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INDUSTRIAL ADVISORY SERVICES AND TRAINING

DP/JOR/87/009

JORDAN

Technical report: Findings and recommendations\*

Prepared for the Government of Jordan  
by the United Nations Industrial Development Organization,  
acting as executing agency for the United Nations Development Programme

Based on the work of J. Cerven, UNIDO expert

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Vienna

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EXPLANATORY NOTES

The following abbreviations have been used in this document:

ACWCI	Arab Company for White Cement Industry
UNIDO	United Nations Industrial Development Organization
FLS	F.L.SMIDTH
BS	British standards
t	Metric ton = 1000 kg
t/h	Metric tons per hour
t/yr	Metric tons per year
tpd	Metric tons per day
kW	Kilowatt
m	Metre
E	Electrical
M	Mechanical
T	Technologic
O	Other

ABSTRACT

Purpose of Projekt: The project is aiming at laying the foundation for an upgrading of maintenance and operational routines in different enterprises. The main emphasis is to identify bottlenecks and shortfalls, to participate in improving installations work routines and conditions in cooperation with counterparts and officials.

Post title: White Cement Plant Expert

Number: DE/JOR/87/009/11-55/319201

Objectives: Assessment of the factory situation and operational routines in particular as well as engagement in corrective activities in close co-operation with local specialists.

Duration: 21 days

Main Conclusions

and recommendations: It has been observed that white cement plant AHALDIYA in JORDAN is in a good condition and has raw materials of a good quality for white cement production. The low /64% of capacity/ production has the main reason in low cement sale, especially to the Syrian market, but for a full production it is recommended to strengthen the management of the plant, henceforth to improve operation of the kiln and remove some weak points in the machinery.

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## INTRODUCTION

During the time from 11.02.1990 to 26.02.1990 the ACWCI-  
- white cement plant KHALDIYA in Jordan was visited by  
mr. JAN ČERVEN, UNIDO-expert for cement plants.

The visit was on the basis of "request for technical assistance from UNDP" by ACWCI AMMAN- JORDAN, UNIDO post  
DP/JOR/87/00911-55/J 19201.

The purpose of the visit to the ACWCI- white cement plant  
KHALDIYA was to make an assesment of the factory situation  
in general and to analyse shortcomings in maintenance and  
operational routines in particular, as well as to engage in  
co-operation with the plant management and local specialists.  
This report is written by mr. JAN ČERVEN, as a result of his  
mission.

The programme of the mission is shown by appendix no.1, and  
a list of the persons met during the mission is shown by  
appendix no.2.

## I. GENERAL FEATURES OF THE PLANT

The White Cement Plant-KHALDIYA is situated near Duleil, 50 km from Amman and has total production 100000 t of white cement per annum.

This plant was built to supply the Jordan and Syrian markets with the white cement with consumption of 35-40000 t/yr for the Jordan market and 60-65000t/yr for the Syrian market. The capital was paid equally by Jordan and Syrian government organizations.

The plant was built on turn-key basis by BABCOCK /BWHI/ of Germany- München and production was started in 1985.

The raw materials which are used in plant:

	Raw mix composition
Limestone:quarried near the factory	80 %
Kaolin:transported by trucks about 40 km from the factory	14%
Sand:transported by trucks about 200 km from the factory	6%

Gypsum is mixed with the clinker at 5 % and is transported by trucks about 100 km from the factory.

White cement produced in the plant has a good quality and meet the BS with minimum whiteness 81 against MgO and 28 days compressive strength over 41 M Pa. White cement is dispatched by the road packed in 50 kg bags.

There are 160 persons working in the plant.

## II. CONDITION OF THE PLANT

### A. Plant in general

The installed plant machinery is in general very good and also in a good condition.

All production spaces and machinery are very clean, on high level. The quality of raw materials enable to produce white cement of very good quality and in the project quantity.

Raw mill is running with 38-40t/h and it is more than project with very good fineness/under 3%-009/ without mechanical or electrical problems. Raw mill produces enough raw meal for the kiln all the time.

Rotary kiln, when it is running 24 h in day makes regulary 300 tpd white clinker, this is a project daily production.

