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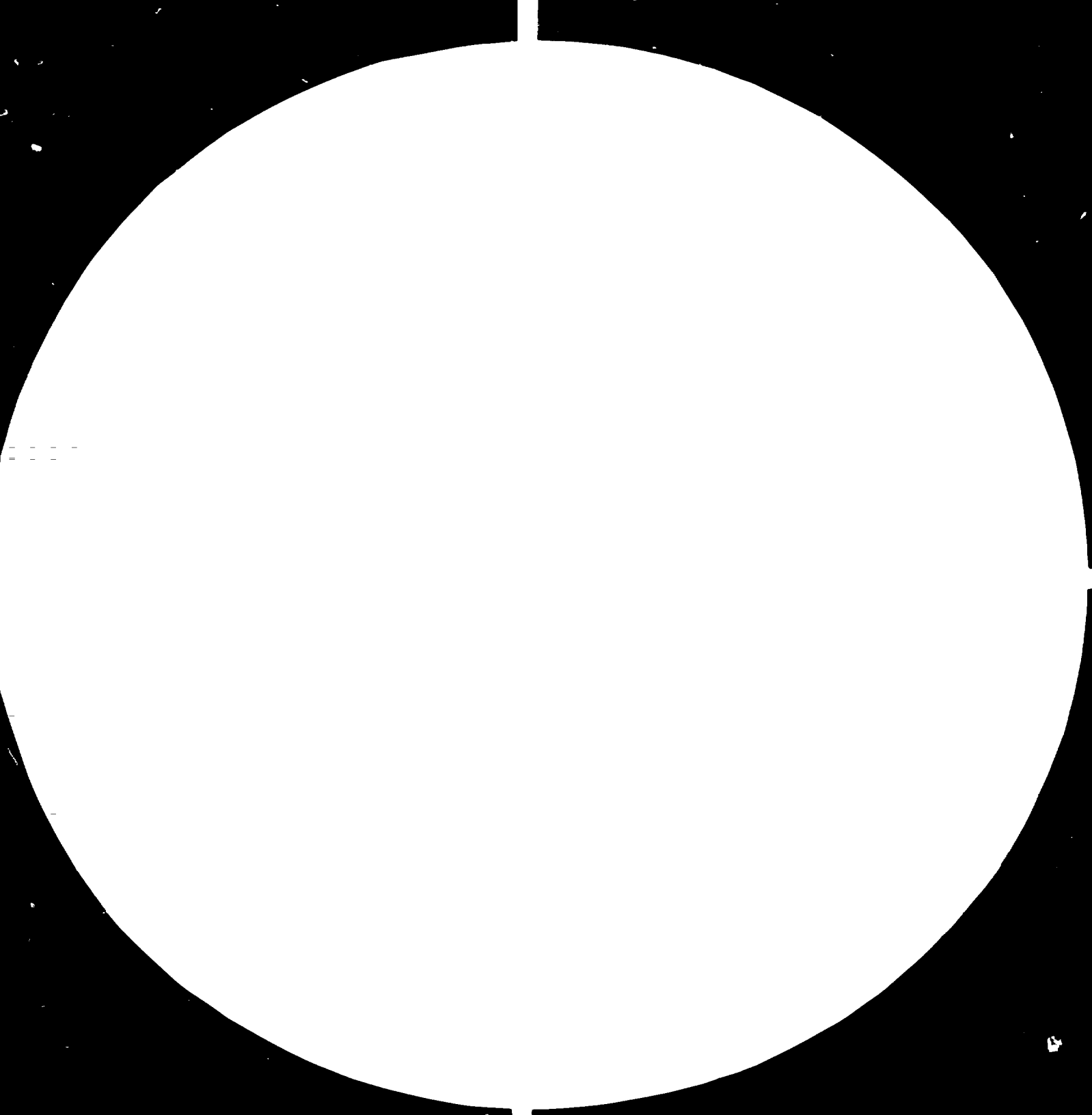

