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PREPARED FOR

INTERNATIONAL COOPERATION ADMINISTRATION

REPORT ON

YEMEN CEMENT PLANT

October 1960

TEC-423

TUDOR ENGINEERING COMPANY, Washington, D. C.

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TABLE OF CONTENTS

		Page No.
	Letter of Transmittal	2
A.	Introduction and Summary	4
	Principal Conclusions	4
	Recommendations	5
B.	Cement Market	5
C.	Capacity of Proposed Plant	8
D.	Proposed Location	8
E.	Raw Materials	9
	Limestone	10
	Clay	11
	Gypsum	11
	Iron Oxide	12
	Water	12
	Fuel	12
	Power	13
F.	The Labor Situation	13
G.	Type of Plant	13
H.	Cement Quality	14
I.	Capital Requirements	15
J.	Annual Cost and Profit	16
	Production Cost	16
	Annual Profit	17
	Cash Flow	18
K.	Foreign Exchange Requirements	20
L.	Procedure to Implement Project	21
	Time Element	21
	Start with Grinding Clinker	21
M.	Substantiating Material	22
N.	Acknowledgments	23
	Appendix A - Task Order No. 423	25
	Appendix B - Analyses of Limestone and Sand Samples	27
	Appendix C - Bibliography of Material Available	29

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401 - 23rd Street, N. W.
State Annex No. 1
Washington, D. C.

October 20, 1960
Ref: TEC-423

Attention: Mr. N. E. Thompson

Gentlemen:

SUBJECT: YEMEN CEMENT PLANT

Field Inspection

Pursuant to Task Order 423, dated May 27, 1960, our cement plant consultant, Mr. Lewis A. Parsons, proceeded to Rome, Cairo and Yemen to investigate all the information available concerning the cement plant proposed for Yemen. (See Appendix A for copy of task order). At Rome, Mr. Parsons contacted the U.S. Embassy and the representatives of Ansaldo Societe Anonyme of Genoa and Impresa Astaldi Estero of Rome. Complete details of the plant proposed by the two Italian companies were reviewed, including equipment lists and engineering brochures of each company. Their respective credit ratings were also obtained.

Mr. Parsons then proceeded to Cairo and met with the staff of the U.S. Embassy as well as with a representative of Ansaldo who was headquartered in Cairo. Considerable information was secured with respect to the production and movement of cement out of UAR and into Yemen and other Middle East countries.

Mr. Parsons was in Yemen from August 24, 1960, to September 5, 1960, investigating all the information available, with particular attention to the factors concerning feasibility, location of

raw materials, location of plant, adaptability of proposed equipment, possible operating methods, and estimate of cost of the proposed plant.

On the return trip the consultant was requested to stop in Cairo and again confer with the Ambassador and his staff.

A stopover was made in Lebanon to investigate material available at the Industry Institute at Beirut. Upon return to Rome, conferences were held with the Ambassador's staff as to the findings.

Mr. Parsons' report is submitted herewith. The introductory section contains a summary of the principal conclusions and recommendations.

A bibliography of reports substantiating the findings of the report is attached as Appendix C.

Respectfully submitted,

TUDOR ENGINEERING COMPANY

John G. Marr

JGM:bb

John G. Marr
Project Manager

A. INTRODUCTION AND SUMMARY

The desirability of constructing a cement plant in Yemen has been under consideration for several years. In 1955 a proposal was made to the Government to build a 150 metric ton (MT) plant by two Italian firms, namely, Ansaldo Societe Anonyme of Genoa, manufacturers and designers, and Impresa Astaldi Estero of Rome, general builders. Cost estimates and outline plans were submitted with their proposal. No action has been taken on this or any subsequent proposals.

The present investigation was undertaken for the purpose of ascertaining the feasibility and cost of establishing a cement plant at this time and securing information and advice as to location, type of process, operating costs and probable profitability. The report which follows, based on field examinations and conferences with informed officials and persons in Cairo, Rome, Lebanon and Taiz, is summarized below.