Cement mill is running with about 21 t/h, this is a project production, with good fineness/Blaine 3700-4200/.

Quality of clinker and cement is in general good and cement is in whiteness and strength much better as BS.

### B. Analysis of the Rotary kiln production.

Rotary kiln is the most important machinery for the year production capacity of the plant and that is why an analysis of the kiln production in the year 1989 was made./Appendix no.4- and no.5/

Rotary kiln was in production in the 1989 year only 229 days and made 61430t of white clinker. Hour production in was 12,36t/h project is 12,5t/h/ but it is a result of many down times.

From 229 production days was 60 down times which made together



3 790 h. The main reasons, which made 93 % of down times /3 531h/ are only six and it is possible to separate them to two groups:

Long duration:	full silos	1 725 h - 1x
	brick lining	1 031 h - 3x/1x from the 1988 year/
	water bath cooler	399 h - 10x
	exhaust fan	233 h - 6x
	EP fan	143 h - 2x
Frequency:	main power supply	13x - 72h
	water bath cooler	10x
	exhaust fan	6x

Full silos more than 45% of total down time/ was the main reason of low clinker production in the year 1989 and can decrease the production also in this year. It is the result of low cement sale especially to the Syrian market. This problem can be solved with the help of government another way it will be necessary to find the other markets. It is recommended to prepare the possibility of white cement packing in 500 kg or 1 000 kg big-bags which can be stored outside too.

Brick lining repairs took a long time while there is only one skilled bricklayer and two other people which learnt themselves the laying of the bricks so the job was not made 24 h in day. It is necessary to increase the number of skilled bricklayers /from one to minimum two/ and to learn the laying of the bricks four other people minimum for to have a possibility of continuous work by the repair of brick lining. The bricks which are used in clinkering zone /Perilex and Almag/ are good. To increase the

life of this type of lining is recommended to follow up exactly the segments of stable and unstable coating and bricks. Always use for area with unstable coating, Perilex for area with stable coating only. To the survey of brick lining which are regularly kept is good to write production of clinker and production hours. Of course every decreasing of kiln down times and improvement of the operation of the kiln increases the life of brick lining.

Water bath cooler was very important reason of kiln down times till September 1989 when this problem was solved. The basis of the problem was in electrical adjustment of water bath cooler speed to the kiln output and then the cleaning of full water bath cooler. Anyway the time of solving this problem was very long.

Exhaust fan is working in hard conditions/transport of hot and dusty gases/ and has several problems/vibrations, cooling, bearing problems, shaft damage/.

To minimize the possible vibrations it is recommended to fix the free bearing support of the exhaust fan in axial direction against axial vibrations. It is very important to minimize the amount of dust in kiln gases by the good efficiency of the preheater. Flaps under all cyclones must be in good condition all the time. It is recommended to repair the exhaust duct from the cyclon I./inside part is not there/ and increase its efficiency. Regularly checking of gas temperature thermometer before the exhaust fan and good kiln operation can protect exhaust fan from overheating.

For better cooling conditions is important to protect exhaust

fan from the raw meal which is falling down from the raw meal weigh belt feeder over the exhaust fan motor. It is possible to attach a hopper with screw conveyor under the weigh belt feeder.

For better cooling of bearings is good to attach cooling discs on the fan shaft from both sides of the fan.

The seal between the housing and shaft of the fan must be repaired for better efficiency of exhaust fan.

For the future is recommended to prepare the change of exhaust fan and motor to increase its capacity for increasing of capacity of the kiln.

EP fan :The main problem of this fan was the start. The starting current was higher as it was set. During the 1989 year was even changed the whole fan but the starting problem was not solved. In the time of mission after consultations with a new power electrical engineer was counted and set a new emergency current for EP fan.

Concerning the long times of electric problem solving it is good that the management of electrical maintenance was strengthened with a new power electrical engineer. It is also recommended to give the responsibility for the whole maintenance to one man- "Maintenance manager".

Main power supply was out 13 x in the year 1989 and it is the reason of kiln down times with the highest frequency. This problem is necessary to solve on the company management level between companies or with a help of government. Too much down times have a negative influence not only on total clinker pro-

duction but also on brick lining life, stability of the clinker quality and all machinery and economy of production.

