Yemen

Mafraq Cement Plant Construction Project

Report date: March 2001
Field survey: September 2000

1. Project Profile and Japan's ODA Loan

Site map: Taizz, the Republic of Yemen


An overview of the Mafraq Cement Plant

1.1. Background

In developing its economy and infrastructure, the former North Yemen*[1] had to import large quantities of basic materials and equipment due to the underdeveloped state of domestic industry. The country was particularly dependent on imports of cement; annual domestic production of cement totaled 785,000 tons (500,000 tons at the Amran plant and 285,000 tons at the Bajil plant) in 1987, while consumption amounted to 1,923,000 tons. Domestic consumption grew at an average annual rate of 11.5% during the period from 1980 to 1987, and demand was expected to increase at an average annual rate of around 5.5% in subsequent years. Meanwhile, partly due to substantial domestic deposits of limestone, required for cement production, the government of the former North Yemen prioritized the construction of cement plants, to produce import substitution effects.

*[1] North and South Yemen were unified in 1990.

1.2. Objectives

The objective was to build a new cement plant in Mafraq, located approximately 40 km west of Taizz, the second largest city in Yemen, to meet the growing demand for cement. The new plant incorporates all processes required for cement production and utilizes the copious domestic limestone deposits.

1.3. Project Scope

The project comprised the construction of a dry cement manufacturing plant with an annual production capacity of 500,000 tons. Facilities included material crushers, material grinders, calciners, cement grinders and packing units. The ODA loan covered all costs quoted in foreign currency for materials, equipment and services

required for plant construction, excluding consultant fees.

1.4. Borrower/Executing Agency

The government of the Republic of Yemen/Yemen Cement Corporation (YCC)

1.5. Outline of Loan Agreement

Loan amount/Loan disbursed amount	¥22.070 billion/¥22.068 billion
Exchange of notes/Loan agreement	September1988/November 1988
Terms and conditions	Interest rate: 1.5%, Repayment period (grace period): 30 years (10 years), Partially untied
Final disbursement date	December 1997

2. Results and Evaluation

2.1. Relevance

Initial plans aimed to meet cement demand in the former Northern Yemen. Subsequently, the north and south were unified, to establish a new state in 1990. In order to meet domestic cement demand, the new state continues to import cement from neighboring countries. Under these circumstances, the Mafraq plant is contributing to increasing domestic self-sufficiency for cement by utilizing abundant domestic limestone deposits and to bringing greater import substitution effects (saving of foreign currency). The project is thus considered relevant.

2.2. Efficiency

(2.2.1.) Implementation Schedule

Commercial operation was initially scheduled to start in June 1991, but in fact commenced in March 1993, 21 months behind schedule. This is attributed to the three reasons outlined below. First, unavoidable factors related to the political confusion that accompanied unification in 1990, delayed the preparations for bidding documents, and the start of construction work was put back by 17 months. Second, the Gulf Crisis forced YCC to procure cement from Romania instead of Saudi Arabia as originally planned. Third, it took time to conclude negotiations to acquire part of the plant site, resulting in a slight delay in the completion of overall construction.

(2.2.2.) Project Costs

The actual total project cost was ¥22.398 billion as compared to the ¥22.597 billion initially estimated. The amount of ODA loan approved was ¥22.070 billion while the disbursed amount was ¥22.046 billion. In terms of project cost, there is no particular problem because both amounts are within the planned range.

2.3. Effectiveness

(2.3.1.) Cement Production

After the plant became operational, cement output fell short of planned levels due to the lack of electric power supply and equipment failures. Annual output increased in subsequent years and in 1999, annual output reached 546,000 tons, exceeding the planned 500,000 tons. In 2000, damage to gears of material crushers forced the plant to suspend operations for a month. Nonetheless, the plant has achieved an operating ratio of over 80% during the past three years (see Table 1 and Figure 1).

Table 1 Achievement Ratios for Major Indicators at the Mafraq Cement Plant

Indicator		1993	1994	1995	1996	1997	1998	1999
Annual production (1,000 tons)	Actual	186(47%)	320(64%)	362(72%)	272(54%)	444(89%)	412(82%)	546(109%)
	Planned	400	500	500	500	500	500	500
Number of operating days per year (days)	Actual	160(75%)	191(66%)	210(73%)	184(64%)	248(86%)	249(86%)	301(105%)
	Planned	214	288	288	288	288	288	288

Figures in parentheses indicate the achievement ratios as compared to initial plans.
Source: Data provided by YCC

Table 2 shows supply and demand for cement in Yemen during the past ten years. Although consumption declined substantially due to the effect of the civil war in 1994, it has subsequently continued to rise year on year. Domestic consumption has continuously exceeded domestic output, and Yemen has depended on imports from neighboring countries to make up the difference. The domestic self-sufficiency ratio in 1999 was about 68%. Under these circumstances, the Mafraq plant meets approximately 25% of domestic consumption, thus contributing to domestic cement supply.