Principal Conclusions

1. Yemen uses about 25,000 MT of cement per year.

2. A cement plant having a capacity of 200 MT per day would be economically feasible.

3. 150 MT per day plant proposed by Ansaldo and Astaldi could accomplish the desired results but a 200 MT plant would probably be more economic.

4. The estimated cost of the completed plant, including engineering, would approximate $4,000,000.

5. It will be necessary to bring in foreign technicians to manage and operate the plant.

6. An employee training period will have to extend over a period of years.

7. Assuming proper management, it should be possible to secure a gradually increasing profit over the first several years, which in the fifth year should approximate $300,000.

Recommendations

1. Capacity of the proposed plant should be fixed at 200 MT per day.

2. The first step in developing a cement plant project in Yemen should be to employ a qualified engineer, not connected with any manufacturer, to prepare complete plans and specifications adapted to a specific location. His contract would provide that he would assist in obtaining and evaluating bids for construction work and would supervise the work after an award was made.

3. At the same time, arrangements should be made to ascertain the quantity and quality of the raw materials available at or near the selected plant site. The information obtained would be transmitted to the design engineer as soon as possible so that quarry operations, transportation facilities and plant design and location could be properly coordinated.

4. The construction work should be awarded on the basis of competitive world-wide bidding.

B. CEMENT MARKET

The cement requirement in Yemen can be forecast to some extent by an examination of the records of cement movements in the general area.

The "Monthly Summary of Foreign Trade for UAR" gives the following export figures for 1958 and 1959.

Destination	Metric Tons 1958 (p. 161)	1959 (p. 172)
Saudi Arabia	135,889	152,063
Gaza Strip	19,644	47,730
Sudan	9,042	500
Yemen	4,000	10,850
USA	-	2,211
Other Countries	49,331	212,415
	217,906	425,769

The Suez Canal Report for 1959 shows that the cement passing south through the canal amounted to 1,684,000 tons (p. 146). Details showing the growth of this traffic since 1920 are given on page 135. Details of some of the movements are given as follows:

Exporting Country (p. 109)	Metric Tons
Yugoslavia	265,000
United Kingdom	210,000
Russia	203,000
Rumania	118,000
UAR	103,000
Belgium	96,000
Tunisia	94,000
Poland	87,000
Sweden	66,000
	1,242,000

Some of the destinations as shown in the same report are as follows:

Destination (p. 109)	Metric Tons
Arabian Gulf Countries	668,000
East African Countries	146,000
South East Asia	298,000
India, Pakistan, Burma, Ceylon	233,000
	1,345,000

The 103,000 MT of UAR cement shown above as shipped through the Suez Canal in 1959, were exported by the Alexandria Portland Cement Company. To this must be added an estimated 350,000 MT shipped directly from Suez without passage through the Canal to obtain approximate total production.

The above figures for 1959 UAR exports show 10,850 MT going to Yemen. To this must be added imports from other countries. The following import figures for 1959 were obtained from the Customs office of the port of Hodeida.

Date of Arrival	Importer	Metric Tons	Origin
March 8	Haiel Said	500	Russia
June 13	El Jabaly	25	Aden
June 24	Haiel Said	3,000	Russia
October 1	Haiel Said	3,750	Russia
November 2	El Jabaly	787	Danzig
November 12	Haiel Said	1,412	Russia
November 25	El Jabaly	1,841	Danzig
		11,315	

These imports do not include any cement imported directly by Russia or Chinese agencies for use on their projects. In addition, some cement has been imported through the ports of Mocha and Rahida, and possibly overland from Aden, but no figures were readily obtainable. No record could be found of any imports from Saudi Arabia. In view of large imports by Saudi Arabia, it seems unlikely that any cement would be exported by that country.

The figures for imports from Egypt and other countries add to 22,165 MT. Assuming an addition of 2,835 MT for other points of entry, the total import into Yemen in 1959 would be 25,000 MT, which is the figure used herein. The figure of 25,000 MT was checked with several Yemen officials, who feel that it is about right.