C. Raw mill kiln and cement mill production control

Raw meal prepared in raw mill from limestone, kaolin and sand has prescribe parameters LSF-0,91

MS-4,5

with fineness under 3%-009, which guarantee by the good operation a good quality of clinker and cement.

For the kiln is very important to have raw meal homogenous in chemical and granulometric composition. The ground step for good homogenous kiln feed is made always in raw mill. Homogenization silos can only improve to certain level what was not good made in the mill. The first-rate effort is to have the raw meal without grate swings on the output from the mill.

Till now the regulation of the raw meal quality in the plant is only from laboratory which count the ratio of raw materials. The operator has no informations about the quality of raw meal. It is necessary to give him regularly this information for he has a possibility of checking the new ratio with the conditions of raw mill and when it is necessary he can make an invention. Very important is to check and clean regularly weigh belt feeders for raw materials.

To rich the full kiln production is not only the question of continuous production but it is important whole the time henceforth to improve operation of the kiln. That's why it is necessary to give to the kiln operators regulary informations con-

servicing the quality of kiln feed and to learn them to use this information for kiln operation to reach all the time the best production results.

The time which is used for the kiln heating after could down time is long. It is recommended to accelerate the heating. First two hours keep the ground temperature 150-200 °C in the inlet housing. Then to increase the inlet temperature with the speed 60 °C/h. During this time is necessary to check if the second kiln tyre is rotated minimum 1mm by one rotation of the kiln. When there is no rotation of this tyre the heating must be decreased. By this way it is possible to start kiln feed in about 12 hours without negative influences on brick lining and save a lot of energy.

When there are some problems and clinker must be stored outside then it is better to give clinker to the gypsum storage indoors as outside.

By the cement mill operating is more important for to have constant quality of white cement to keep the same specific surface as to keep the hour production. It is necessary to follow up the optimum return flow. Negative influence to the cement mill capacity has not enough crushed gypsum/some pieces more than 10 cm/. It is recommended to change the gypsum jaw crusher by a bigger one to increase the capacity and decrease inlet size of gypsum for cement mill.

#### D. Management of the plant

As mentioned previously the plant is in a very good condition. It is not only that it was good built but it is also

a result of a good mechanical maintenance and management. The solicitude about spareparts repairs of old parts and storing of the spareparts is on a good level. Also the quality of white cement is a result of a good job which was made in the plant.

Anyway it is always necessary to prepare conditions for better and better results in all fields of activities of the plant management. That is why it was recommended to appoint a production manager and one maintenance manager which can organize serious planning on the basis of regulary made analysis in the actual time.

Till now is all responsibility concerning daily production problems, quality, training of the personnel, checking and also electric and mechanical maintenance cooperation on the head of plant manager.

While there are many other problems which are from out-side of the plant and also workers problems in the plant it is very important for the better future of the plant to protect plant manager of necessity to solve daily problems and to give him more space for other kind of activities which are in responsibility of plant manager.

### III. RECOMMENDATIONS

1. It is recommended to appoint a production manager. The production manager must be a qualified chemical engineer and should have at least five years of experiences in dry-process cement production.
2. It is recommended to appoint one maintenance manager responsible for the whole maintenance in the plant, which will manage the management of electrical maintenance too. The maintenance manager must be a qualified mechanical engineer and should have at least five years of experiences in cement plant maintenance.
3. It is recommended to increase the number of skilled bricklayers from one to minimum two and to learn the laying of the bricks minimum four other people/till now only two/, to have a possibility of continuous work by the repair of the brick lining.
4. It is recommended to give regular <sup>to the operators</sup> informations concerning the raw meal quality from raw mill and kiln feed and to learn them to use this important information for better kiln operation.
5. It is recommended to introduce daily "down time reports" /see Appendix no.6./filled by shift engineers.
6. It is recommended to analyse every month the production-down times, quality, maintenance and all problems concerning the white cement production in the plant with a final monthly report made by production manager.
7. It is recommended don't storage the clinker outside but in a gypsum storage and gypsum storage out-side.