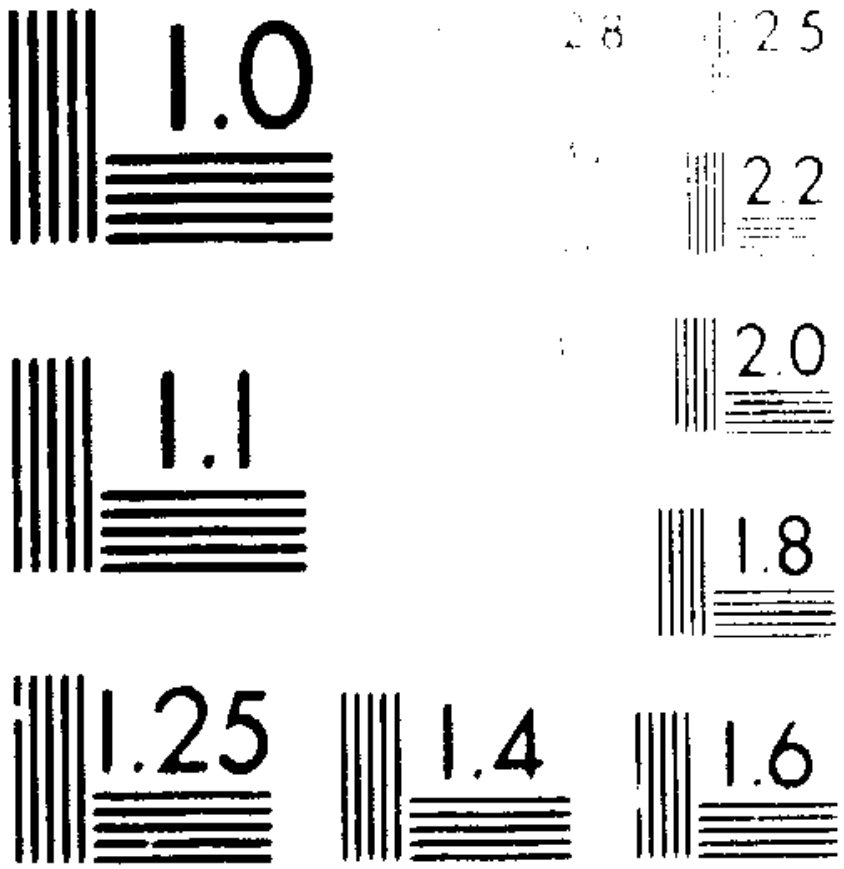
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UNITED NATIONS
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ASSISTANCE TO THE LIBYAN CEMENT FACTORY, BENGHAZI

TF/LIB/75/002

LIBYAN ARAB JAMAHIRIYA

Libya. Replacing cylpebs by grinding balls in Benghazi I and Hawari cement mills.

Prepared for the authorities of the Libyan Arab Jamahiriya
by the United Nations Industrial Development Organization

Based on the work of A.R. Marei, project co-ordinator

V.82-24049

Explanatory notes

References to "tons" are to metric tons (t).