Table 2 Supply and Demand of Cement in Yemen

Indicator	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Domestic consumption (1,000 tons)	1,488	1,526	1,990	1,802	1,312	1,432	1,448	1,552	1,812	2,145
Domestic self-sufficiency ratio (%)	56.1	55.4	40.9	60.2	69.7	76.0	72.0	79.6	65.8	67.8
Mafraq plant's domestic market share (%)	-	-	-	10	24	25	19	29	23	25

Source: Data provided by YCC

Cement produced at the Mafraq plant is primarily consumed in the neighboring Mafraq/Ibb area. The eastern part of Yemen close to Oman, and Aden and its vicinity, the location of large ports and harbors, is partially dependent on imported cement due to the distances from domestic cement plants, and transport costs are high.

(2.3.2.) Recalculation of the Financial Internal Rate of Return (FIRR)

The recalculation of the FIRR based on the same assumptions as those used at the time of appraisal revealed that it was 4.97%, lower than the 7.5% initially predicted. One reason was stagnant production at the plant. Another was that actual plant shipment prices to calculate FIRR were around 50-70% lower than initial forecasts.

2.4. Impact

(2.4.1.) Foreign Currency Saving Effects

In Yemen, cement consumption has always exceeded output, and has imported cement from Saudi Arabia, Oman and other neighboring countries to make up the difference. In 1998, it imported approximately 620,000 tons of cement using foreign currency amounting to US$29.92 million, or 3.7% of the country's foreign currency reserve for the year (see Table 3). Meanwhile, Yemen continued to post trade deficits after unification, and had trade deficits of approximately $700.5 million in 1998.

Under these circumstances, the Mafraq cement plant has contributed to correcting the country's imbalance of international payments. For example, the plant helped save approximately US$24.7 million*[2] in foreign currency, i.e. saving through import substitution.

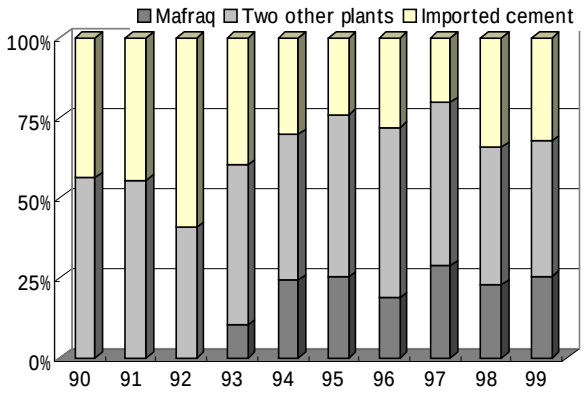

Figure 1 Percentage of Imported Cement to Total Consumption

Created using data provided by YCC

*2 The figure was obtained by multiplying the cement CIF price of US$60.00 per ton, which was announced by the Yemeni government, by output at the Mafraq plant in 1998.

(2.4.2.) Environmental & Social Impacts

The operation manual stipulates that wastewater discharged from the plant to residential areas shall undergo neutralization after it passes through settling ponds. In fact, however, the operation manual is not strictly complied with and such wastewater is drained off to *wadi* (rocky watercourse which is dry except during the rainy season) without undergoing neutralization. In addition, untreated filth and dirt deposited in settling ponds is dumped in desert areas. Japan Bank for International Cooperation (JBIC) plans to provide special assistance for project sustainability (SAPS) with the aim of conducting surveys on the above-mentioned issue and making recommendations on improvement measures (see Section 2.5.3).

It was predicted that the area located within a 1-km radius of the plant would be

affected by noise, vibration, dust, etc., generated by the project. Therefore, 15 families living in the area were relocated with compensation of approximately US$4,000 per family on average. According to YCC, the relocations incurred no major problems although compensation negotiations with one landowner continue.

(2.4.3.) Creation of Employment in Surrounding Areas

Yemen's support of Iraq's invasion of Kuwait during the Gulf War in 1990 incurred economic sanctions, resulting in the repatriation of more than one million Yemeni people working in neighboring Arab countries. Unemployment rose as a result, reaching 30%*[3] in 1995. Under these circumstances, the Mafraq cement plant hired the majority of its 648 new employees from the nearby city of Taizz. If the employees engaged in cement-related industries outside the plant and in distribution are also factored in, the plant is contributing to employment creation in the area in which it operates.