C. CAPACITY OF PROPOSED PLANT

A cement plant designed to meet Yemen's 1959 consumption of 25,000 MT would require a capacity of only 80 MT per day, assuming 300 working days per year. The Italian designer previously referred to proposed a capacity of 150 MT. This size would be less economical to operate than a larger plant and does not provide sufficient margin to take care of the probable future growth in cement consumption. With an ample supply of low-priced cement, consumption might reach 50,000 MT per year in three or four years. It is recommended that 200 MT per day be adopted as the design capacity, which would permit the manufacture of 60,000 MT per year. This should take care of Yemen's needs for several years and might provide small quantities for export to nearby countries, if production costs prove to be low enough to meet foreign competition.

D. PROPOSED LOCATION

The best location for a cement plant is never a simple problem. Often many months are spent on investigation of this aspect alone, involving detailed market studies, freight rates (or costs of truck transport), and competition from other plants. Such a detailed study was impossible in the time available for the present report.

The Italian engineers have proposed a location close to a limestone deposit about 2 miles south of the town of Bajil. It is close to the new road being built by the Chinese from Hodeida to San'a. It is about 40 miles from Hodeida where new docks and facilities have created an important port and through which fuel oil and other imported supplies for the plant can be obtained.

The location at Bajil is tentatively approved, subject to modification if further studies should be undertaken. The reasons for its choice are as follows:

1. Although no definite figures are available, the largest cement market in Yemen appears to be around San'a.

2. A plant at Bajil would dominate the San'a market. It would, however, be at a small disadvantage in competing with foreign cements in the Hodeida, Mocha and Taiz markets. This disadvantage will be reduced as the roads are improved, and particularly if a new road is built between Hodeida and Taiz.

3. A plant at Hodeida would have very little advantage over Bajil. The cost of bringing the limestone to Hodeida would approximate the cost of shipping cement from the plant to Hodeida, and the advantage of being on the Hodeida-San'a road would be lost. Competition from imports would increase, possibly enough to wipe out the small indicated profit margin.

4. A plant at San'a would be an advantage to the San'a market, but nowhere else in Yemen.

5. Exports are impossible with the present indicated costs. If exporting should become possible at some future time, it would be substantially as easy from Bajil as from Hodeida.

E. RAW MATERIALS

The quantities of the principal raw materials required are shown in the following table.

RAW MATERIALS TO PRODUCE 200 TONS OF CEMENT PER DAY

	Metric Tons	
	Per Day	Per Year (300 Days)
Limestone	288	86,400
Clay and sand	72	21,600
Fuel oil	46	13,800
Gypsum	8	2,400
Water	720	216,000

The availability of the materials listed above, and others of lesser importance, is discussed below.

Limestone

There are several low hills of limestone south of Bajil, rising a few hundred feet above the surrounding desert. They are disconnected above the surface. No attempt was made to estimate the tonnage in these hills, but from visual inspection it is more than ample for the projected plant. Over 10,000,000 MT of limestone are exposed, which would be sufficient for 100 years at 100,000 MT per year.

To ascertain the quality, three grab samples were taken, over a width of 150 ft. each, from the limestone outcrops pointed out to us as having been sampled by the Italian engineers. They were analyzed in a U.S. laboratory (see Appendix B, Samples 2, 3 and 4) and proved to be quite uniform, which is a very good sign. The average composition was as follows:

Item	Per Cent
Loss on ignition	42.58
SiO_2	.51
AL_2O_3	.99
Fe_2O_3	.43
CaO	53.73
MgO	.75
Na_2O	.82
K_2O	.40
$CaCO_3$ (calculated)	9[illegible].80

The above analysis checks reasonably well with the results reported by the Italians.

The limestone is excellent except for the alkalis, which seem to be much too high. Cement made from it would contain too much alkali for the best modern practice. It is believed, however, judging by the rest of the analysis, that a more accurate determination of the alkalis would give lower results for these constituents.

The above comments on limestone are based on visual inspection and a limited number of samples. Although it is not considered that there is much danger of the limestone being inadequate in either quantity or quality, good engineering would require that the deposits be drilled and surface sampled according to the usual technique before being irrevocably committed to a plant. At least three holes should be drilled several hundred feet deep, the limestone surface sampled at right-angles to the strike, and the resultant sections averaged for tonnage and grade.