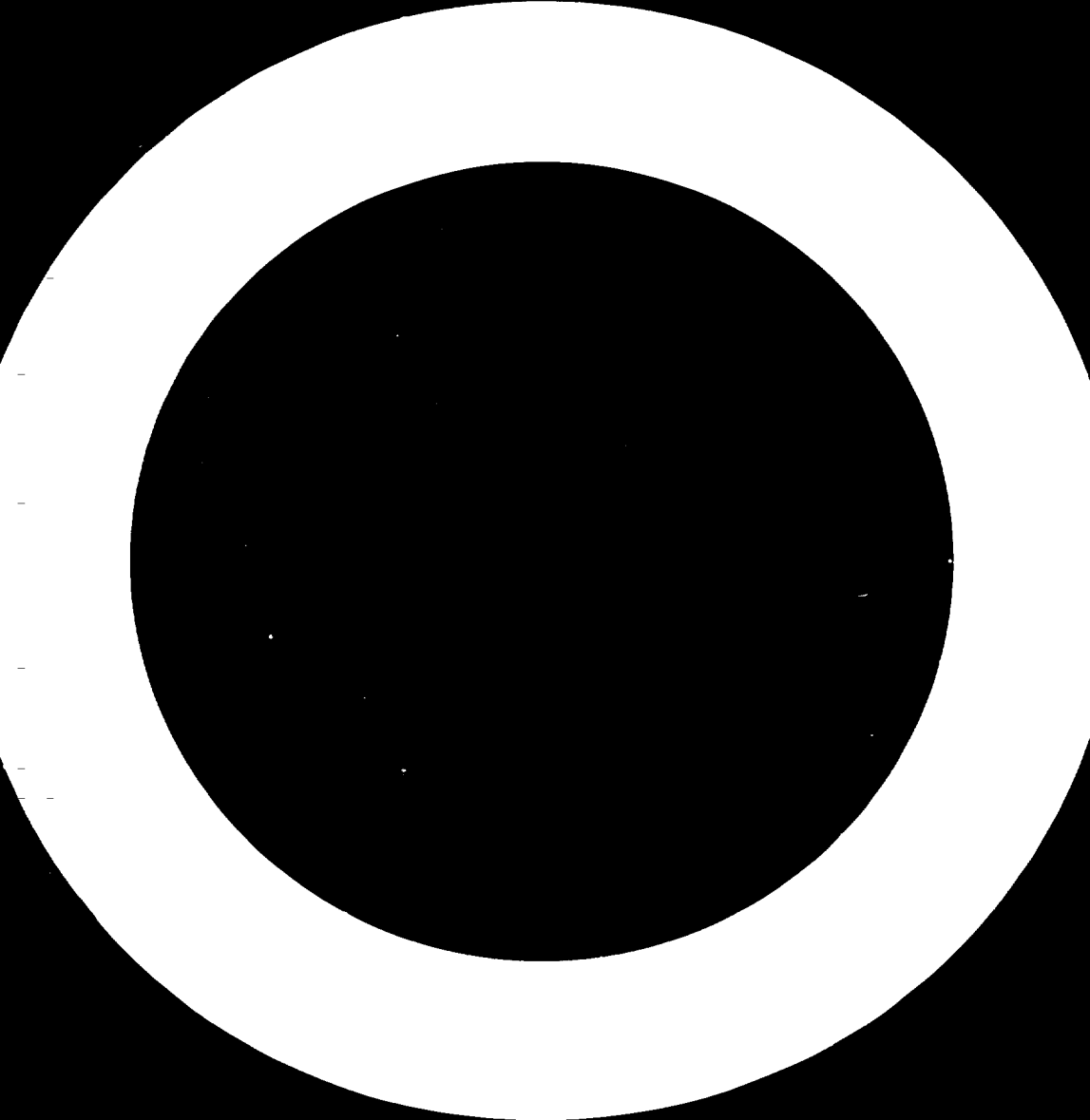
Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

ABSTRACT

This project "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/75/002), is being carried out for the authorities of the Libyan Arab Jamahiriya by the United Nations Industrial Development Organization (UNIDO) under a trust-fund agreement. This project, which was approved in 1975 and has been operating since 1976, is designed to give direct assistance to the cement industry.

This report is based on the work of the expert who took over as project co-ordinator in May 1980 and who is acting also as technical adviser on the various problems arising in the Libyan Cement Company plants, Benghazi and Hawari.

The report deals with the problems caused by the wearing of the cylpebs in the second compartment of Benghazi cement mill I and the Hawari cement mills, and the need to replace them with grinding balls. A calculation is made of the bulk volume and weight of the grinding media which would be required for this operation.



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INTRODUCTION

This project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/75/002), is being carried out for the authorities of the Libyan Arab Jamahiriya by the United Nations Industrial Development Organization (UNIDO) under a trust-fund agreement. This project, which was approved in 1975 and has been operating in the field since 1976, is designed to give direct assistance to the cement industry.

Industrial development in cement began in the Libyan Arab Jamahiriya, at Benghazi in 1972, with the start of the first rotary kiln with an annual production capacity of 200,000 tons. After rapid growth, the annual capacity reached 2 million tons of normal portland cement.

Industrial growth and the increasing need for trained staff made it necessary to request technical assistance and to initiate training for national personnel. The UNIDO project began in November 1976 with a building-materials adviser and by March 1981 had grown to include 73 experts covering various industrial activities in the field of cement and the building-materials industry under the control of the Libyan Cement Company, Benghazi. It is planned to expand this number to 100 experts with diversified specializations.

This report is based on the work of the expert who was appointed co-ordinator of the project on 10 May 1980 for an initial period of 18 months. His duties are to follow up and monitor the work of specialists assigned to the building-materials industry complex in Benghazi and also to act as technical adviser on the various problems arising in the Libyan Cement Company plants, Benghazi and Hawari, and as a consultant on developments in the Libyan cement industry generally.

One of the first problems he studied after taking up his duties was that of the wearing of the cylpebs in the second compartment of two-compartment cement mills such as the closed-circuit cement mill in Benghazi I.