8. It is recommended to change the position of gas analyser from the side to which is rotating the kiln to the other side to lower the coating and plugging of material for to become the good results of gas analysis all the time.
9. It is recommended to attach as soon as possible/by the longer shut down of the kiln/ the exhaust dust from the cyclon I, inside the cyclon which is not there and it decrease the efficiency of the preheater.
10. It is recommended to follow up exactly the segments of stable and unstable coating in clinkering zone and for area with stable coating to use bricks Perilex, for area with unstable coating use bricks Almag only.
11. It is recommended to accelerate the heating of the kiln after could shut down from 24 hours to approximately 12 hours/the start of the kiln feed/.
12. It is recommended to fix the free bearing support of the exhaust fan in axial direction against axial vibrations and for better cooling to attach cooling discs from both sides of the fan on the fan shaft.
13. It is recommended to attach under the kiln raw meal weigh belt feeder a hopper with screw conveyer with output to the weigh belt feeder discharge spout to protect the cooling system of exhaust fan motor from raw meal dust falling down from this weigh belt feeder.
14. It is recommended to prepare the change of exhaust fan and motor to increase its capacity.
15. It is recommended to change the gypsum jaw crusher to increase the capacity of gypsum crushing and decrease inlet size of the gypsum for cement mill.



16. It is recommended to prepare the possibility of white cement packing in 500 kg or 1 000 kg big-bags to be more flexible in cement distribution and to have a possibility to storage for some time cement outside.

17. It is recommended to prepare the conditions for boarding of plant employees in the plant for to make better social climate in the plant.

18. It is recommended for the next time to organize such a mission for longer time /minimum one month/ and during kiln production to have a possibility to find all kinds of problems and to make training with operators.

APPENDIX 1

PROGRAMME FOR WHITE CEMENT PLANT EXPERT IN JORDAN.

Post title:white cement plant expert

Name of expert: M.Sc. JAN ČERVEN

Post key code: DP/JOR/87/009/11-55/J.19201

Duration: 21 days / 08.02.1990-28.02.1990/

- 08.-09.02.90 Travel to Vienna and briefing in Vienna
- 10.02.90 Arrival to Amman
- 11.02.90 Introduction at UNDP and ACWCI in Amman
- 12.02.90 Introduction to management at whitecement plant. General discussions
- 13.02.90 General inspection of the limestone quarry, laboratory,raw mill,kiln and cement mill which are stopped for full silos /cement and clinker/
- 14.02.-18.02.90 Analysis of the kiln production in the year 1989 and JAN. 1990. Discussions with plant manager and technical management cocerning the kilu down time reasons and maintenance.
- 20.-25.02.90 Following the raw mill,kiln and cement mill production,management.Discussions with plant manager,shift engineers,kiln and mills operators and laboratory a-nd quality control manager concerning operating methods and quality control.
- 26.02.90 Inspection of workshops and stores for spare-partes.Final discussions with the management concerning report conclusions and recommendations

27.02.90 Departure from ACWCI.  
27.02.90 Departure for Vienna.  
28.02.90 Debriefing in Vienna and travelling.

APPENDIX 2

ARAB COMPANY FOR WHITE CEMENT INDUSTRY -KHALDIYA- JORDAN

List of management met during the mission

10.02.1990-26.02.1990

<u>T I T L E</u>	<u>N A M E</u>
General Manager	Fewfik Y. Batarseh
Plant Manager	Moh'd R. Shaaban
Mechanical Maintenance Manager	Dipl.-Ing.Sami Naifa
Elektrical Maintenance Manager	Imad El- Hijazi
Laboratory and Quality control Manager	H.Moh'd Y. Alkhatib
Shift engineers	Eng.F. Salameh Eng.D. Marashdeh Eng.S. Atawneh Eng.Z. Yousef

APPENDIX 3

MAJOR MACHINERY AND INSTALLATIONS

Name of cement plant: ACWCI -Khaldiya-JORDAN

CRUSHER FOR LIMESTONE: Single shaft hammer crusher/O+K/

Capacity: 120 t/h

from max.800mm to 0-25mm/max:10% to35 mm/

RAW MILL: Closed circuit grinding mill,utilizing hot gasses from kiln for drying.Raw mill has two chambers.Ø 3,4 x 8,5 m

Capacity: 35 t/h /fineness 009- 3% /

Motor: 950 kW

Air classifier: FLS -USF/RSJ Ø 500 mm

KILN: Dry process rotary kiln with threestages preheater, with four dedusting cyclons and by-pass.For cooling there is water bath cooler,for drying-drier utilizing hot kiln gasses for drying.