Such a program could be directed by a young mining engineer with a couple of years experience in that kind of work. The complete investigation might take a year. In order to conserve time, it is suggested that the exploration work be done concurrently with the plant design, with a clause in the engineering contract providing that it could be terminated by payment for work done if the limestone should prove unsuitable.

Clay

Ample clay is reported to be available relatively close to the plant site. The clay sampled by Ansaldo has too high an iron content. A sample of dune sand was taken and according to its analysis this should blend with the clay to make a satisfactory mix. (See Appendix B, Sample 5).

Gypsum

No investigation was made of gypsum resources. Normally

the quantity required is about 4 per cent of the weight of the clinker which would be 8 MT per day in the present case. If a local supply cannot be developed, importation will be necessary.

Iron Oxide

A small amount of iron oxide is normally required for blending with the raw mix. With the clay-sand blend mentioned above, a great deal of iron oxide would probably not be required. The small amount needed should not be a serious problem.

Water

The quantity of water available should be definitely determined before any irrevocable commitments for a plant are made. A 200 MT dry plant will require around 500 litres of water (130 gal) per minute. This can probably be reduced if necessary by conservation and by reclaiming used water in cooling ponds, but there is a minimum below which it is not possible to go without getting into trouble in the plant. It is reported that the many shut-downs of the Jidda plant in Saudi Arabia were caused in part by insufficient water.

A well drilled for the textile mill at Bajil is reported to have produced 1000 litres per minute, but the effect on the water table is not known.

It is suggested that at least three wells be drilled and gauged in the vicinity of the projected plant site. They should be pumped until the effect on the water table is determined. The best information available is that the wells should be about 40 meters deep.

Fuel

The only logical fuel is Bunker C oil, which is plentiful in the Middle East. It is currently costing the Lebanon plants $21.00 per MT delivered at the plant. The same price has been assumed

for Yemen. However, oil prices vary greatly, and at present oil is being sold at a discount from the published prices.

A consumption of oil of 507 lb per ton of clinker has been assumed, equivalent to 23 per cent of the clinker weight. Lebanon plants average 20 per cent of the clinker weight, which might be reached by the Yemen plant after a few years operation. When first operated, the figure of 23 per cent is more probable. The requirement is therefore 46 MT of oil per day.

Power

A power unit of some type must be provided in or nearby the plant to provide for operation of equipment.

F. THE LABOR SITUATION

Almost every job in a cement plant is skilled. A few laborers are needed, but outside of that every job requires a man thoroughly trained in its performance. The Yemeni should be able to handle trucks and bulldozers or similar moving equipment easily, but the other jobs, such as crushing, milling, burning, packing, drilling, power shoveling and the like, are outside their experience and will require specially trained men. Not all these jobs are equally difficult, but all require a period of apprenticeship. For this reason it is believed that the only sound method would be to import key men from foreign plants, and have them train Yemen apprentices. This would necessarily increase the cost of operation greatly for the first few years.

G. TYPE OF PLANT

Several types of cement plant are in use. The "dry" plant is one in which the raw material is ground and blended dry and fed thus to the rotary kiln. A "wet" plant is one in which the raw material is ground into a slurry with water. This type of plant requires a

larger amount of water since all of the water is used to make slurry goes up in steam and is lost. Other differences between a wet plant and dry plant are:

1. The dry plant uses more power for grinding the raw mix.

2. The dry plant uses much less fuel. The saving in fuel far exceeds the extra cost of raw-grinding.

3. The wet plant slurry is easier to blend and sample than the dry mix, although in recent years blending and sampling a dry mix has been perfected so that it is no longer a serious problem.

Some consideration was given by Ansaldo to the Lepol kiln, which is a complicated combination of a modulizer, traveling grates, and a system of baffles and valves usually controlled by thermostats. The fuel economy is great, up to one-half, at the expense of more operating labor and maintenance. On account of the lack of cement men in Yemen, and the necessity of importing trained men from some other country for every key post until Yemen labor is trained, it is not believed that the Lepol kiln, with its many complications, would be practicable.