FINDINGS AND RECOMMENDATIONS

A. Charging the Benghazi I closed-circuit cement mill with grinding balls

Problems have arisen from charging the second compartment in two-compartment cement mills with cylpebs. These wear down to such an extent that they cause clogging of the diaphragm partitions.

The Libyan Cement Company (LCC) carried out tests in which the cylpebs in the second compartment of the closed-circuit cement mill at Benghazi I were replaced with grinding balls only.

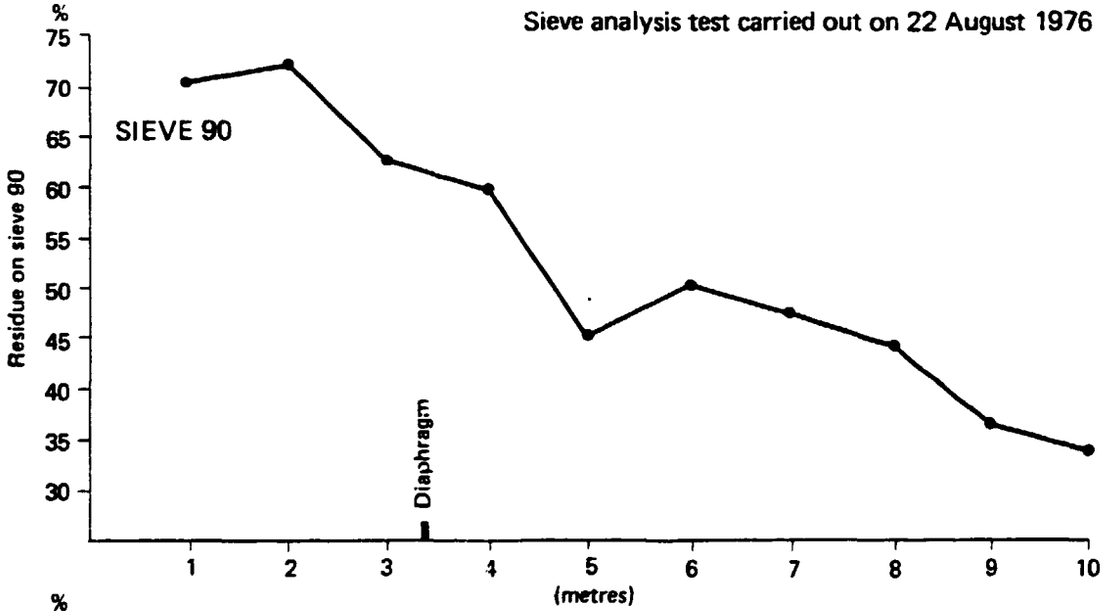
The trial period started on 10 June 1976. The mill was charged at that time with grinding balls only according to the following data:

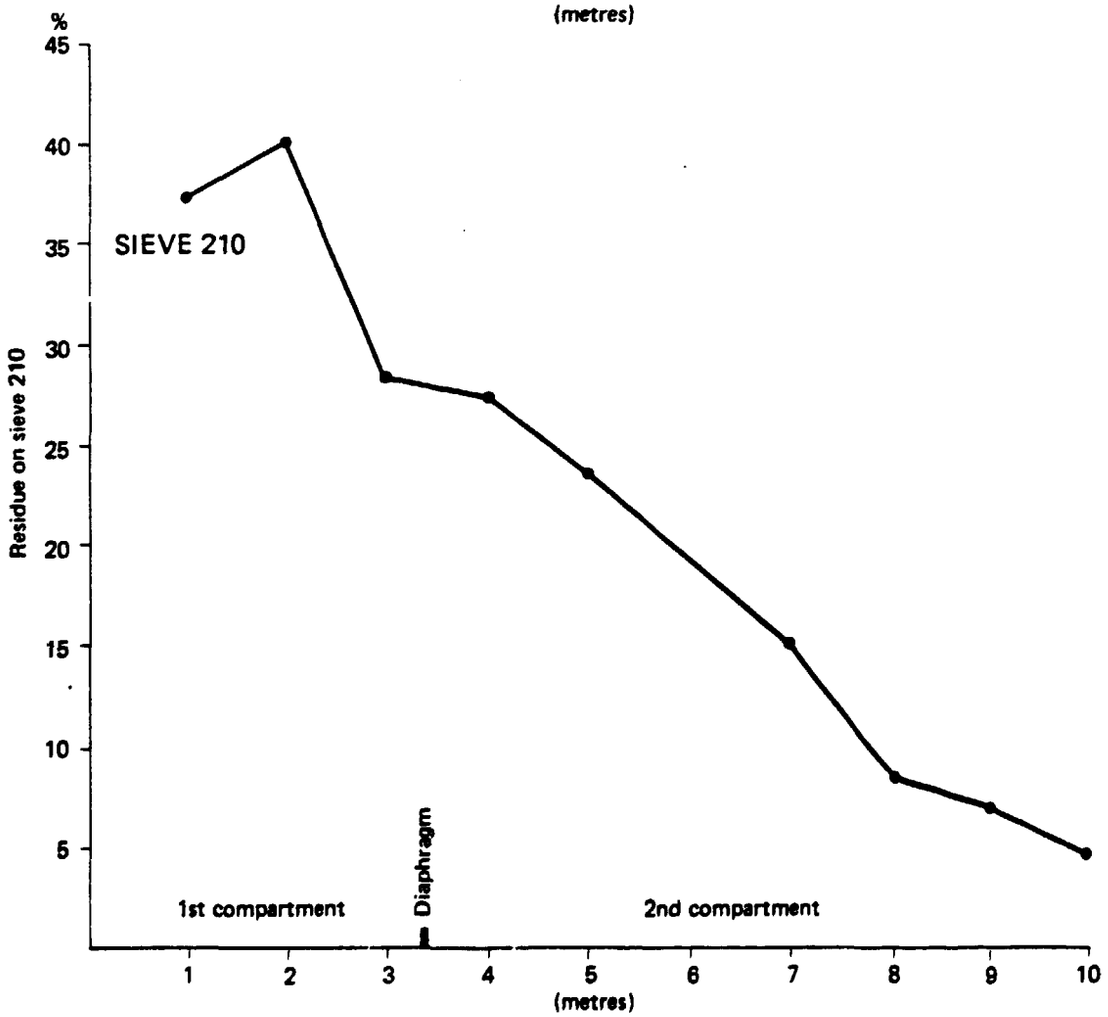
Compartment number	Usable length of mill (m)	Diameter of mill (m)	Ball diameter (mm)	Weight of grinding balls (t)
I	3.25	3.3	90	13
			80	9
			70	6
			60	4
				32
II	7.25	3.3	60	8
			50	13
			40	21
			30	28
				70
Mill feed 35 t/h			Total	102

The fineness of the cement produced during 24 days ranged between 2,600 and 3,740 cm^2/g (Blaine). More than 70% of the cement fineness within the trial period exceeds 3,000 cm^2/g (Blaine).

The sieving-analysis curves as shown in the figure indicate that the mill was giving satisfactory results. The mill has been stopped since the sieving-analysis test was carried out. During 1980, it has been in operation for limited periods, mainly while Benghazi cement mill II was stopped for repairs and maintenance. However, the production of the mill in 1980 has not been tested. Another sieving-analysis test was carried out within its operation period but unfortunately the sieving-analysis curves showed unreasonable results.

Sieve analysis test carried out on 22 August 1976





During the daily meeting with A. Fathi, the Works Manager, this matter was discussed and the co-ordinator's advice sought. The co-ordinator calculated the volume of the two compartments of Cement mill I as follows:

$$\text{Compartment I} = \frac{3.14 \times 3.3^2}{4} \times 3.25 = 27.783 \text{ m}^3$$

$$\text{Compartment II} = \frac{3.14 \times 3.3^2}{4} \times 7.25 = 61.9781 \text{ m}^3$$

It is recommended that 30% of the volume of the first compartment and 27% of the volume of the second compartment should be charged with grinding balls. Using these percentages, the bulk volume of the media in the two compartments will be according to the following calculation;

$$\text{Compartment I} = 27.7831 \times 0.3 = 8.3349 \text{ m}^3$$
$$\text{Compartment II} = 61.9781 \times 0.27 = 16.7341 \text{ m}^3$$

To calculate, approximately, the bulk weight of the grinding balls required for charging the first and second compartments, the bulk volumes of the first and second compartments are multiplied by 4.55 and 4.7 t/m^3, respectively. Thus the approximate weight of the grinding media can be calculated as follows:

$$\text{Compartment I} = 8.3349 \times 4.55 = 37.9238 \text{ t}$$
$$\text{Compartment II} = 16.7341 \times 4.70 = 78.6503 \text{ t}$$

Total weight of the required grinding balls for charging the two compartments: 116.5741 t.

