industrial countries have reached their present high industrial level through the development of metallurgical industries. These industries are the main support of national economy for any country, without which other branches of national economy can not be developed. Development of heavy, machine, building, chemical and other industries depends mainly on the level of development of ferrous metallurgy.

One of the main parameters of industrial development is the amount of steel produced annually per capita. In Egypt this parameter amounts to 70 kg in comparison with 1000 kg in developed countries.

Therefore, for the development of industry in Egypt, first of all, it is necessary to increase the production of iron and steel as soon as possible, in order to increase the amount of produced steel per capita in nearest future.

A detailed reported on the Egyptian steel industry up to the year 2000 was prepared by the National Council for production of Economic Affairs in 1978. The recommended minimum production target was estimated to be 15 million tons of crude steel, in the following stages.(1)

Year	1990	1995	2000
Production (million tons)	6.5	10	15

by this program, the annual consumption of steel per Capita will reach 250 kg in the year 2000

This increase in the production will be fulfilled by the expansion of iron and steel making and intensifying the metallurgical process in different metallurgical companies.

In Egypt there is two integrated plants, the first is the Egyptian Iron and Steel Complex (in Helwan) based on sintering, blast furnace and B.O.F furnace, and the second one is Alexandria National Iron & Steel Co. (ANSDK) works at El-Dekhila (15 km to the west of Alex. city) based on direct reduction (DR) of pellets and electric arc furnace (EAF) route.

The technical operation of the blast furnace out put in Helwan Iron complex is below the desired specifications.(2)

A rise in pig iron production in Egypt is attained by intensifying the blast furnace process, reducing the consumption of coke and improving the properties of iron ore charge.

The yearly production of pig iron at present time is about one million tons/annums.

The upgrading of the quality of these products (pig iron) at the existing production facilities is an essential National-economic problem whose solution will allow not only in increasing the pig iron production but also substantially improving the technical and economical characteristics of blast furnace operation.

1.2. Historical Review of Agglomeration

Methods of agglomeration of iron ores and iron-containing waste products, fuel dust, pyrites residues ...etc, have been under consideration. Since the end of the last century. They may be classified as follows:-

1- Briquetting
2- Nodulizing (rotary kiln sintering)
3- Vacuum extrusion
4- Sintering (grate sintering)
5- Pelletizing

The development of these processes was accelerated during the second world war when a general ore shortage made it imprative to use all available raw materials.

1- Briquetting

Briquetting involves the pressing of fines Fig. 1.1 with or without binders, into a block of some suitable size and shape and then subjecting it to a hardening process.

A wide range of binders has been used such as tar and pitch, organic (cereal products), sodium silicate, ferrous sulphate, magnesium chloride with iron turnings, limestone