After balancing the various factors, a dry plant is recommended for Yemen.

H. CEMENT QUALITY

The plant should be designed to make cement which will meet generally accepted specifications. If not, it would become just

one more cement plant making an inferior product, and on critical concrete work the pressure would be great to obtain better cement from abroad.

There is nothing particularly difficult about making a specification cement. If the raw materials are suitable, all that is required is proper laboratory control, and a management policy that will not tolerate inferior cement. The laboratory must be developed and the technicians must be trained during the period required to get the plant into full production and it is just as easy to train them to do precise work as to let them get by with bad work.

The raw materials, by proper blending of the clay and sand, should permit making Types I, II and III cements. These are all that are normally required in a modern plant.

I. CAPITAL REQUIREMENTS

An estimate of the construction cost of a 150 MT per day cement plant as of 1960 was obtained from the Italian engineers and contractors in dollars as follows:

Equipment furnished by Ansaldo FOB Genoa:	
Cement manufacturing equipment	$1,770,000
Power Plant	475,000
Crushers, quarry equipment, laboratory, shop, fuel oil plant and storage tanks for water and oil	315,000
Total	$2,060,000
Construction work by Astaldi Estero:	
Freight and erection, building complete plant, and running tests	$1,280,000
Total	$3,340,000

Attempts to obtain a quotation from the same sources on a 200 MT plant were not successful. For the larger plant, the construction cost is estimated at $4,000,000.

Working capital is estimated at $800,000.

J. ANNUAL COST AND PROFIT

Production Cost

The cost of operating a 200 MT per day plant in Yemen, where no local trained workers are available, and where qualified key men must be imported, is impossible to calculate with precision. All the nearby foreign plants, for which costs are available or can be estimated from balance sheets, are much larger and have been in operation many years. As a basis for an estimate, it was decided to use a plant in Lebanon, with a daily production of 700 MT. The cost of operating this plant, after payment of taxes, is $10.30 per MT. The corresponding cost of the Yemen plant is derived as follows:

Total cost in Lebanon, less tax	$10.30
Add for smaller capacity	6.00
Add for foreign supervision	6.00
Total	$22.30 per MT

This represents the production cost during the first year of full capacity operation, including depreciation, but without any excise taxes.

This is a very high cost, but a lower one cannot be justified under the prevailing conditions. It is expected that these costs would come down slowly, so that the first profit margin is probably the smallest. However, training men unfamiliar with cement plants is a long process. It would probably be several years before the costs would approach normal for a plant of this size.

Annual Profit

The probable maximum sale price will be fixed by the cost of imported cement, which is now $23.10 FOB dock before payment of custom duties. Allowance must be made for the haul from the port of Hodeida. The indicated profit during the first year of full production is then estimated as follows:

Item	Per MT
Sale price of imported cement, FOB dock	$23.10
Hauling to Bajil, 40 miles @ 10¢	4.00
Sale price FOB Bajil	$27.10
Cost of manufacturing at Bajil	22.30
Gross Profit	$ 4.80
Amortization of $4,800,000 in 20 years without interest based on 60,000 MT per year	4.00
Indicated Net Profit	$ .80

The hauling rate of 10¢ per MT-mile used above is based on use of the road now under construction. Present rates over existing roads are reported by the auditor of USOM at Taiz to be 30¢ per MT-mile.

Some amplification of the above figures is necessary. A 200 MT plant is necessarily a high-cost plant even under stabilized operation. At the beginning, when all labor for key posts must be imported, when Yemeni apprentices are being paid for learning and while sales are less than nominal capacity, exact costs are impossible to predict. The costs given are the best estimates possible, but they are still only estimates, and small shifts in the factors used would show a loss instead of a profit. It will probably take five years for the plant to stabilize with local labor, develop its market, and show an assured profit.

Moreover, the profit shown is for sales in the high-net or best market area, which is in and around San'a. No cement plant sells all its production in its high-net territory. To expand its market to 60,000 MT per year, it will be necessary for a Yemen plant, no matter where located, to sell throughout the country. Every sale, except those between Bajil and San'a, must be at a lower price to compete with imports, so that the average price must necessarily be less than the price shown. How much less will depend upon how the market develops, but it is not to be expected that the plant can amortize a loan and pay a profit until after several years of operation.