The grinding media can be distributed in each compartment according to the following percentages:

Compartment number	Ball diameter (mm)	Distribution (%)	Weight (t)
I	90	20	7.5848
	80	25	9.4810
	70	35	13.2733
	60	20	7.5848
			37.9239
II	50	17	13.3706
	40	17	13.3706
	30	33	25.9546
	25	33	25.9546
			78.6504
		Total	116.5743

The following considerations should be taken into account before charging the mill and testing the output:

(a) The nearest size of commercial ball diameter has to be selected;

(b) It is preferable to select larger ball diameters at the outset as the grinding balls decrease in size as grinding proceeds day by day and, therefore, the correct diameter for the desired results will be achieved after a time;

(c) A coarser mill feed requires larger grinding balls and vice versa.

Accordingly, the following can be recommended.

Recommendations

1. The cement mill should be put into normal operation.

2. From the start of the operation of the cement mill, its output ought to be measured in a special cement silo, besides keeping daily records of the input quantities, energy used, voltage, blaine fineness, residue on the sieves etc.

3. After a few days of normal operation of the cement mill, the mill has to be stopped and a sieving-analysis test carried out.

4. On the basis of the sieving-analysis test curve, any necessary changes in the grading of the original grinding-media can be made, within the parameters previously calculated and recommended.

5. It is also recommended that balls with smaller diameters (20 mm) should be added where necessary to produce a finer output.

6. In some cases, it is preferable to add 60 mm balls in the proportion of 2-3% of the total charge in the second compartment, depending on the sieve-analysis test.

B. Charging the Hawari cement mills with grinding balls

It has also been decided to replace the cylpebs in the second compartment of the Hawari cement mills with grinding balls. The expert was asked to estimate the required quantities of grinding media for charging these cement mills. The dimensions of the cement mills are:

Length of the first compartment = 4.255 m
Length of the second compartment = 8.580 m
Diameter of cement mill = 4.2 m

The volume of the two compartments of the Hawari cement mill can be calculated as follows:

$$\text{Compartment I} = \frac{3.14 \times 4.2^2}{4} \times 4.255 = 58.9 \text{ m}^3$$

$$\text{Compartment II} = \frac{3.14 \times 4.2^2}{4} \times 8.580 = 118.8 \text{ m}^3$$

It is recommended that 30% of the first and 27% of the second compartment volume should be charged with grinding balls. Using these percentages for charging the two compartments, the bulk volumes of the grinding media in the two compartments will be according to the following calculation:

Compartment I = $58.9 \times 0.3 = 17.67 \text{ m}^3$
Compartment II = $118.8 \times 0.27 = 32.0 \text{ m}^3$

The bulk weight of the grinding media required to charge the first and second compartments will therefore be as follows:

Compartment I = $17.67 \times 4.55 = 80.0$ t
Compartment II = $32.0 \times 4.7 = 150.4$ t

The total weight of grinding balls required for charging the two compartments would be: 230 t

+20% spare: 46 t
Total quantity required 276 t (approximately)

The grinding media should be distributed in each compartment according to the following percentages:

Compartment number	Ball diameter (mm)	Distribution (%)	Weight (t)
I	90	20	16
	80	25	20
	70	35	28
	60	20	16
			80
II	50	9	13.5
	40	9	13.5
	30	30	45
	25	26	39
	20	26	39
			150
		Total	230

The considerations and recommendations previously mentioned for Benghazi cement mill I have also to be taken into account when applying the distribution percentages in charging the Hawari cement mill for the first time. In addition, the following recommendations are made.

Recommendations

1. It is preferable that, in the LCC tender documents for the lining plates and the grinding media, the opportunity to estimate and select the appropriate distribution of grinding media in the mill should be given to the producers.

2. The tender documents should give the dimensions of the cement mill, i.e. diameter and length of each compartment, and the tender should also include the [illegible]-mill lining plates and partitions so that the lifetime of both mate[illegible] are guaranteed.

3. A selection of the proper alloys, especially for the manufacture of the grinding media and the lining plates, gives an improvement in the specific-wear rate. We recommend a molybdenum-nickel-chromium well-tempered alloy with a Brinell hardness of more than 600.

4. Surplus quantities of the grinding media and the lining plates, up to at least 20%, have to be supplied under the tender.

5. The specific wear of the grinding media must be within the range of 15-60 grams per ton of cement.