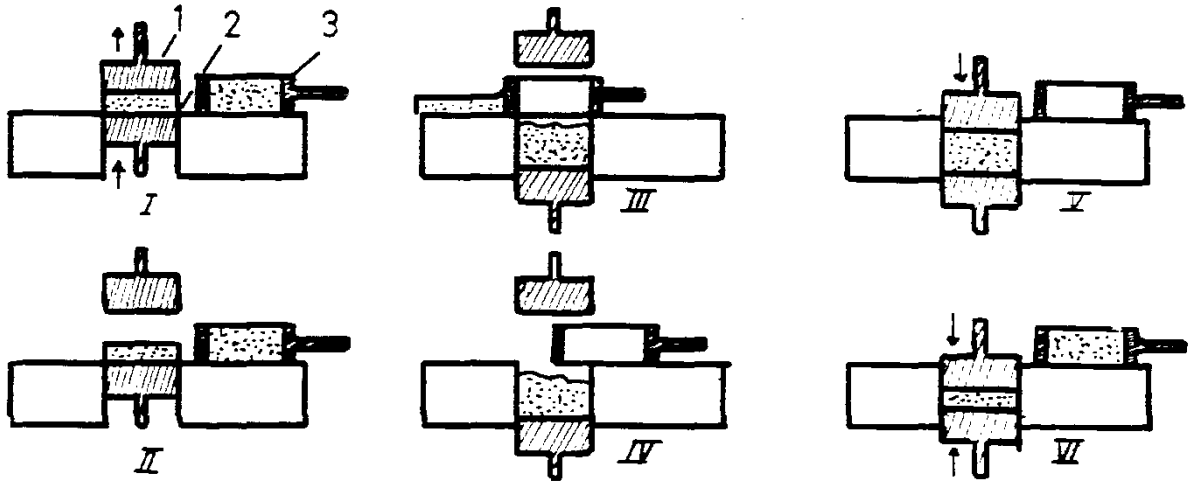

Fig. 1.1. Diagrammatic sketch of briquetting process.

I _ VI ; The production system of briquets.

1_ The upper press. 2_ The lower press_

3_ Charge box.

and cement. Production of briquettes for use in blast furnace decreased after 1950 and had ceased by about 1960.[3,4]

It is difficult to mention all briquetting processes, which have been tried, but the following are the most important of them:

1-a The grondal process

This was the earlist process. It was developed at the Pitkarauta work in Finland in 1899 and in 1913 was in use at 38 works in Europe and the U.S.A.

Fine ore, mixed with water, was pressed into oblong blocks of the size of building bricks, which were hardened by passing them through a tunnel kiln heated to 1350°C.[5]

1-b Briquetting with cement binder

This method was used in U.S.A. during 1940. The woodward iron company of Alabama produced large tonnages of briquettes.[6] Other American companies, including the Armco Steel Corporation, produced and used cement briquettes but on a small scale.

1-c Hot briquetting

During the last 40 years, two hot briquetting processes have been developed to the pilot-plant stage. The United States Steel Corporation process produced pillow shaped briquettes by pressing ore fines at temperatures between (800 and 1050°C) on a roll press under a force of 50-60 tons

weight.[7] The Dravo Corporation of Pittsburgh developed a similar process, but the heating is carried out under slightly reducing conditions.[8]

1-d Carbonate-Bonded briquettes

A process for hardening briquettes or pellets of ore containing some hydrated lime has been developed in Russia. The use of a catalyst, such as molasses in addition to the lime, enabled the briquettes to be hardened at a low temperature 300°C in atmosphere of CO_2.[9]

2. Nodulizing (rotary-kiln sintering)

In the nodulizing process Fig. 1.2 iron-bearing fines and carbon are passed through a rotary kiln, inclined at a few degrees to the horizontal, counter-current to hot gases produced by a gas fired burner.[10] This process was used for many years in Western Europe and U.S.A. particularly for the treatment of flue dust.

Nodulizing kilns were first used in about 1914 and continued in operation until 1960.

3. Vacuum extrusion

Vacuum extrusion Fig. 1.3 has been used in the ceramic industry for many years to make strong dense shapes. In 1950, attempts were made to adopt the process of agglomeration in U.S.A. and England.[11]