Cash Flow

The accompanying Cash Flow tabulation is an attempt to show these various factors quantitatively. The average sale price is shown as decreasing to $20.00 per MT after the first two years. This is virtually a necessity if the plant is to realize its full potential in Yemen. Costs for the purpose of the Cash Flow are figured without depreciation, which is purely a book transfer and does not affect the cash position. They are shown as decreasing $2.00 per MT each year from the third to the fifth year, when they are assumed to be stabilized. The costs for the first two years are higher, since during those years the plant is not producing its full capacity. It is assumed that production in the last half of the second year might reach full capacity with a cost, less depreciation, of $18.30 ($22.30 - 4.00). Thereafter, costs would decrease due to improved efficiency. The starting cash of $300,000 was taken from the $800,000 working capital, it being assumed that the remainder would be frozen in supplies, spare parts, material in process and receivables.

It will be noted that the calculated cash position is rather thin until the beginning of the fifth year. Some temporary additional financing may be necessary to tide the plant over this period.

The picture as shown represents a reasonable outline of what might be expected from a well-managed, efficiently run plant. It takes no account of custom duties or excise taxes, which might alter the outcome considerably. It is believed that high prices, supported by high tariffs on imported cement, would seriously restrict the use of cement and prevent the plant from developing as it should.

CASH FLOW

(excluding depreciation charges)

		Cash
Cash, beginning first year		$300,000
Income from Sales, 30,000 tons @ $27.10	$813,000	
Cost, 30,000 tons @ $28.00	840,000	
	(27,000)	
Amortization	240,000	
Profit (Loss)	($267,000)	33,000
2nd Year		
Income from Sales, 45,000 tons @ $24.00	$1,080,000	
Cost, 45,000 tons @ $19.40	870,000	
	210,000	
Amortization	240,000	
Profit (Loss)	($30,000)	3,000
3rd Year		
Income from Sales, 60,000 tons @ $20.00	$1,200,000	
Cost, 60,000 tons @ $15.00	900,000	
	300,000	
Amortization	240,000	
Profit (Loss)	$ 60,000	63,000
4th Year		
Income from Sales, 60,000 tons @ $20.00	1,200,000	
Cost, 60,000 tons @ $13.00	780,000	
	420,000	
Amortization	240,000	
Profit (Loss)	$ 180,000	243,000
5th Year		
Income from Sales, 60,000 tons @ $20.00	$1,200,000	
Cost, 60,000 tons @ $11.00	660,000	
	540,000	
Amortization	240,000	
Profit (Loss)	$ 300,000	$543,000

K. FOREIGN EXCHANGE REQUIREMENTS

When the cement plant reaches full capacity production at 60,000 MT per year, the foreign exchange funds required per year will be about as follows:

Item	Cost per Year
Fuel Oil, 13,800 tons @ $14.20	$196,000
Gypsum, 2,400 tons @ $ 5.00	12,000
Foreign Labor, equivalent to 60,000 tons @ $ 6.00	360,000
Spare Parts	100,000
Total	$668,000

Fuel Oil

This is taken at $21.00 less $6.80 unloading and hauling in Yemen.

Labor

The cost estimate shows a $6.00 per ton surcharge for imported labor. It is assumed that this part of the money will be sent to the home base of the employees. This cost should decrease after Yemeni employees have had a few years of training.

Spare Parts

These are taken as 1/20 of the basic cost of the plant for equipment, i.e., without erection.

Comparison with Present Expenditures

At the present time foreign exchange expend[illegible] for cement are about as follows:

25,000 MT @ $23.10 -- $577,000 per year

It is thus seen that more money will leave Yemen when operating a 60,000 MT plant locally than is now leaving for cement purchases. The quantities of cement, of course, are different. If only 25,000 MT was produced at the new plant, the foreign exchange cost might be about $500,000 per year.