*[3] Source: *CIA World Fact Book 2000*

2.5. Sustainability

(2.5.1.) Operation and Maintenance

Currently, 648 personnel are engaged in the operation and management of the plant. Of these, 158 engineers and technical experts are responsible for operation while 78 engineers and technical experts are responsible for maintenance. Presently, the number of employees by far exceeds planned levels, and this is partly attributed to the government's policy, which takes employment measures into consideration. In addition, the contractors engaged to build the plant provided plant personnel with guidance in operation for the three years from 1993 to 1995. The term of guarantee for plant facilities was set for seven years until April 2000, and problems arising from defective facilities were eliminated free of charge under the technical guidance of contractors.

(2.5.2.) Profitability

Production costs at the Mafraq plant were YR9,213/ton in 1999, approximately 1.72 times as high as the YR5,351/ton achieved by the Amran plant, which has the same production capacity. This is due to unstable output and to high electricity charges*[4] as compared to those at the Amran plant, which has power generation facilities in its precincts. The other plants (Amran and Bajil) that are owned and operated by YCC are making a profit while the Mafraq plant is not currently profitable (see Table 3). Although the Mafraq plant has increased its output year on year and has attained its initial production goals, there is still room for future increases in profitability.

*[4] At the Mafraq plant, electricity consumption totaled 96 GWh and electricity bills amounted to YR900 million. At the Amran plant, on the other hand, electricity consumption totaled 84 GWh and electricity bills amounted to YR400 million. All figures are from 1999.

Table 3 Real Profitability of the Mafraq Cement Plant Table 3 Real Profitability of the Mafraq Cement Plant

Indicator	1993	1994	1995	1996	1997	1998	1999	2000
Sales (YR1 million)	324	572	632	467	1,183	1,020	1,018	-
Total expenditures* (YR1 million)	337	774	619	578	830	1,164	1,305	-
Gross profit (YR1 million)	-13	-202	13	-110	352	-143	-287	-
Plant shipment prices (YR/ton)	1,626	1,812	1,826	2,006	2,673	2,495	1,860	2,192
Production costs per ton* (YR/ton)	1,810	2,421	1,709	2,127	1,871	2,826	2,390	-

Source: Data provided by YCC (based on 1993 prices)

* Figures include employee salaries, loan repayments, depreciation, costs for materials and fuels and electricity charges, and maintenance expenses. In 1999, these accounted for 10%, 10%, 31%, 40% and 9% of total expenditures, respectively.

(2.5.3.) Sustainability

Although output is gradually increasing, operations remain unstable after the expiration of the contractor's guarantee. While the other two plants (Amran and Bajil) controlled by YCC are making a profit, the Mafraq plant has yet to attain profitability and lacks the funds to procure spare parts.

In order to raise its profitability and foster independent development, the plant is being urged to ensure stable production and reduce electricity charges, which account for 17.9% of total costs, by installing power generation facilities to guarantee a stable supply of electricity. It is also being urged to implement other measures such as reducing the number of employees, which is far in excess of the 357 initially planned. From an environmental perspective, it will be necessary to resume appropriate processing of plant wastewater, including neutralization, which has been suspended due to insufficient budgeting.

With respect to the project-related issues described above, JBIC is currently considering the provision of support to enhance the effects of the project, which is essential to develop economic and social infrastructure in Yemen, by rendering SAPS. SAPS consists of (1) surveys concerning the operation and maintenance of plant facilities, (2) surveys of environmental impact and environmental improvement measures, (3) surveys of cement production systems, (4) surveys for improved management, and (5) recommendations based on the results of these surveys.

Comparison of Original and Actual Results

Item	Plan	Results
1. Project scope	Material crushers · Hammer crusher (1 unit: 500 tons/h) · Jaw crusher (1 unit: 100 tons/h) · Cone crusher (1 unit: 100 tons/h) Material grinder · Grinding mill (1 unit: 135 tons/h) Calciners · Pre-heater (1 unit: 1,700 tons/day) · Rotary kiln (1 unit: 1,700 tons/ day) Cooler · Clinker cooler (1 unit: 1,700 tons/ day) Cement crushers · Grinding mill (1 unit: 90 tons/ day; 320 m^3/kg) · Grinding medium (1 unit) · Driving unit (1 unit) Packers · Packing units (3 units: 100 tons/h each)	 417 tons/h 88 tons/h 88 tons/h 127.8 tons/h Same as left Same as left Same as left 84.4 tons/h Same as left Same as left Same as left
2. Implementation schedule	September 1988 to June 1991 (33 months)	February 1990 to April 1993 (39 months)
3. Project cost Foreign currency Local currency Total ODA loan portion Exchange rate	 ¥22.070 billion YR22.5 million ¥22.597 billion ¥22.07 billion YR1.00 = ¥12.9 (March 1988)	 ¥22.046 billion YR20.823 million ¥22.398 billion ¥22.046 billion YR1.00 = ¥11.4 (October 1993)