Kiln dimensions: Ø 3,4x 65 m

Capacity: 300 tpd white clinker

The kiln is oilfired.

Clinker silos: 2 x 5 000 t /used 9 000 t /

Cement mill: Closed circuit grinding mill with two chambers.

Ø 3,4 x 11,5m

Capacity: 21 t/h

Motor: 1 200 kW

Air classifier: FLS-USF / RSJ Ø 4 500 mm

Cement silos: 4 x 2 000 t /used 7 200 t /

ANALYSIS OF THE PRODUCTION

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	1989	1.1990
Kiln production	/t/	5732	7428	-	-	5429	7251	5766	6118	7096	4720	8890	3000	51 430	8043
Kiln Running Hours	/h/	454	578	-	-	442	588	469	510	582	383	713	251	4 970	650
Kiln Running Hours	/%/	61,02	86,01	-	-	59,40	81,67	63,04	68,54	80,83	51,48	99,03	33,73	56,74	87,37
Kiln production	/t/h/	12,62	12,85	-	-	12,28	12,33	12,29	12,00	12,19	12,32	12,47	11,95	12,36	12,37
Kiln production	/d/	22	28	-	-	21	26	21	24	27	18	30	12	229	30
Kiln production	/d/%/	11/50	21/75	-	-	12/57	19/73	16/76	12/50	21/78	13/72	27/90	8/67	160/70	20/67
number of down times	/no/	9	7	-	-	9	7	3	11	3	4	3	4	60	10
clinker stock	/t/	8631	12671	9547	5241	5855	5305	5355	5748	8250	5418	6837	2235		10 040
cement stock	/t/	7231	7198	6750	5379	6345	6725	6228	6166	6151	5363	6950	7449		7209
cement production	/t/	2871	3552	3270	3783	5767	8002	5997	6015	4806	6839	8804	7916	67 622	2973
cement tot. despatched	/t/	2533	3586	3718	5154	4801	7813	6494	6077	4821	6628	8217	7417	67 269	2784
cement exp. despatched	/t/	-	960	40	1240	1760	3720	2120	2260	1360	2785	4695	4545	25 485	204

APPENDIX 5

Down time-rotary kiln, 1989

1989	E h/times	M h/times	T h/times	O h/times	Cause
JANUARY total 290h/9x	48/2	-	237/6	5/1	water bath cooler E 48/2 cleaning inlet T 16/2 cleaning exhaust fan T 1/1 cleaning burner T 4/2 brick lining T 216/1
FEBRUARY total 94h/7x	13/3	16/1	25/1	40/2	exhaust fan E,M 29/4 cleaning drier T 25/1 main power supply O 19/1 full silos O 21/1
MARCH total 744h					fullsilos O 744
APRIL total 720h					full silos O 720
MAY total 302h/9x	16/3	-	30/4	256/2	full silos O 240 water bath cooler E 13/1 exhaust fan E 2/1 main power supply O 13/2 cyclon cleaning T 6/1 cleaning burner T 21/1
JUNE total 132h/7x	41/2	84/1	3/1	4/3	water bath cooler E 40/1 exhaust fan bearing M 84/1 main power supply O 4/3 cyclon cleaning T 3/1 burner E 1/1
JULY total 275h/3x	-	215/2	60/1	-	exhaust fan M 109/1 water bath cooler M 34/1 cleaning drier T 60/1 EP fan M 72/
AUGUST total 234h/11x	124/4	-	105/4	5/3	EP fan-start E 71/2 cleaning burner T 2/1 main power supply O 5/3 water bath cooler clean- ing T 103/3 water bath cooler E 53/2
SEPTEMBER total 138h/3x	67/-	-	43/1	28/2	water bath cooler E, T 108 cleaning inlet T 2/1 main power supply O 26/1 emergency switch O 2/1
OCTOBER total 361h/4x	5/1	-	334/2	22/1	4,5m brick lining T 331/1 cleaning inlet T 3/1 main drive E 5/1 no reason O 22/1