L. PROCEDURE TO IMPLEMENT PROJECT

The first step in developing a cement plant project in Yemen would be to employ a qualified engineer, not connected with any manufacturer, to prepare complete plans and specifications adapted to a specific location. His contract would provide that he would assist in obtaining and evaluating bids for construction work and would supervise the work after an award was made.

At the same time, arrangements should be made to ascertain the quantity and quality of the raw materials available at or near the selected plant site. The information obtained would be transmitted to the design engineer as soon as possible so that quarry operations, transportation facilities and plant design and location could be properly coordinated.

The construction work should be awarded on the basis of competitive world-wide bidding.

The Time Element

If the limestone is drilled and the tonnage and grade determined before any work is started on plant design, the time between the decision to go ahead and the first cement to come from the plant will be of the order of four years. If the limestone is drilled concurrently with the plant design, this might telescope the time into three years.

Starting with Grinding Mills

The suggestion has been made that in order to produce

cement quickly, the finish-grind mills might be erected first and clinker be imported to grind while the rest of the plant is being built. No quantitative figures have been given to support this suggestion. It appears that delivery of the finish-grind mill would take at least six months, and perhaps considerably more for the motor and switchboard. Moreover, such an operation could require many other accessories, viz, laboratory, shops, diesel power-plant, pack-house, power distribution and many buildings. There would be the usual confusion from attempting to operate and finish construction at the same time. Clinker costs almost as much as cement, and the plant would certainly lose money from such a start. Although not without merit, the suggestion should be thoroughly investigated cost-wise and time-wise before giving it serious consideration.

M. SUBSTANTIATING MATERIAL

The substantiating material on which this report is based was secured from numerous sources in Washington, Rome, Cairo, Beirut and Taiz. Personal interviews and conferences with groups of people contributed much. When possible, reports, brochures and statistical tables were secured as substantiating evidence. A bibliography of the reports available in the Washington office of Tudor Engineering Company is attached as Exhibit C. A brief description of the source and type of evidence follows:

From FAO in Rome

The United Nations Food and Agriculture Organization in Rome made available its "Report on the FAO Mission to Yemen", dated 1960. This provided excellent factual material on the people, government, climate and agriculture of the country.

From Ansaldo and Astaldi in Rome, Cairo and Taiz

Plans showing the proposed layout and elevations of the plant, a list of all of the machinery to be supplied, and an estimate of cost, were secured from Ansaldo, the designer. Astaldi, the

construction company which expected to erect the plant in accord with the Ansaldo plan, also provided considerable information. Technical brochures indicating activities of both firms are available as well as reports on financial ratings.

From the UAR in Cairo

The Department of Statistics and Census of the UAR in Cairo provided monthly summaries of foreign trade which indicated the flow of cement from UAR to other countries in the Middle East, including Yemen, and to Africa.

The Suez Canal Authority made available a report dated 1959 entitled "The Suez Canal Report". This indicates the movement of cement through the Suez Canal.

From Industry Institute - Beirut

Reference to this institute and its activities was interwoven into several reports reviewed in Taiz. It was indicated that they had been concerned in analyzing the cement industry in areas of the Middle East and had done some work in Yemen. A brochure indicating the activities of the institute was secured and is available.

From U.S. Embassies in Rome and Cairo

Conferences with numerous members of the staffs of the U.S. Embassies in Rome and Cairo prior to entry into Yemen produced a variety of valuable information. Meetings were held with them at their request, after the field work had been completed, to advise them of the general findings and to pick up additional information which they had assembled in the meantime.

N. ACKNOWLEDGMENTS

This survey could not have been completed without the cordial cooperation of everybody contacted. So many were of help

that it is impracticable to mention them all by name. Grateful thanks are due the U.S. Ambassador in Cairo, the Honorable George Frederick Reinhardt, and the staffs of the American Embassies in Rome, Cairo and Beirut; to Ralph Workinger, USOM Director in Taiz and his staff; to Fernando Kher, representative of Ansaldo in Cairo, and to Dr. Carbone of the Italian Embassy in Taiz.