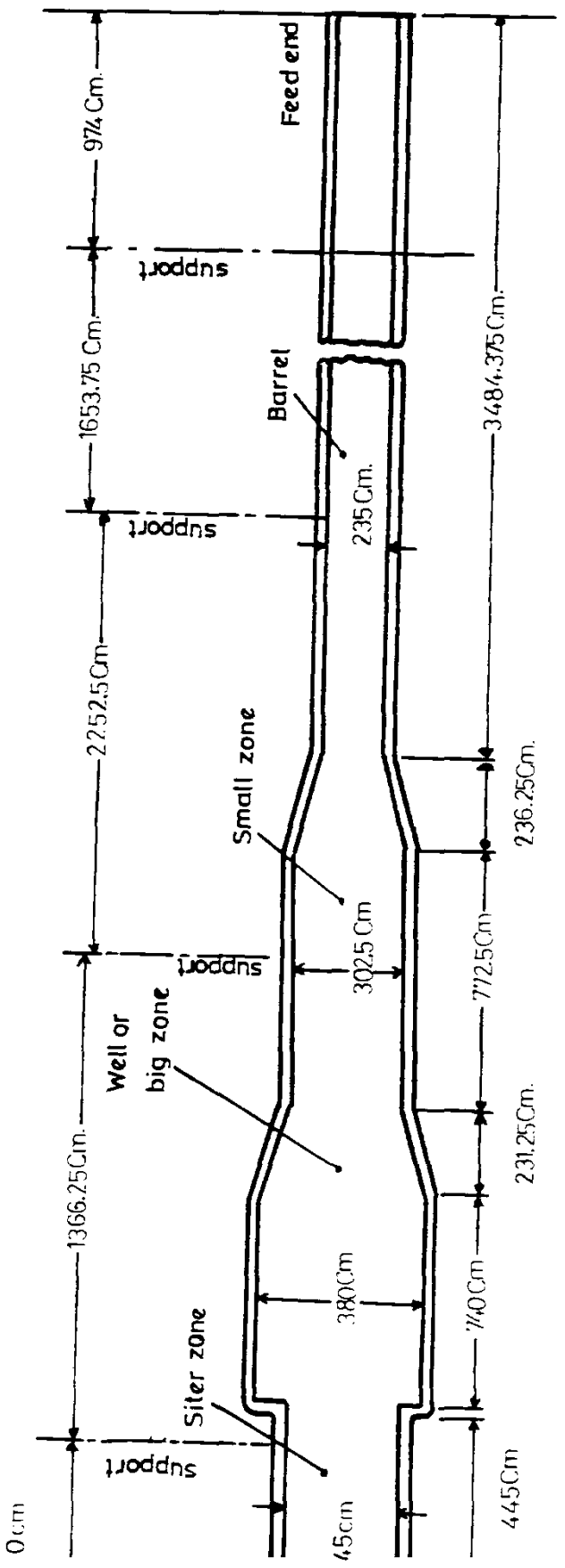

Fig. 1.2. Section through nodulizing . kiln.

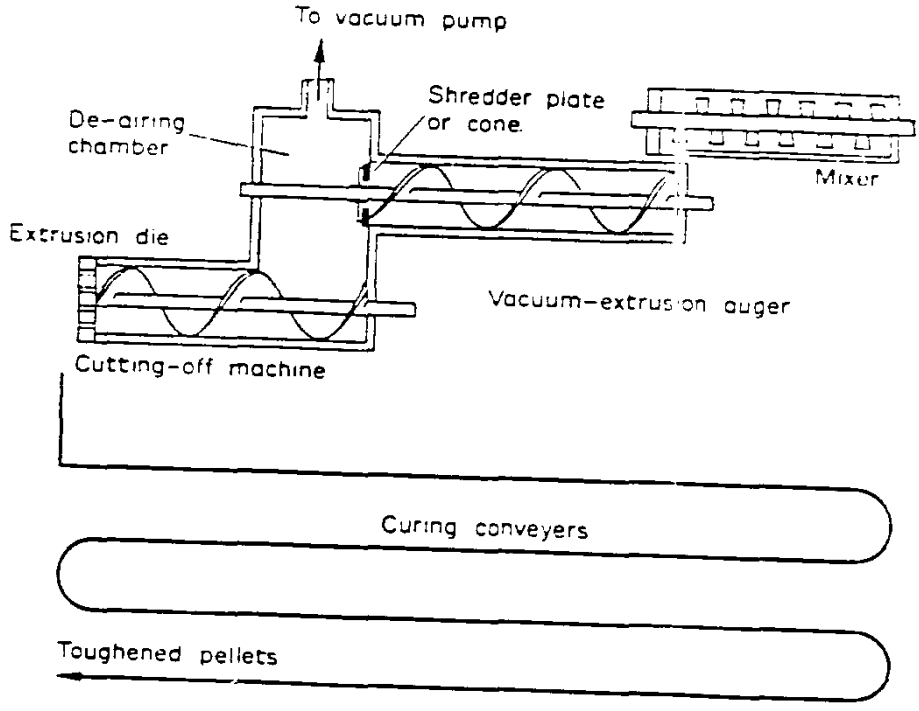

Figure 1.3. Diagrammatic sketch of vacuum extrusion plant