1989	E h/times	M h/times	T h/times	O h/times	Cause
NOVEMBER total 7h/3x	-	-	2/1	5/2	main power supply O 5/2 cleaning inlet T 2/1
DECEMBER total 493h/4x	-	8/2	485/2	-	11,5mbrick lining T484/1 cleaning burner T 1/1 exhaust fan M 8/2
"1989" total 3790h/60x	314h/15x	323h/6x	1324h/23x	1829h/16x	

Summary:

full silos : 1725h/1x  
 brick lining : 1031h/3x  
 water bath cooler : 399h/10x  
 exhaust fan : 233h/6x  
 EP fan : 143h/2x  
 main power supply : 72h/13x

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3531h/35x



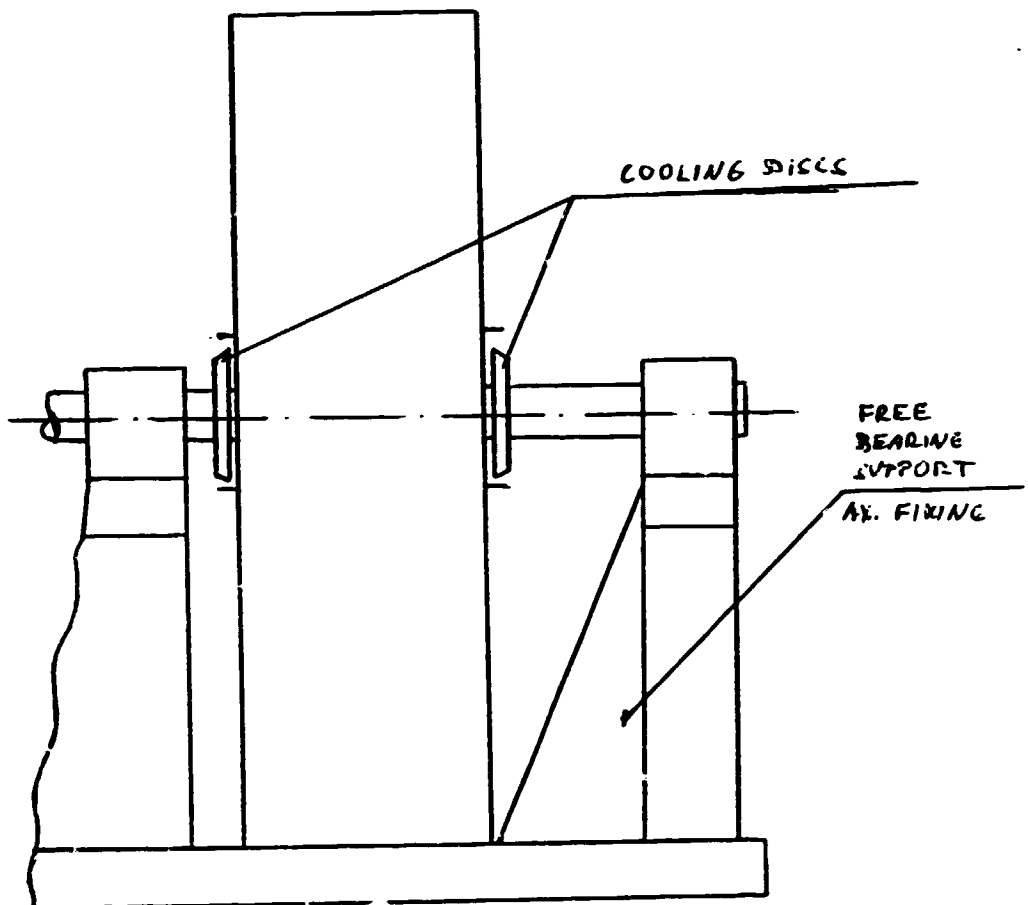
APPENDIX 6

DAILY DOWN TIME REPORT

DATE:

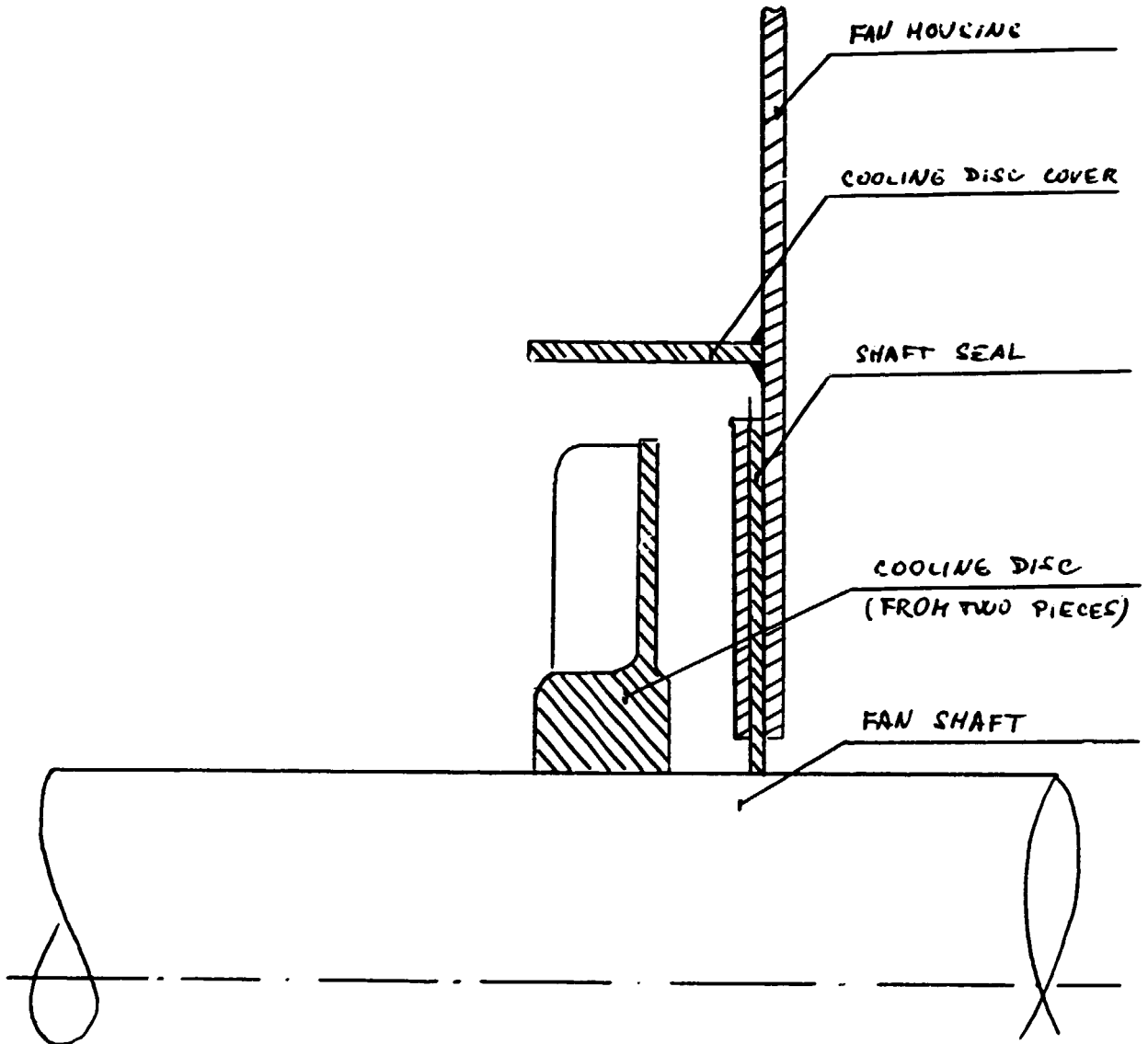
EQUIPMENT	DOWN TIME	E	M	T	O	total	CAUSE
	from-to	h	h	h	h	h	
RAW MILL							
Total in day							
KILN							
Total in day							
CEMENT MILL							
Total in day							
Shift engineer :	1	2			3		
Signature :							

APPENDIX 7



Exhaust fan  
Fixing of the free  
bearing support  
Principle drawing

APPENDIX 8



Exhaust fan  
Cooling disc  
Principle drawing