The following Yemen officials were especially helpful:

His Excellency Sayyed Yahya Abdul Qader, Viceroy and Governor of Hodeida;

His Excellency Sayyed Abu Tajeb, Director of the Foreign Office in Taiz; and

Colonel Ali Lutff Althawr.

APPENDIX A

TASK ORDER NO. 423

CEMENT PLANT ENGINEERING

YEMEN

APPENDIX A

TASK ORDER ICA No. 423
OFFICE OF INDUSTRIAL RESOURCES
INTERNATIONAL COOPERATION ADMINISTRATION
Washington 25, D. C.

Date: May 27, 1960

PIO/T No. 99-25-042-3-09007-A-7
(Proj. 042)

TO: Tudor Engineering Compan

ICA Project No. and Title: Cement Plant Engineering

Country: Yemen

Project Engr./Mgr.: C. McNaron

Phone Extension: 3783

Assignment: Send a consultant to Yemen to confer with ICA representatives, and local government officials to review available information, reports and documents; to make recommendations concerning procurement, location, feasibility, equipment and operating methods, estimate of cost and to provide technical advice concerning the establishment of a cement plant in Yemen.

Target Date: ASAP

Acknowledged:

(Sgd) John G. Marr
Tudor Engineering Company

(Sgd) N. E. Thompson
by J. G. Lightfoot
N. E. Thompson
Chief, Engineering Division
Office of Industrial Resources

(Sgd) C. W. Allen
C. W. Allen, Director
Office of Industrial Resources

APPENDIX B

ANALYSIS

OF

LIMESTONE AND SAND SAMPLES

Penniman & Browne, Inc.

Baltimore, Maryland

APPENDIX B

REPORT OF ANALYSIS

No. 606070 October 6, 1960

Sample of Mineral

From Tudor Engineering Company

Marked For Chemical Analysis

	LIMESTONE				SAND
SAMPLE NO.	1	2	3	4	5
Loss on Ignition	1.84	42.41	42.56	42.78	3.39
Silica, SiO_2	82.14	0.58	0.33	0.61	69.40
Aluminum Oxide, Al_2O_3	10.85	1.47	0.72	0.78	13.39
Iron Oxide, Fe_2O_3	0.39	0.37	0.38	0.54	2.05
Calcium Oxide, CaO	0.88	54.10	52.74	54.34	5.72
Magnesium Oxide, MgO	0.24	0.83	0.59	0.83	2.41
Sodium Oxide, Na_2O	0.25	0.70	0.95	0.82	0.18
Potassium Oxide, K_2O	1.48	0.30	0.38	0.52	0.52

Samples #2 and #3 showed definite evidence of sulfide content.
Sample #1 claimed to be limestone. Test indicated it was not limestone.

Analysis made by Penniman & Browne, Inc., Baltimore, Maryland.

APPENDIX C

BIBLIOGRAPHY OF MATERIAL

AVAILABLE

WASHINGTON OFFICE - TUDOR ENGINEERING COMPANY

APPENDIX C

BIBLIOGRAPHY OF MATERIAL AVAILABLE WASHINGTON OFFICE - TUDOR ENGINEERING COMPANY

Ansaldo, S. A.	Constructions Mecaniques et Metalliques
Ansaldo, S. A.	Chantiers Navals
Ansaldo, S. A.	Equipment List - Proposed Plant
Ansaldo, S. A.	Plans and Elevations - Proposed Plant
Ansaldo, S. A.	Mechanical Engineering Activities
Chemical Analysis	Limestone and Clay - Cementir Laboratorio Centrale, Italy
Chemical Analysis	Limestone and Sand - Penniman & Browne, Inc., Baltimore, Maryland
Department of Statistics and Census, UAR	Monthly Summary of Foreign Trade 1. January to December 1958 2. January to December 1959
FAO	"Report of the Mission to Yemen" 1960
Financial Rating	Impresa Astaldi Estero
Financial Rating	Ansaldo S. A.
Impresa Astaldi Estero	Impresa Costruzioni Civili Ed Impianti Industriali
Industry Institute	Beirut, Lebanon (Brochure)
Suez Canal Authority	Suez Canal Report 1959